Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce and Science, Kopargaon

CRITERION- 1

CURRICULAR ASPECTS

Key Indicator- 1.3 Curriculum Enrichment

1.3.1 QnM:- Institution integrates crosscutting issues relevant to Professional Ethics, Gender, Human Values, Environment and Sustainability in transacting the Curriculum

Institution Integrates Cross-Cutting Issues in transacting the curriculum

(Subject / Issue wise)

2021-2022

Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce & Science, Kopargaon

Mohiniraj Nagar, Kopargaon, Tal: Kopargaon, Dist: Ahmednagar Pin-423601

Cross-Cutting Issues in Transacting the Curriculum 2021-2022

(Professional Ethics/ Gender/ Human Values/ Environment and Sustainability)

Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce & Science, Kopargaon

Crosscutting Issues in Syllabus of English

Crosscutting Issues in 2019 Pattern:

Sr. No.	Class	Course Code	Course Name	Addressed issues
1	B. A. English	CC-11011/11012	FYBA: Compulsory English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
2	B. A. English	(General Paper-1) 11331/11332	FYBA: Optional English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
3	B. A. English	CC-23001/24001	SYBA : Compulsory English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
4	B.A. English	DSC-1 A 123331/24331	SYBA: Appreciating Drama	Gender/ Human Values /Environment and Sustainability
5	B.A. English	DSC-2A 23332/24332	SYBA: Appreciating Poetry	Gender/ Human Values /Environment and Sustainability
6	B.A. English	SEC-1A 23333/24333	SYBA: Advanced Study of English Language	Professional Ethics
7	B.A. English	SEC-2A 23334/24334	A Certificate Course in Skill Development	Professional Ethics
8	B.A. English	CC-35001/36001	TYBA: Compulsory English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
9	B.A. English	SEC 1-C & SEC 1-D- 35331/36331	Enhancing Employability Skills	Professional Ethics
10	B.A. English	DSE-1C& DSE-1D-35332/36332	Appreciating Novel	Gender/ Human Values /Environment and Sustainability
11	B.A.	DSE-2C DSE-2D	Introduction to Literary	Gender/ Human Values

	English	35333/36333	Criticism	/Environment and Sustainability
12	B.A. English	SEC 2-C SEC2-D) 35334/36334	Mastering Life Skills and Life Values	Professional Ethics
13	M.A English	10601/20601	Paper 1.1/Paper 2.1 : English Literature from 1550 to 1798	Gender/ Human Values /Environment and Sustainability
14	M.A English	10602/20602	Paper – 1.2/ Paper – 2.2: English Literature from 1798 to the Present	Gender/ Human Values /Environment and Sustainability
15	M.A English	10603/20603	Paper 1.3/2.3: Contemporary Studies in English Language	Professional Ethics
16	M.A English	10604/20604	Paper – 1.4: Literary Criticism and Theory	Gender/ Human Values /Environment and Sustainability
17.	M.A English	30601/40601	Paper 3.1/4.1: Indian Writing in English (Core Paper)	Gender/ Human Values /Environment and Sustainability
18.	M.A English	30604/40604	Paper 3.4/4.4: Indian Literatures in English Translation	Professional Ethics/Gender/ Human Values /Environment and Sustainability
19	B. A. English	30606 /40606	Paper 3.6/4.6: American Literature	Gender/ Human Values /Environment and Sustainability
20	M.A English	30608/40608	Paper 3.8/4.8: World Literature in English	Gender/ Human Values /Environment and Sustainability
21	M.A English	30094/40094	Skill Development-3/4	Professional Ethics
22	F.Y.B. Com	111/121	FYBCom: Compulsory English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
23	F.Y.B. Com	117-A/127-A	FYBCom: Additional English	Professional Ethics/Gender/ Human Values /Environment and Sustainability
24	SYBSC	23321/24321	ENGLISH (Ability Enhancement Compulsory Course-AECC)	Professional Ethics/Gender/ Human Values /Environment and Sustainability
25	SYBSC (Computer Science)	23922/24922	ENGLISH (Ability Enhancement Compulsory Course-AECC)	Professional Ethics/Gender/ Human Values /Environment and Sustainability
26	SYBCA	308/408	ENGLISH(Ability Enhancement Compulsory Course-AECC)	Professional Ethics/Gender/ Human Values /Environment and Sustainability

Dr. V. C. Thange
Head, Dept. of English
Head
Department of English
K. J. Somaiya College, Kopargaon

Dr. V. C. Thange
IQAC, Coordinator
Co ordinator
IQAC, K. J. Somaiya College
Kopar... Dist. A.Nagar

Dr. B. S. Yadav
Principal
Pr... al
K.J. Somaiya College of Art:
...mmerce & Science, Kopargaon

F. Y. B. A Compulsory English
(w. e. f. 2019-2020)
(Choice Based Credit System)
70:30-Pattern
(70-Semester-End Exam & 30-Internal Evaluation)

Prescribed Text: ***Literary Gleam: An Anthology of Prose and Poetry*** **(Board of Editors- Orient BlackSwan)**

Objectives:

a) To expose students to the best examples of prose and poetry in English so that they realize the beauty and communicative power of English

b) To instill human values and develop the character of students as responsible citizens of the world

c) To develop the ability to appreciate ideas and think critically

d) To enhance employability of the students by developing their linguistic competence and communicative skills

e) To revise and reinforce structures already learnt in the previous stages of learning.

Semester-I

Prose:
1. Engine Trouble — R. K. Narayan
2. On Saying 'Please' — A. G. Gardiner
3. The Gift of the Magi — O. Henry

Poetry:
1. A Red, Red Rose — Robert Burns
2. Leave this Chanting and Singing — Rabindranath Tagore
3. The Felling of a Banyan Tree — Dilip Chitre

Grammar:
1. Articles
2. Prepositions
3. Verbs
   Regular and Irregular Verbs
   Auxiliary Verbs: Primary and Modal
4. Punctuation

Communication Skills:
1. Greeting and Taking Leave

2. Introducing Yourself
3. Introducing People to One Another
4. Making Requests and Asking for Directions
5. Making and Accepting Apology

Semester- II

Prose:
1. In Sahyadri Hills, A Lesson in Humility — Sudha Murthy
2. The Model Millionaire — Oscar Wilde
3. The Eyes are not Here — Ruskin Bond

Poetry:
1. My Heart Leaps Up — William Wordsworth
2. Ozymandias — P. B. Shelley
3. Success is Counted Sweetest — Emily Dickinson

Grammar:
1. Tenses
2. Subject–Verb Agreement
3. Vocabulary

Communication Skills
1. Inviting and Accepting/Declining Invitations
2. Making a Complaint
3. Congratulating, Expressing Sympathy and Offering Condolences
4. Making Suggestions, Offering Advice and Persuading

- Each semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be three hours allotted to internal evaluation. Changes as per the university guidelines shall be communicated from time to time.

F. Y. B. A- Optional English (General Paper-1)
(w. e. f. 2019-2020)
(Choice Based Credit System)
70:30-Pattern
(70-Semester-End Exam & 30-Internal Evaluation)

Prescribed Text: ***Initiations: Minor Literary Forms & Basics of Phonology*** **(Board of Editors- Orient BlackSwan)**

Objectives:

a) To expose students to the basics of literature and language and develop an integrated view about language and literature in them

b) To acquaint them with minor forms of literature in English and help them to appreciate the creative use of language in literature

c) To introduce them to the basics of phonology of English so that they can pronounce better and speak English correctly.

d) To prepare students to go for detailed study and understanding of literature and language

e) To enhance the job potential of students by improving their language skills

Semester - I

Prose Pieces:

1. A Lesson My Father Taught Me - A.P.J. Abdul Kalam

2. Toasted English - R. K. Narayan

Short Stories:

1. The Romance of a Busy Broker - O. Henry

2. The Open Window - Saki

Poetry:

1. Sonnet 29: 'When in disgrace with Fortune and men's eyes' - William Shakespeare
2. The World is too much with Us - William Wordsworth
3. The Listeners - Walter de la Mare
4. No Men are Foreign - James Kirkup

Language Studies:

Introduction to the Sounds of English: Part - I

(Discrepancy between English Spelling and Pronunciation, Phonetic Symbols and Transcription, The Concept of Phoneme and Minimal Pairs.)

Semester - II

Short Stories:

1. The Doll's House - Katherine Mansfield
2. The Thief – Ruskin Bond

Poetry:

1. I remember; I remember – Thomas Hood
2. Where the Mind is without Fear - Rabindranath Tagore
3. The Mountain and the Squirrel - R. W. Emerson
4. Up – Hill - Christina Rossetti

One Act Plays:

1. The Monkey's Paw - W.W. Jacobs
2. Swansong - Anton Chekhov

Language Studies:

Introduction to the Sounds of English: Part - II

(The Concept of Syllable, Monosyllabic and polysyllabic Words, The Concept of Word Stress and Different Standards of Pronunciation i.e. British Received Pronunciation, General American English and General Indian English.)

F. Y. B. Com Compulsory English
(w. e. f. 2019-2020)
(Choice Based Credit System)
70:30-Pattern
(70-Semester-End Exam & 30-Internal Evaluation)

Prescribed Text: ***Success Avenue*** **(Board of Editors- Orient Blackswan)**

Objectives:

a) To offer relevant and practically helpful pieces of prose and poetry to students so that they not only get to know the beauty and communicative power of English but also its practical application
b) To expose students to a variety of topics that dominate the contemporary socio-economic and cultural life
c) To develop oral and written communication skills of the students so that their employability enhances
d) To develop overall linguistic competence and communicative skills of students

Semester- I

Prose

Unit-1- The Beggar- Anton Chekhov

Unit-II- Black Money and the Black Economy- C. Rammanohar Reddy

Unit-III- The Nightingale and the Rose- Oscar Wilde

Unit-IV- Muhammad Yunus: An Economics for Peace- Farida Khan

Poetry

Unit-V- Up-Hill- Christina Rossetti

Unit-VI- Stay Calm- Grenville Kleiser

Communication and Life Skills

Unit-VII- Meeting and Greeting People and Dialogue Writing

Unit-VIII- Group Discussions, Interview and Interviewing Skills

Unit-IX- Presentation Skills

Semester- II

Prose

Unit-I - Indra Nooyi: A Corporate Giant- Indra Krishnamurty Nooyi

Unit-II- Appro JRD- Sudha Murthy

Unit-III- Fur- Saki

Unit-IV- After Twenty Years- O' Henry

Poetry

Unit-V- O Captain! My Captain- Walt Whitman

Unit-VI - The Prayer for My Daughter- W. B. Yeats

Communication and Life Skills

Unit-VII- Letter Writing, Report Writing and Blog Writing

Unit-VIII- Resume Writing and E-Mails

Unit-IX- Non-Verbal Communication

As indicated in the CBCS (Choice Based Credit System) Restructured Programme of Savitribai Phule Pune University at undergraduate level to be introduced from the academic year 2019-20, this subject (Compulsory English), like other subjects under B. Com. Degree Course, shall have 70+30 pattern. There will be written examination of 70 marks of 3 hrs duration for this subject at the end of each semester. The class work (internal evaluation) shall carry 30 marks. Each semester shall have 3 credits for teaching. Each credit is equal to 15 hours so this course shall have 45 teaching hours. In addition to that there shall be three hours allotted to internal evaluation. Changes as per the university guidelines shall be communicated from time to time.

F. Y. B. Com (Additional English)
(w. e. f. 2019-2020)
(Choice Based Credit System)
70:30-Pattern
(70-Semester-End Exam & 30-Internal Evaluation)

Prescribed Text: ***Pearls of Wisdom*** **(Board of Editors-Orient Blackswan)**

Objectives

a) To expose students to a good blend of old and new literary extracts having various themes that are entertaining, enlightening and informative so that they realize the beauty and communicative power of English
b) To make students aware of the cultural values and the major problems in the world today
c) To develop literary sensibilities and communicative abilities among students

Term-I

Unit-I

1. The Sporting Spirit – George Orwell
2. The World Is Too Much With Us – William Wordsworth

Unit-II

1. Do Insects Think? - Robert Benchley
2. The Fortune Teller - Joseph Furtado

Unit-III

1. Good Manners – J.C Hill
2. Where the Mind is Without Fear - Rabindranath Tagore

Unit-IV

1. My Financial Career-Stephen Leacock
2. I Sit and Look Out - Walt Whitman

Term-II

Unit-I

1. Playing the English Gentleman - M.K Gandhi
2. All the World's a Stage - William Shakespeare

Unit-II

1. How Wealth Accumulates and Men Decay – G.B Shaw
2. My Grandmother's House- Kamala Das

Unit-III

1. What Men Live By? - Leo Tolstoy
2. Laugh and be Merry - John Masefield

Unit-IV

1. The Pleasures of Ignorance – Robert Lynd
2. To Daffodils- Robert Herrick

As indicated in the CBCS (Choice Based Credit System) Restructured Programme of Savitribai Phule Pune University at undergraduate level to be introduced from the academic year 2019-20, this subject (Compulsory English), like other subjects under B. Com. Degree Course, shall have 70+ 30 pattern. There will be written examination of 70 marks of 3 hrs duration for this subject at the end of each semester. The class work (internal evaluation) shall carry 30 marks. Each semester shall have 3 credits for teaching. Each credit is equal to 15 hours so this course shall have 45 teaching hours. In addition to that there shall be three hours allotted to internal evaluation. Changes as per the university guidelines shall be communicated from time to time.

S. Y. B. A.

Compulsory English (Core Course-CC)

(Choice Based Credit System-70:30-Pattern)
(w. e. f- 2020-2021)
(03 Credit Course)

Preamble:

The course aims at contributing to the overall personality development of the students. They have to be good human beings before anything else. This laudable aim involves instilling essential human values like tolerance, understanding, sympathy, respecting the differences, living in harmony with nature, protecting the environment etc. In our prose and poetry selections we have kept these considerations in mind. We offer an adequate mix of British, American, Indian and other writers and poets because we want our students to be responsive to an era of globalization but at the same time they have to be rooted in Indian culture and ethos.

Our students have to develop into responsible citizens of the world. They have to become confident and face the challenges of life successfully. Effective use of language is necessary for success in all walks of life. Hence we have focused on enhancing the linguistic skills of the students by concentrating on essential aspects of grammar and enrichment of vocabulary. Apart from the professional and technical qualifications of the employees, the present day employers generally look for certain soft skills which relate to some positive personality traits, attitudes and social skills. Hence the course includes units on some essential soft skills. The course is thus a value oriented and a skill-based course.

Objectives:

a) To expose students to the best examples of literature in English and to contribute to their emotional quotient as well as independent thinking.
b) To instill universal human values through best pieces of literature in English
c) To develop effective communication skills by developing ability to use right words in the right context.
d) To enhance employability of the students by developing their basic soft skills
e) To revise and reinforce the learning of some important areas of grammar for better linguistic competence.

- **Each** semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be 03 hours allotted to internal evaluation. **(3x15=45+3=48).** It is applicable to all other papers/courses.
- **Considering** the choice-based credit system (CBCS) and the semester pattern, both Semesters-III & IV will have a uniform evaluation pattern of 100 marks each. There will be an 'Internal Examination' for 30 marks and 'Semester-end Examination' for 70 marks.
- **The Internal** Examination for 30 marks will be conducted at college level.
  Assignment/group discussion/tutorial/seminar/oral/project for 10 marks
  A Mid-semester Written Test for 20 marks

Semester-III

Prescribed Text: *Panorama: Values and Skills through Literature* **(Board of Editors- Orient BlackSwan)**

Unit-I- Prose

1. A Simple Philosophy- **Seathl**
2. The Homecoming- **Rabindranath Tagore**
3. The Verger- **Somerset Maugham**

Unit-II- Poetry

1. The Palanquin Bearers- **Sarojini Naidu**
2. On the Grasshopper and the Cricket- **John Keats**
3. Pied Beauty- **George Manley Hopkins**

Unit-III- Grammar

1. The Passive Voice
2. Direct and Indirect Speech
3. Negative Sentences

Unit-IV- Vocabulary

1. One-word substitutes
2. Idioms
3. Suffixes and prefixes

Unit-V- Soft Skills

1. Leadership skills
2. Teamwork skills

Semester-IV

Prescribed Text: *Panorama: Values and Skills through Literature* **(Board of Editors- Orient BlackSwan)**

Unit-I- Prose

1. The Chicago Speech- **Swami Vivekananda**
2. The Lottery Ticket- **Anton Chekhov**
3. The Open Window- **Saki (H. H. Munro)**

Unit-II- Poetry

1. On Another's Sorrow- **William Blake**
2. Laugh and Be Merry- **John Masefield**
3. The Rock and the Bubble- **Louisa May Alcott**

S. Y. B. A.

Skill Enhancement Course-SEC-1A

(Old General English-G-2)

(Choice Based Credit System-70:30-Pattern)
(w. e. f- 2020-2021)
(03 Credit Course)

Title of the Paper: Advanced Study of English Language

Prescribed Text: *Linguistics: An Introduction-* **(Ed. Board of Editors, Orient BlackSwan)**

Preamble:

Language is basically a skill-based subject. The present course is a skill enhancement course. Effective use of language involves multiple skills, namely listening, speaking, reading and writing. In order to acquire these skills and become efficient users of language our students need to be conversant with different aspects of language. Thus the students need to know phonological aspects of language like correct pronunciation, stress, tone groups, intonation patterns etc. The basics of morphology acquaint students with the structure of words and word formation processes. Morphology combined with lexical semantics contributes to the enrichment of vocabulary and helps the students to use right words in a right place in their communication. English in India is a second language and in a second language learning situation, developing insight into the process of sentence formation is very important. Syntax part of the course takes care of this crucial aspect in the development of language skills.
Mere correctness of language is not enough. We have to use language appropriately in a given context. Grounding in pragmatics contributes to the language skills of students by helping them produce contextually appropriate utterances. The sociolinguistics part of the course focuses on language variation because language is not a monolithic phenomenon. Awareness of diversity in language use can make the learner a better user of language. The course thus enhances the linguistc and communicative skills of the students.

Objectives of the Course:

a) To familiarize students with the various components of language.
b) To develop overall linguistic competence of the students.
c) To introduce students to some advanced areas of language study.
d) To prepare students to go for detailed study and understanding of language.

Semester-III

Course Content-

1. Phonetics and Phonology part from- **Linguistics: An Introduction**
2. Morphology part from- **Linguistics: An Introduction**

3. Sociolinguistics part from- **Linguistics: An Introduction**

(Following topics from **chapter – 1, 2, 3 and 4 of the prescribed book)**

1. Phonology:

15 Clock Hours

1. Organs of speech, speech mechanisms,
2. Description and classification of consonants and vowels,
3. Concept of syllable,
4. Word accent, sentence accent,
5. Tone groups, placement of nuclear/tonic accent,
6. Concept of intonation, uses/types of tones

2. Morphology:

15 Clock Hours

1. What is morphology?
2. Concept of morpheme, allomorph, zero allomorph, types of morphemes (free and - bound), Prefixes and Suffixes (class-changing and class-maintaining),
3. Inflectional and Derivational suffixes, borrowings

3. Sociolinguistics:

15 Clock Hours

1. National varieties of English: British, American and Indian
2. Regional and social dialects, standard dialect, concept of register, formal and informal styles
3. Pidgins and Creoles, code-switching and code mixing

Semester-IV

Prescribed Text: ***Linguistics: An Introduction-*** **(Ed. Board of Editors, Orient BlackSwan**

Course Content-

1. Syntax part from- **Linguistics: An Introduction**
2. Semantics part from- **Linguistics: An Introduction**
3. Pragmatics part from- **Linguistics: An Introduction**

(Following topics from **chapter – 5, 6 and 7 of the prescribed book)**

1. Syntax:

15 Clock Hours

1. Concept of Phrase, Phrase structure rules/ types of Phrases: Noun phrase, Adjective phrase, Adverb phrase, Prepositional phrase and Verb phrase.
2. Concept of Clause, Parts of Clauses: Subjects and objects, complements and Adverbials, Concept of Subject –verb Concord, Clause patterns.
3. Types of Sentences: Structural Classification - Simple Sentence, Compound Sentence and Complex sentence
4. Types of Sentences: Functional Classification - (affirmatives/interrogatives/imperatives) Wh –questions, Yes-No Questions, Tag

S. Y. B. A.

Discipline Specific Course (DSC-1A)

(Old Special Paper-I)

(Choice Based Credit System-70:30-Pattern)
(w. e. f- 2020-2021)
(03 Credit Course)

Title of the Paper: Appreciating Drama

Preamble:

Drama is an age-old form of literature. Moreover, it is a performing art form. It has been undergoing several transformations in its form and performance till date. In this sense, the world of drama has been exploring and exposing very many distinguishing theoretical, literary and theatrical dimensions. At the backdrop of the very dynamics of drama, the syllabus prescribed under this paper attempts to give justice to the multi-dimensional aspects of drama. The course contents and the evaluation patterns are radically designed to keep pace with the age of technology and to empower the learners for futuristic academic avenues.

Objectives:

1. To introduce Drama as a major form of literature
2. To introduce minor forms of Drama
3. To acquaint and enlighten students regarding the literary and the performing dimensions of drama
4. To acquaint and familiarize the students with the elements and the types of Drama
5. To encourage students to make a detailed study of a few sample masterpieces of English Drama from different parts of the world
6. To develop interest among the students to appreciate and analyze drama independently
7. To enhance students' awareness regarding aesthetics of Drama and to empower them to evaluate drama independently

Semester-III

Course contents-

UNIT-I

Theory of Drama:

1. Drama, the Literary Form
2. Drama, the Performing Art Form
3. Elements of Drama:
   i) Literary Elements: (Theme, Plot, Characters, Diction, Conflict, Setting etc.)
   ii) Theatrical Elements: (Stage directions, Light effects, Music, Costumes, Stage

property, Makeup etc.)
4. Types of Drama: (Tragedy, Comedy, Tragicomedy, Problem play, Absurd drama)
5. An Introduction to Minor Forms of Drama: (e.g. One-act-play, Skit, Street play, a short Radio play, Pantomime etc.)

UNIT-II

A Midsummer Night's Dream by William Shakespeare

Semester-IV

Title of the Paper: Appreciating Drama

UNIT-I

Arms and the Man by George Bernard Shaw

UNIT-II

The Fire and the Rain by Girish Karnad

Select Bibliography:

1. Abrams M.H. 1957. A Glossary of Literary Terms. Madras: Macmillan India Press.
2. Anandlal. 2004. Ed. The Oxford Companion to Indian Theatre. New Delhi: Oxford University Press.
3. Berthold M. 1999. The History of World Theatre. New York: Continuum.
4. Briggs J. & Jefferson N.C. 2003. Encyclopedia of Stage Lighting. : McFarland
5. Brown J.R. 1972. Theatre Language. London: The Penguin Press.
6. Craig E.G. 1911. On the Art of the Theatre. London: William Heinemann Ltd.
7. Crook T. 1999. Radio Drama. Routledge; 1st Edition
8. Dharwadkar A. 2005. Theatres of Independence. New Delhi: Oxford University Press
9. Hughes M. 2013. A History of Pantomime. Remember When
10. Jagadale U.S. 2014. Communication in Drama: A Pragmatic Approach. PartridgeIndia.
11. Mamet D. 1994. Goldberg Street: Short Plays and Monologues. Grove Press

S. Y. B. A.

Discipline Specific Course (DSC-2A)

(Old Special Paper-II)

(Choice Based Credit System-70:30-Pattern)
(w. e. f- 2020-2021)
(03 Credit Course)

Title of the Paper: Appreciating Poetry

Rationale:

Poetry has been the oldest form of literature and continues to be an important part of art and culture. It conveys a thought, describes a scene, or narrates a story in a concentrated, lyrical arrangement of words. It can be structured with rhyming lines and meter or can also be freeform that follows no formal structure. Poetry on the level of content offers a huge variety of aesthetic and worldly experiences. It offers new perspectives to look at the usual matters. The present course is designed in line with such liberating and enriching nature of poetry. This is an introductory course and it is intended that students learn the basics of poetry through its theory and the practical application of some of the terms related to poetry. Given its elementary nature this course cannot afford to be ambitious in its scope and selection of poems. Poems are not necessarily selected from different nationalities and cultures and no specific theme is maintained in the selection of poems. However it is seen in the selection that students get exposed to a variety of experiences through poems of different mold and that their aesthetic and human sensibilities get enriched.

Objectives:

1. To acquaint students with the terminology in poetry criticism (i.e. the terms used in appreciation and critical analysis of poems)
2. To encourage students to make a detailed study of a few sample masterpieces of English poetry
3. To enhance students awareness in the aesthetics of poetry and to empower them to read, appreciate and critically evaluate poetry independently

Semester-III

Course Content-

Prescribed Text: *Mirage: An Anthology of English Poetry* Ed. Board of Editors, Orient Blackswan

A) Theory of Poetry

(a) What is poetry? Significant development in the art of poetry during major periods
(b) Elements of poetry: Rhythm, Meter, Sound Structure, Stanza Forms,
(c) Figures of Speech, Symbols, Imagery, Simile, Metaphor, Personification and other Poetic Devices like Repetition and Contrast.
(d) Types of Poetry: Elegy, Sonnet, Dramatic Monologue, Lyric, Ode, Ballad

B) Poems:

1. The Nightingale- **Philip Sidney**
2. Sonnet 3- **William Shakespeare**
3. The Sun Rising- **John Donne**
4. London- **William Blake**
5. Ode on a Grecian Urn- **John Keats**
6. To a Skylark- **P. B. Shelley**

Semester-IV

Prescribed Text: ***Mirage: An Anthology of English Poetry*** **Ed. Board of Editors, Orient Blackswan**

Poems:

1. My Last Duchess- **Robert Browning**
2. Sailing to Byzantium- **W. B. Yeats**
3. Futility- **Wilfred Owen**
4. A Bird Came Down the Walk- **Emily Dickinson**
5. Talking in Their Sleep- **Edith M. Thomas**
6. What Is Life- **John Clare**
7. Sympathy- **Paul Laurence Dunbar**
8. The Awakening- **James Weldon Johnson**
9. The Wind- **Amy Lowell**
10. Freedom- **Rabindranath Tagore**
11. Caged Bird- **Maya Angelou**
12. Failure of Communication- **Judith Wright**

Select Bibliography:

1. Abrams M.H. 1957. *A Glossary of Literary Terms*. Madras: Macmillan India Press.
2. Drew Elizabeth. 1959. *Poetry- A Modern Guide to Its Umderstanding and Enjoyment*. Dell Publishing Co.
3. Lennard John. 2005. *The Poetry Handbook: A Guide to Reading Poetry for Pleasure and Practical Criticism*. OUP.
4. Moon Brian. 2001. *Studying Poetry: Activities, Resources and Texts*. NCTE.
5. Oliver Mary. 1994. *A Poetry Handbook*. Harcourt Brace & Company.
6. Williams Rhian. 2009. *The Poetry Tool Kit: The Essential Guide to Studying Poetry*. Bloomsburry
7. Wolosky Shira. 2001. *The Art of Poetry: How to Read Poem*. OUP.

(S.Y.B.A)

Skill Enhancement Course-(SEC-2A & 2B)

(w.e.f-2020- 2021)

"A Certificate Course in Skill Development"

[Two Credit Course For Each -Sem-III & IV -2x15=30 Hours For Each Sem]

Objectives:

1. Enhancing the skill of using English for everyday communication
2. To acquaint the students with the verbal and nonverbal communication
3. To create opportunities to access exposure of speaking in various contexts
4. To acquaint and familiarize the students with soft skills
5. To develop interest among the students to interact in English

Suggestions to Teachers:

1. It is a learner-centric course.
2. The course aims at developing skill among the students.
3. Learning can be facilitated through interactive and informal guiding sessions.
4. Participation and up-gradation of the students' performance needs to be encouraged.
5. Practicals, Exercises, Activity monitoring, Projects, Seminars, Presentations, Group Discussions are some of the activities that the teachers are expected to encourage.
6. Relevant and innovative ideas of both the students and the teachers are always appreciable for a successful completion of this course
7. The concerned faculty/teachers have to maintain the record of the students (Given in the Evaluation pattern) as the credits to the students need to be given on the basis of preserved record.
8. **Nature of Evaluation-** Internal (College) 25 Marks and Semester End University Examination- 25 Marks

SEMESTER-III- (SEC 2-A)

Course content:

Unit-I

1- Introducing Yourself and Others
2- Joining and Leaving Conversation
3- Accepting/Declining Invitations

Unit-II

4- Asking/Giving/Refusing Permission
5- Digital Literacy
6- Project Management

SYBSC & SYBSC (Computer Science)

ENGLISH

(Ability Enhancement Compulsory Course-AECC)

(Choice Based Credit System-35:15-Pattern)
(w. e. f- 2020- 2021)

(02-Credit Course)

Text: ***Horizons: English in Multivalent Contexts*** (Board of Editors- Orient BlackSwan)

Preamble:

This is an ABILITY ENHANCEMENT COURSE. Considering the needs of students and the requirements of professional sectors, the syllabus of this paper is designed to enhance linguistic and professional skills of the students. In the age of technology, it's high time for the students to acquire and exercise the skill and sub-skills of using English in multivalent contexts.

The paper aims at a balanced up-gradation of the students, focussing on their ability enhancement. Hence, to avoid a lopsided professional development, the humane values are also taken care of by accommodating literature section in the syllabus. The other units cater to the needs of enhancing speaking ability, writing ability, the ability to face an interview, the ability of using soft skills effectively while planning one's work and working on the plans. By and large, the present syllabus is an attempt to galvanise the existing competencies of the students and enhancing their abilities for a better performance and better results.

Objectives:

1. To introduce the use of English in multimedia
2. To acquaint the students with the language skills in multivalent contexts
3. To acquaint and enlighten students regarding the speaking skill in various contexts
4. To acquaint and familiarize the students with advanced writing skills in different contexts
5. To acquaint and familiarize the students with soft skills
6. To minimize the gap between the existing communicative skills of the students and the skills they require at professional level
7. To develop competence among the students to appreciate and analyze short stories and poetry

Semester-III

Text: ***Horizons: English in Multivalent Contexts*** (Board of Editors- Orient BlackSwan)

Content-

UNIT-I- LITERATURE **10 Clock Hours**

1. **Short Story:**
   i) 'A Shadow': R. K. Narayan
2. **Poetry:**
   i) La Belle Dame sans Merci: John Keats
   ii) Where the Mind is without Fear: Rabindranath Tagore

UNIT-II-CONVERSATIONAL SKILL **10 Clock Hours**

(Sample Dialogues, Useful Expressions and Exercises)

1. Introducing Yourself and Others
2. Asking, Giving and Refusing Permission
3. Describing Daily Routine
4. Complaining and Apologizing
5.

UNIT-III-INTERVIEW TECHNIQUES **10 Clock Hours**

1. Job Application Letter
2. Resume Writing
3. GDPI
4. Presentations

Semester-IV

Text: ***Horizons: English in Multivalent Context*** (Board of Editors- Orient BlackSwan)

UNIT-I-LITERATURE **10 Clock Hours**

1. **Short Story:**
   i) My Lost Dollar: Stephen Leacock
2. **Poetry:**
   i) The Bird Sanctuary: Sarojini Naidu
   ii) Stopping by Woods on a Snowy Evening: Robert Frost

UNIT-II-WRITING SKILLS **10 Clock Hours**

(Sample Passages, Useful Techniques and Exercises)

Savitribai Phule Pune University

(Choice Based Credit System-70:30-Pattern)

(w. e. f- 2021-2022)

T. Y. B. A- English

Semesters	New Nomenclature of Courses/Papers	Old Nomenclature of Courses/Papers	Credits
V	CC-Compulsory English	Compulsory English	03
VI	CC-Compulsory English	Compulsory English	03
V	SEC-1-C	G-3	03
VI	SEC-1-D	G-3	03
V	DSE-1-C	S-3	3+1=04
VI	DSE-1-D	S-3	3+1=04
V	DSE-2-C	S-4	3+1=04
VI	DSE-2-D	S-4	3+1=04
V	SEC-2-C	-----	02
VI	SEC-2-D	-----	02

T. Y. B. A.

Compulsory English

(CC-Core Course- 03 Credit)

Rationale:

The present course is a core course and it basically consists of two components: the literature component and the skills component. The literature component includes some of the best samples of English short stories, essays and poems written by writers of different nationalities (British, American, Indian etc.) This cultural mix is deliberate. We are living in a globalized world and our students need to have at least a cursory acquaintance with different cultures in the outside world. This is particularly important in a pluralistic society like ours. The core course is a part of the humanities. It aims at contributing to the linguistic and communicative abilities of the students. At the same time it also aims at fostering humanitarian attitude in our students and make them better human beings. Our prose and poetry selections in the literature part of the syllabus take care of these humanistic and aesthetic considerations.

The skills component of the syllabus includes language skills (i.e. grammar part and writing skills), soft skills and employability skills. All these are necessary in the contemporary world to make our students confident and enable them to face the real life challenges successfully. The core course is essentially a language course. Linguistic competence is absolutely necessary for achieving success in almost all the fields of life. Hence we have concentrated on

some important aspects of grammar. There are certain writing skills and communicative skills required in all work environments today. These have also been included in the syllabus. Some soft skills and employability skills are necessary from the viewpoint of the employer as well as the employee for his own career advancement. In fact no employee can survive without these skills in the modern day work place. We have kept all these practical considerations in mind while preparing the present syllabus. It is thus a composite course focusing on human values and useful, practical skills.

Objectives:

a) To familiarize students with some excellent pieces of prose and poetry in English so that they realize the beauty and communicative power of English.
b) To enable students to become competent and effective users of English in real life situations.
c) To contribute to the overall personality development of the students.
d) To instill humanitarian values and foster sympathetic attitude in the students.
e) To train the students in practical writing skills required in work environment.
f) To impart knowledge of some essential soft skills to enhance their employability.

***Each** semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be 03 hours allotted to internal evaluation. **(3x15=45+3=48).**

***Considering** the choice-based credit system (CBCS) and the semester pattern, both Semesters-V & VI will have a uniform evaluation pattern of 100 marks each. There will be an 'Internal Examination' for 30 marks and 'Semester-end Examination' for 70 marks.

***The Internal** Examination for 30 marks will be conducted at college level.
a) Assignment/group discussion/tutorial/seminar/oral/project for 10 marks
b) A Mid-semester Written Test for 20 marks

SEMESTER-V

Prescribed Text: *Exploring New Horizons* (Ed-Board of Editors- Orient BlackSwan)

Unit-I- Prose (12 Clock Hours)

1. The Phantom Luncheon – Saki
2. Function of Education –J. Krishnamurti
3. God sees the Truth but Waits – Leo Tolstoy

Unit-II- Poetry (12 Clock Hours)

1. The Neutral Tones – Thomas Hardy
2. Strange Meeting – Wilfred Owen
3. Have you got a brook in your little heart – Emily Dickinson

Unit-III- Grammar (08 Clock Hours)

1. Adverbs and their types (manner, place, time, frequency etc.)
2. Synthesis of sentences by using participles, infinitives, adverbials etc.)
3. Types of Sentences according to function: Declaratives, Interrogatives, Imperatives

Unit-IV- Writing (08 Clock Hours)

1. Paragraph Writing
2. Note-making and Note-taking
3. Reference Skills (Using dictionaries/thesaurus/encyclopedias/year books/table of contents/indices etc)

Unit-V- Soft Skills and Employability Skills (05 Clock Hours)

1. Body Language/Non-verbal Communication
2. Tips for Effective Communication
3. Telephone Skills
4. Teleconferences

SEMESTER-VI

Prescribed Text: *Exploring New Horizons* (Ed-Board of Editors-Orient BlackSwan)

Unit-I- Prose (12 Clock Hours)

1. Shakespeare's Sister – Virginia Woolf
2. After Twenty Years – O. Henry
3. The Conjuror's Revenge – Stephen Leacock

Unit-II- Poetry (12 Clock Hours)

1. The Man of Life Upright – Thomas Campion
2. Money Madness – D.H. Lawrence
3. The Toys – Coventry Patmore

Unit-III- Grammar (08 Clock Hours)

1. Transforming Declarative sentences into Yes-No questions
2. Transforming Declarative sentences into Wh- questions
3. Transforming Positive Imperative sentences into Negative imperatives

Unit-IV- Writing (08 Clock Hours)

1. Email Writing
2. Using Graphs and Charts
3. Dialogue Writing

Unit-V- Soft Skills and Employability Skills (05 Clock Hours)

1. Stress Management
2. Motivation and Positive Approach
3. Goal Setting
4. Adaptability Skills

Skill Enhancement Course (SEC 1-C & SEC 1-D)
(Old G-3)
(w. e. f. 2021-2022)

Title of the Paper: Enhancing Employability Skills

(Credit-3)

Prescribed Text- *Aspirations: English for Careers*
(Board of Editors- Orient BlackSwan)

Rationale:

TYBA students are on the threshold of their career. Hence, it is necessary to orient and prepare them for different careers they can join after graduation. Considering the various career opportunities available to Arts graduates, the syllabus aims at awareness raising, competence building and skill enhancement of the learners. All the units in the book, besides offering exposure to the use of English in different careers, are radically designed to keep pace with the age of technology and to empower the learners for the present as well as the upcoming career avenues.

Course Outcomes:

After studying the paper successfully, the learners will be able:

1. To get the awareness of career opportunities available to them.
2. To identify the career opportunities suitable to them.
3. To understand the use of English in different careers.
4. To develop competence in using English for the career of their choice.
5. To enhance skills required for their placement.
6. To use English effectively in the career of their choice.
7. To exercise verbal as well as nonverbal communication effectively for their career.

Each** semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be 03 hours allotted to internal evaluation. **(3x15=45+3=48).

***Considering** the choice-based credit system (CBCS) and the semester pattern, both Semesters-V & VI will have a uniform evaluation pattern of 100 marks each. There will be an 'Internal Examination' for 30 marks and 'Semester-end Examination' for 70 marks.*

***The Internal** Examination for 30 marks will be conducted at college level.*
a) Assignment/group discussion/tutorial/seminar/oral/project for 10 marks
b) A Mid-semester Written Test for 20 marks

SEMESTER-V (SEC 1-C)

Course content:

Unit-I- Exploring Careers (12 Clock Hours)

1. Creative Writing
2. Translation
3. Journalism
4. English for Academia and Other Careers

Unit-II- Basic Preparation for Jobs (11 Clock Hours)

1. Writing Job Application/Cover Letter
2. Writing Résumés
3. Group Discussions and Personal Interviews
4. Writing Notices, Agendas and Minutes

Unit-III- English for Employability Skills (11 Clock Hours)

1. Communication: An Introduction
2. Formal and Informal English
3. Description, Narration and Demonstration
4. Soft Skills for Employers and Employees

Unit-IV- English for the Corporate Field (11 Clock Hours)

1. English for Sales Services
2. English for Customer Services
3. Presentation Skills
4. Writing Project Proposals and Reports

SEMESTER-VI (SEC 1-D)

Prescribed Text- *Aspirations: English for Careers* (Board of Editors- Orient Black Swan)

Unit-V- English for Competitive Examinations (12 Clock Hours)

1. Vocabulary
2. Tenses
3. Prepositions
4. Précis Writing

Unit-VI- English for Research Purposes (11 Clock Hours)

1. Research Writing
2. Writing a Research Proposal
3. Writing a Research Paper
4. Strategies for Writing Effective Research Papers

Discipline Specific Elective (DSE-1C& DSE-1D)

(Old S-3)

(w. e. f. 2021- 2022)

Title of the Paper: Appreciating Novel

(Credit-3+1=4)

Rationale:

The impact of literature in human society is undeniable. Literature acts as a form of expression for each individual author. Some books mirror society and allow us to better understand the world we live in. Literature is important because it teaches the universal human experiences. It also provides different meanings to different people or teaches different lessons to the same person at different stages of his life. The novel is one of the major forms of literature which generally deals imaginatively with human experiences, usually through a connected sequence of events involving a group of persons in a specific setting. It is a genre of fiction and fiction may be defined as a form of art. It is not a short story in prose; instead, it is actually an extensive and illustrated account of series of events that happened right through the life of a character. By studying and appreciating novel, the students can develop their interpretative abilities and enhance their analytical skills.

Objectives:

a) To introduce students to the basics of novel as a literary form

b) To expose students to the historical development and nature of novel

c) To make students aware of different types and aspects of novel

d) To develop literary sensibility and sense of cultural diversity in students

e) To expose students to some of the best examples of novel

* **Each** semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be 03 hours allotted to internal evaluation. **(3x15=45+3=48).**

* **Considering** the choice-based credit system (CBCS) and the semester pattern, both Semesters-V & VI will have a uniform evaluation pattern of 100 marks each. There will be an 'Internal Examination' for 30 marks and 'Semester-end Examination' for 70 marks.

* **The Internal** Examination for 30 marks will be conducted at college level.

a) Assignment/group discussion/tutorial/seminar/oral/project for 10 marks

b) A Mid-semester Written Test for 20 marks

* **Semester V and VI -DSE 3+1** = One credit is for Research Project/field visit/ or any other Subject-centric activities to be undertaken by the students in consultation with the concerned teacher. The concerned teachers have to evaluate and maintain the record of research project/field visit/ or any other subject-centric activity.

SEMESTER-V (DSE-1C)

Course content:

A) Theory of Novel: (20 Clock Hours)

(a) What is Novel? A brief history of novel as a literary form

(b) Elements of Novel: Theme, Characters, Plot, Structure Narrative Techniques, Point of view, Conflict, Setting and atmosphere, Dialogue

(c) Types of Novels: epistolary, picaresque, bildungsroman, historical, regional, Psychological, satire, realistic, experimental novel, science fiction

(d) In addition to this, other literary terms related to novel/fiction be considered for background study

B) *Silas Marner*- George Eliot (25 Clock Hours)

SEMESTER-VI (DSE-1D)

A) *A Farewell to Arms*- Ernest Hemingway (20 Clock Hours)

B) *The Painter of Signs*- R. K Narayan (25 Clock Hours)

Reference Books:

1) E. M. Forster, Aspects of the Novel, Harcourt, Inc. 1955

2) Terry Eagleton, The English Novel: An Introduction. Blackwell, 2005

3) Walter Allen, The English Novel (London, 1954)

4) Arnold Kettle, Introduction to the English Novel, (2 vols, London, 1951)

5) Ian Watt, The Rise of the Novel, London,1957

6) J. Davis, Factual Fictions: The Origins of the English Novel, (New York, 1983)

7) Geoffrey Day, From Fiction to the Novel, (London, 1987)

8) Dominic Head, The Cambridge Introduction to Modern British Fiction, 1950– 2000. Cambridge, 2002

9) Walter L. Reed, An Exemplary History of the Novel: The Quixotic versus the Picaresque, (Chicago, 1981)

10) Richard Chase, The American Novel and its Tradition, New York, 1957

13) Nadel, Ira Bruce, Biography: Fiction, Fact and Form. London: Macmillan,

Discipline Specific Elective (DSE-2C & DSE-2D)

(Old S-4)

(w. e. f. 2021- 2022)

Title of the Paper: Introduction to Literary Criticism

(Credit-3+1=4)

Rationale:

Literary criticism is as ancient as literature. It has provided different views, perspectives, approaches and terms to understand literature in its diverse forms. It consists of interpretation, judgment, analysis and evaluation of literature. It makes readers aware of form and content of literature, structure and substance of literature. It deals with text and context in its analysis and provides many different views on literature. Literary criticism has undergone many changes in its long journey from the classical antiquity to the modern period. It has branched off from its earlier preoccupations like author's superiority and search for universal meaning and has taken on new pursuits. The present course is designed to introduce students to the basics of literary criticism and the age wise important critical concepts.

Objectives:

a) To introduce students to the basics of literary criticism
b) To make them aware of the nature and historical development of criticism
c) To make them familiar with the significant critical approaches and terms
d) To encourage students to interpret literary works in the light of the critical approaches
e) To develop aptitude for critical analysis

* **Each** semester shall have 3 credits for teaching. Each credit is equal to 15 hours, so this course shall have 45 teaching hours. In addition to that there shall be 03 hours allotted to internal evaluation. **(3x15=45+3=48).**

* **Considering** the choice-based credit system (CBCS) and the semester pattern, both Semesters-V & VI will have a uniform evaluation pattern of 100 marks each. There will be an 'Internal Examination' for 30 marks and 'Semester-end Examination' for 70 marks.

* **The Internal** Examination for 30 marks will be conducted at college level.

a) Assignment/group discussion/tutorial/seminar/oral/project for 10 marks
b) A Mid-semester Written Test for 20 marks

* **Semester V and VI -DSE 3+1** = One credit is for Research Project/field visit/ or any other Subject-centric activities to be undertaken by the students in consultation with the concerned teacher. The concerned teachers have to evaluate and maintain the record of research project/field visit/ or any other subject-centric activity.

Course Content:

SEMESTER-V (DSE-2C)

Unit-I- Orientation (15 clock hours)

1. Literary Criticism- definitions and functions
2. Types of Criticism- historical, biographical, sociological and psychological
3. Literature of knowledge and literature of power

4. Qualities of a good critic

Unit-II- Traditional Criticism (15 clock hours)

1. **Classical Criticism** - Aristotle's Concept of Imitation (Ref- Poetics), Longinus's Five Sources of Sublimity (Ref- on the Sublime)
2. **Neo-Classical Criticism**–Dryden's definition of play (Ref-An Essay on Criticism), Samuel Johnson's defense of Shakespeare

Unit-III- Romantic/Victorian Criticism (15 clock hours)

Wordsworth's definition of poetry, Coleridge's distinction between fancy and imagination, Matthew Arnold's three estimates of poetry

SEMESTER-VI (DSE-2D)

Unit-I- Modern Criticism (15 clock hours)

Eliot's theory of impersonality, William Empson's seven types of ambiguity, Georg Lukacs' concept of realism, Sigmund Freud's structure of human mind- id, ego and superego

Unit-II- New Criticism (15 clock hours)

Allen Tate's concept of tension, Cleanth Brooks' notion of paradox as the structure of poetry, Wimsatt and Beardsley's concept of intentional fallacy

Unit-III- Critical Terms and Practical Criticism (15 clock hours)

Critical Terms:

1. Catharsis
2. Allegory
3. Diction
4. Irony
5. Motif and theme
6. Genre
7. Metaphor
8. Point of view
9. Subjective and objective
10. Satire

Practical Criticism:

Practical criticism of poems, passages from novels and plays, etc. (Teachers are advised to deal with poems, prose passages from the poems and novels that students have studied during their graduation)

Reference Books:

1) Kulkarni Anand et al. (2021). *Explaining Literary Theory*. Namya Press, New Delhi.
2) Kulkarni Anand B. & Chaskar Ashok G. *An Introduction to Literary Criticism and Theory*. Orient Blackswan, Hyderabad, 2015
3) Atherton Carol. *Defining Literary Criticism*. Palgrave, 2005
4) Dorsch T. S. *Classical Literary Criticism*. Penguin, 1981 (reprinted version)
5) Kennedy George A. *A New History of Classical Rhetoric*. Princeton: Princeton University Press, 1994.
6) Ross Andrew. *The Origins of Criticism*. Princeton Univ. Press, 2002

Skill Enhancement Course (SEC 2-C & SEC 2-D)

(w. e. f. 2021- 2022)

Title of the Paper: *Mastering Life Skills and Life Values*

[Two Credit Course For Each Sem- Sem-V & VI -2x15=30 Hours For Each Sem]

Objectives:

1. To equip the students with the social skills
2. To train the students interpersonal skills
3. To build self-confidence and communicate effectively
4. To Encourage the students to think critically
5. To learn stress management and positive thinking
6. To enhance leadership qualities
7. To aware the students about universal human values
8. To develop overall personality of the students

Suggestions to Teachers:

1. It is a learner-centric course.
2. The course aims at developing skills among the students.
3. Learning can be facilitated through interactive and informal guiding sessions.
4. Participation and up-gradation of the students' performance needs to be encouraged.
5. Practical, Exercises, Activity monitoring, Projects, Seminars, Presentations, Group Discussions are some of the activities that the teachers are expected to encourage.
6. Relevant and innovative ideas of both the students and the teachers are always appreciable for a successful completion of this course
7. The concerned faculty/teachers have to maintain the record of the students as credits to the students need to be given on the basis of preserved records.

Nature of Evaluation- Internal (College) 25 Marks and Semester End University Examination- 25 Marks

SEMESTER-V (SEC 2-C)

Course Content:

Life Skills

Unit-I

1. Meaning and Nature of Life Skills
2. Importance of Life Skills
3. Problem Solving and Decision-making skill

Unit-II

4. Critical and Creative Thinking Skill

5. Interpersonal skills: Understanding and Cooperating with Others
6. Management of Stress and Emotions

Question paper pattern

SEMESTER-V (SEC 2-C)

Question-1- Attempt any ONE of the following. 10 Marks
(1 Out of 2- Unit-I)
Question-2- Attempt any ONE of the following. 10 Marks
(1 Out of 2- Unit-II)
Question-3- Attempt any ONE of the following. 05 Marks
(1 Out of 2- Unit I- & II)

Total Marks- 25

SEMESTER-VI (SEC 2-D)

Unit-I **Life Values**

1. Meaning and Nature of Values
2. Importance of Human Values
3. Moral Values
4. Ethical Values

Unit-II

5. Professional Values
6. Aesthetic Values
7. Psychological Values
8. Self-Awareness and Self-Management

Question paper pattern

SEMESTER-VI (SEC 2-D)

Question-1- Attempt any ONE of the following. 10 Marks
(1 Out of 2- Unit-I)
Question-2- Attempt any ONE of the following. 10 Marks
(1 Out of 2- Unit-II)
Question-3- Attempt any ONE of the following. 05 Marks
(1 Out of 2- Unit- I & II)

Total Marks- 25

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M. A. (English) Part I (w.e.f. June 2019-20)

(Credit and Semester System-CSS)

Rationale for studying/teaching literature

• The rationale for studying Literature in English is that it primarily reinforces the guiding principles for education reform outlined in the UGC guidelines.

• The Literature component in English Curriculum provides learners with learning experiences to appreciate and enjoy literature, encourage self-expression and creativity, enhance their critical and analytical skills, improve their competence in the use of English, develop their cultural understanding as well as positive values and attitudes conducive to lifelong learning, and prepare them for further study or work.

• The aims of studying/teaching the Literature component in English curriculum are to enable learners to appreciate and enjoy a wide range of literary or creative texts and to appreciate other related cultural forms.

• The curriculum helps learners to develop a humanistic outlook on life. Through a close interaction with literary/creative works, which portray a range of human thoughts, emotions and experiences, learners gain knowledge and an understanding of the nature of human existence and of the world.

• The study of Literature has many practical advantages—it provides ample opportunities for learners to develop their creativity, sharpen their critical and analytical skills, and enhance their language proficiency.

• It broadens students' awareness of the general culture of different places where English is used and enhances their appreciation and understanding of culturally diverse societies.

• The intellectual, aesthetic and emotional qualities which learners develop by studying literature in English prepare them for further study or work, particularly in areas such as publishing and the media, where creativity, critical thinking and intercultural understanding are highly appreciated.

Rationale for studying English Language/Linguistics and English Literature: English has attained the status of a global language and it is being taught world over for various purposes. In India, English has always been an important language and it has also been a second language in our country. Its importance has increased further in the recent times when it began to be considered as a language of opportunities, a language that can enhance geographical and social mobility. Young people with a good command of English are in great demand in the IT-BPO sectors and in many other prominent domains of profession. A sound knowledge of the English language can also secure lucrative jobs in the world of media. A similar knowledge is a need for many students who seek to work as teachers in schools and centres of higher learning. While teaching English for communicative purposes is an important activity in schools and colleges, teaching/studying the language scientifically is an absolute necessity for those students who

Paper 1.1: English Literature from 1550 to 1798

1) AIMS AND OBJECTIVES

1) To introduce students to the major movements and figures of English Literature through a study of selected literary texts/pieces published during the period prescribed for study.

2) To enhance learners' literary sensibility and their emotional response to literary texts and to help them understand the thematic and stylistic preoccupations of the writers prescribed for study.

3) To enable them to critically examine the writers' thematic concerns and to point out the (in)significance of such concerns in the postcolonial context.

4) To help them recognize the distinctive ways in which the writers differed, in their ideological positions, from their counterparts belonging to different ages.

5) To provide learners some basic information about England's political, social and cultural developments during the period prescribed for study.

6) To enable them to critically assess the 'universal' values that writers tend to project in their writings.

7) To help learners apply the literary-critical principles they study in the paper 'Literary Criticism and Theory' to the texts prescribed or to any other text they read.

8) To explain to the learners the canonical relevance of the texts prescribed for them.

9) To help them identify potential areas of research on which they can work independently for securing a degree or merely for the sake of obtaining knowledge.

10) To enhance their proficiency in English

2) COURSE CONTENT Most of the texts/excerpts listed below are available online. Some of the online resources/sites are given under the section titled 'References.' Teachers and students must also consult standard editions of the texts for authenticity and accuracy.

Semester-I

Allotment of Credits: One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours). This also includes the completion of the background to each period/age. The allotment is as follows:

1) Unit I: Philip Sidney, Edmund Spenser, Walter Raleigh, Robert Herrick: **16 clock hours**

2) Unit II: John Donne, Andrew Marvell, George Herbert, Edmund Waller- **18 clock hours**

3) Unit III: Christopher Marlowe: *Edward II*- **13 clock hours**

4) Unit IV: William Shakespeare: *The Tempest*- **13 clock hours**

Unit-I:

Sir Philip Sidney: The following lyric from *Astrophel and Stella*: 'Come Sleep! O Sleep, the certain knot of peace'

Edmund Spenser: The following poem from *Amoretti*–"Ye tradefull Merchants that with weary toyle"

Sir Walter Raleigh: "The Lie"

Robert Herrick: "Delight in Disorder"

Unit-II

John Donne: i) "The Sunne Rising" ii) "Batter my heart, three-person'd God"

Andrew Marvell: "On Mr. Milton's Paradise Lost"

George Herbert: i)"Death" ii) "The Collar"

Edmund Waller: "Go, lovely Rose"

Unit-III

Christopher Marlowe: *Edward II*

Unit-IV

William Shakespeare: *The Tempest*

Paper – 2.1: English Literature from 1550 to 1798

Semester-II

Unit-I: John Milton: **12 clock hours**

Unit-II: John Dryden, Alexander Pope and William Blake **18 clock hours**

Unit-III: Richard Steele, Joseph Addison, Ben Jonson: **16 clock hours**

Unit-IV: Jonathan Swift: **14 clock hours**

COURSE CONTENT

Unit-1

Paper – 1.2: English Literature from 1798 to the Present

1) AIMS AND OBJECTIVES

1) To introduce students to the major movements and figures of English Literature through a study of selected literary texts/pieces published during the period prescribed for study.

2) To enhance learners' literary sensibility and their emotional response to literary texts and to help them understand the thematic and stylistic preoccupations of the writers prescribed for study.

3) To enable them to critically examine the writers' thematic concerns and to point out the (in)significance of such concerns in the postcolonial context.

4) To help them recognize the distinctive ways in which the writers differed, in their ideological positions, from their counterparts belonging to different ages.

5) To provide learners some basic information about England's political, social and cultural developments during the period prescribed for study.

6) To enable them to critically assess the 'universal' values that writers tend to project in their writings.

7) To help learners apply the literary-critical principles they study in the paper 'Literary Criticism and Theory' to the texts prescribed or to any other text they read.

8) To explain to the learners the canonical relevance of the texts prescribed for them.

9) To help them identify potential areas of research on which they can work independently for securing a degree or merely for the sake of obtaining knowledge.

10) To enhance their proficiency in English

2) COURSE CONTENT Most of the texts/excerpts listed below are available online. Some of the online resources/sites are given under the section titled 'References.' Teachers and students must also consult the print versions of the texts for authenticity and accuracy.

Allotment of Credits: One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours). This also includes the completion of the background to each period/age. The allotment is as follows:

Semester-I

Unit-I: ST Coleridge, William Wordsworth: **14 clock hours**

Unit-II: PB Shelley, John Keats, Felicia Hemans: **16 clock hours**

Unit-III: Mary Shelley: **15 clock hours**

Unit-IV: Jane Austen: **15 clock hours**

Unit-I

S. T. Coleridge: i) "Frost at Midnight"; ii) "Dejection: An Ode"

William Wordsworth: "Resolution and Independence"

Unit-II

P. B Shelley: "England in 1819"

John Keats: i) "Ode on a Grecian Urn" ii) "On First Looking into Chapman's Homer"

Felicia Hemans: "The Bird's Release"

Unit-III

Mary Shelley: *Frankenstein*

Unit-IV

Jane Austen: *Persuasion*

Paper – 2.2: English Literature from 1798 to the Present

Semester-II

Unit I: Elizabeth Barrett Browning, Alfred Tennyson, Robert Browning: **12 clock hours**

Unit II: TS Eliot, WB Yeats, Siegfried Sassoon: **16 clock hours**

Unit III: Seamus Heaney, Anthony Thwaite, Kathryn Simmonds, Jean Rhys: **20 clock hours**

Unit IV: Tom Stoppard: **12 clock hours**

Unit-I

Elizabeth Barrett Browning: "The Cry of the Children"

Alfred Lord Tennyson: From *In Memoriam* "I envy not in any moods"

Robert Browning: "Among the Rocks"

Unit-II

T. S. Eliot: "Preludes"

Sales, Roger. *Tom Stoppard: Rosencrantz and Guildenstern Are Dead* [Penguin Critical Studies] London / New York: Penguin, 1988

Paper 1.3: Contemporary Studies in English Language

1) AIMS AND OBJECTIVES

1. To introduce students to the basic tools essential for a systematic study of language

2. To acquaint students with the basic concepts and issues in linguistics

3. To introduce them to various sub-disciplines of linguistics

4. To initiate them into some of the theoretical assumptions underlying language and to enable them to apply the acquired linguistic skills in real life situations

5) To introduce learners to the syntactic features of the English language

6) To help them shake off some of the regional features of English pronunciation

7) To enable them to use English with confidence and with a better understanding of its appropriate social applications.

2) COURSE CONTENT

[**Note:** Teachers are expected to discuss in class the background to major linguistic theories, linguists and their theoretical models. There will be a separate question on the linguistic background]

A note on the allotment of Credits: One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours). The allotment is as follows:

Semester-I

Unit-I: Introduction to Linguistics and Contemporary Theories/Views of Language: **15 clock hours**

Unit-II: Phonology: **15 clock hours**

Unit-III: Morphology: **15 clock hours**

Unit-IV: Syntax: **15 clock hours**

Unit-1: Introduction to Linguistics and Contemporary Theories/Views of Language

A) Introduction: What is Linguistics? Major branches of Linguistics (Psycholinguistics, Sociolinguistics, Computational linguistics, Historical linguistics), Linguistics in the 20th century: A short history

B) Ferdinand de Saussure's Structuralist View of Grammar:

i) Synchronic and Diachronic Studies

ii) Langue and Parole

iii) Syntagmatic and Paradigmatic Relations

iv) IC Analysis

C) Chomsky's Theory of Transformational Generative Grammar:

i) Language acquisition: The Cognitivist approach

ii) Competence and Performance

iii) The Concepts of Kernel and Non- Kernel Sentences (i.e. Deep and Surface Structure]

D) Dell Hymes' Concept of Communicative Competence

Unit-II: Phonology

i) The Phonemes of English: Description and Classification

ii) The Syllable: Structure and Types, Syllabic Consonants

iii) Word Stress: Degrees of Stress, Stress Shift, Grammatical Stress

iv) Sentence Stress: Use of Weak and Strong Forms, Tone Groups, The Concept of Nucleus (types of nucleus: end-placed and contrastive), Tonic Accent, Pre-tonic Accent, Post-tonic Accent

v) Intonation Patterns/Uses of Tones, Grammatical, Attitudinal and Accentual functions of Intonation

Unit-III: Morphology

i) Structure of words: The concepts of Morpheme and Allomorph

ii) Types of Morpheme (free, bound, prefixes, suffixes: class changing, class-maintaining, inflectional, derivational), General Principles of Lexicography.

iii) Some word formation processes: Reduplication, Clipping, Blending

iv) Morphophonemic Changes, Phonological and Morphological Conditioning

v) Problems of Morphological Analysis

Unit-IV: SYNTAX

a) Sentences and their Parts

b) Words

[For the topics under Syntax, please refer to: Geoffrey Leech, Margaret Deuchar & Robert Hoogenraad's *English Grammar for Today: A New Introduction* 2nd edn. Palgrave, 2006]

Richards, Jack C. and Richard W. Schmidt, ed. *Language and Communication*. Longman, 1993.

Saeed, John. *Semantics*. Oxford: Blackwell, 1997.

Saussure, Ferdinand De. A *Course in General Linguistics* (with introduction by Jonathan Culler), Fontana: Collins, 1974.

Trask, R. L. *Language : The Basics*. Routledge, 2003.

Trudgill, Peter. *Sociolinguistics: An Introduction to Language and Society*. Rev. edn. Penguin, 1983.

Valin, Robert. An Introduction to Syntax. CUP, 2001.

Verschueren, Jeff. *Understanding Pragmatics*. London: Edward Arnold, 1999.

Paper – 1.4: Literary Criticism and Theory

1) OBJECTIVES

1) To introduce students to the nature, function and relevance of literary criticism and theory

2) To introduce them to various important critical approaches and their tenets

3) To encourage them to deal with highly intellectual and radical content and thereby develop their logical thinking and analytical ability

4) To develop sensibility and competence in them for practical application of critical approach to literary texts

2) ALLOTMENT OF CREDITS

One credit is equal to 16 clock hours per unit for both semesters. This also includes the completion of the background survey and basics of critical approaches. The allotment is as below:

Semester-I

Background survey and basics of critical approaches: 6 clock hours

Unit I: Classical Criticism- 12 clock hours (6 clock hours to each essay)

Unit II: Neoclassical Criticism-12 clock hours (6 clock hours to each essay)

Unit III: Romanticism and Victorian Criticism-18 clock hours (6 clock hours to each essay)

Unit IV: Modernism and New Criticism- 12 clock hours (6 clock hours to each essay)

Semester-II

Background survey and basics of critical approaches: 6 clock hours

Unit I: Structuralism and Poststructuralism-12 clock hours (6 clock hours to each essay)

Unit II: Psychoanalysis and Reader Response Criticism-12 clock hours (6 clock hours to each essay)

Unit III: Marxist Criticism and Cultural Studies - 18 clock hours (6 clock hours to each essay)

Unit IV: Feminist Criticism and Postcolonialism-12 clock hours (6 clock hours to each essay)

3) COURSE CONTENT

Teachers are expected to discuss the background contexts to critical approaches, basics, important theorists and critics in the beginning of their course teaching. There shall be a separate question on the critical background.

Semester-I

Unit-I: Classical Criticism

i) Aristotle- Poetics (Chapter 6 to 10)

ii) The Theory of Rasa- S. N. Dasgupta (from Indian Aesthetics: An Introduction, ed. by V. S. Seturaman, Macmillan, 1992)

Unit-II: Neoclassical Criticism

i) Aphra Behn- Preface to The Lucky Chance

ii) Samuel Johnson- Preface to Shakespeare

(both texts from The Norton's Anthology of Theory & Criticism) **

Unit-III: Romanticism and Victorian Criticism

i) S. T. Coleridge- Biographia Literaria (Chapter 13 & 14)

ii)Mary Wollstonecraft-Vindication of the Rights of Women (Chapter II)

(both texts from The Norton's Anthology of Theory & Criticism)

ii) Matthew Arnold- The Study of Poetry

Unit-IV: Modernism and New Criticism

i)T. S. Eliot- The Function of Criticism

Savitribai Phule Pune University

M. A. English-Part-II-CBCS Pattern

(Semester-III & IV)

(From the Academic Year 2020-21)

- **Allotment of Credits:** One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours). It is applicable to all the papers.
- **Examination Rules:**

1- Assessment shall consist of a) In-semester continuous assessment and b) end semester assessment. Both shall have an equal weightage of 50 % each.
2- The teacher concerned shall announce the units for which each in-semester assessment will take place. However, the end-semester assessment shall cover the entire syllabus prescribed for the course.
3- An in-semester assessment of 50% marks should be continuous and at least two tests should be conducted for full course of 4 credits and a teacher must select a variety of procedures for examination such as:
   i. Written Test/or Mid Term Test (not more than one or two for each course)
   ii. Term Paper
   iii. Journal/Lecture/Library notes
   iv. Seminar presentation
   v. Short Quizzes
   vi. Assignments
   vii. Extension Work
   viii. An Open Book Test (with the concerned teacher deciding what 2 books are to be allowed for this purpose)
   ix. Mini Research Project by individual student or group of students. The concerned teacher in consultation with the Head of the PG Department shall decide the nature of questions for the Unit Test. Semester end examination for remaining 50% marks will be conducted by the SPPU.

List of Papers (Sem-III&IV)

Semester-III

Paper 3.1: Indian Writing in English (Core Paper)

Any three papers out of the following seven options:

Paper 3.2: Applied Linguistics

Paper 3.3: Cultural Studies

Paper 3.4: Indian Literatures in English Translation

Paper 3.5: Academic Writing and Critical Reading

Paper 3.6: American Literature

Paper 3.7: Pragmatics and Digital Humanities

Paper 3.8: World Literature in English

Semester-IV

Paper 4.1: Indian Writing in English (Core Paper)

Any three papers out of the following seven options:

Paper 4.2: Applied Linguistics

Paper 4.3: Cultural Studies

Paper 4.4: Indian Literatures in English Translation

Paper 4.5: Academic Writing and Critical Reading

Paper 4.6: American Literature

Paper 4.7: Pragmatics and Digital Humanities

Paper 4.8: World Literature in English

Paper-3.1: Indian Writing in English (Core Paper)

Rationale:

This course attempts to offer an overview of Indian Writing in English. In India, literature written in English was initially labelled as Indo-Anglian, then Indo-English, and more recently, as Indian Writing in English (IWE). IWE has its roots in the colonial past. As a result of the British rule in India, the English language became a vital part of Indian culture. In his *Preface to Kanthapura*, Raja Rao affirms that English is the language of our intellectual make up just like Sanskrit or Persian in the ancient/medieval past. From the pre-independence era to the present times, works written by Indian English writers have been receiving worldwide critical appreciation. Indian Writing in English reflects the multi-cultural, multilingual society of modern India. IWE has established its qualitative excellence and it is now accepted as a part of the English literature curriculum despite some initial resistance. It represents the rich cultural heritage of Indian literary tradition, adopts various literary forms and also addresses different issues.

This paper aims to introduce students to a wide range of Indian Writing in English through various literary genres such as Fiction, Poetry, Non Fictional Prose and Drama. The paper is designed to acquaint students with the highly pluralistic and ideological dimensions of this literature. It is expected that students, through this course, will obtain an overall view of the remarkable contribution made by Indian authors to the body of English Literature

Objectives:

1) To introduce students to the various phases of the evolution in Indian Writing in English. (i. e. the major movements and figures of IWE)
2) To make them aware of Indian cultural ethos and indigenous belief systems through the study of major literary works in the domain of Indian English literature.
3) To acquaint them with the writings of different Indian writers and help them to appreciate the variety and diversity of Indian Writing in English.
4) To expose students to the corpus of Indian Writing in English, and explain the socio-political and cultural contexts in which the works were written and received.
5) To develop the ability of students to critically examine and restate their understanding of literary texts.
6) To expose students to the uniqueness of artistic and innovative use of the English language in IWE and to enhance the literary and linguistic competence of students.
7) To instill human values and develop literary sensibility among students through exposure to IWE texts.

Course Content:
Most of the texts/excerpts listed below are available online. Some of the online resources/sites are given under the section titled 'References.' Teachers and students must also consult the print versions of the texts for authenticity and accuracy. This is applicable to all the courses listed in this document.

Allotment of Credits: One credit is equal to15 clock hours and every semester is allotted 04 credits (60 clock hours). This also includes the completion of the background to each period/age.

Semester-III

Unit-I: *Kanthapura*- Raja Rao - 15 clock hours

Unit-II: *Nectar in a Sieve*- Kamala Markandaya- 15 clock hours

Unit-III: Derozio to Naidu- 15 clock hours

Henry Derozio: 1) *Freedom to the Slave* 2) *The Orphan Girl*

Toru Dutt: 1) *Sita* 2) The Sower

Manmohan Ghose: 1) *Can IT Be?*

Sri Aurobindo: 1) *Rose of God* 2) *The Tiger and the Deer*

Rabindranath Tagore: 1) *Defamation* 2) *Little Flute*

Sarojini Naidu: 1) *Autumn Song* 2) *Summer Woods*

Unit-IV: *My Days: A Memoir*- R. K. Narayan - 15 clock hours

Paper-4.1: Indian Writing in English (Core Paper)

Semester-IV

Unit-I: *The God of Small Things*- Arundhati Roy 15 clock hours

Unit- II: *The White Tiger*- Aravind Adiga 15 clock hours

Unit-III: Dom Moraes to Present Day 15 clock hours

Dom Moraes: 1) *Absences* 2) *The Garden*
Nissim Ezekiel: 1) *Urban* 2) *Philosophy*

Kamala Das: *The Sunshine Cat*
A.K. Ramanujan: *Still Another View of Grace*
Jayanta Mahapatra: *A Missing Person*
Arun Kolatkar: *The Indicator*
Eunice de Souza: *Catholic Mother*
Vikram Seth: *Sit*

Unit- IV: *Nagamandala* - Girish Karnad 15 clock hours

Suggestions for Teachers:

Teachers teaching the paper are expected to briefly discuss the literary background, movements, important writers and works. There will be a separate question to test students' familiarity with the background of the text and the writer and their times. Teachers are expected to compare and contrast the prescribed texts with their contemporaries from Indian Writing in English. The prescribed syllabus should be taught to the students with special emphasis on the issues such as the representation of culture, identity, history, national and gender politics.

It will also be useful for the students if they are briefly introduced to the socio-political and historical conditions of 19th and 20th century India. The dominant literary tendencies and trends, the stylistic features of the authors prescribed for study, the major thematic concerns in the texts, etc. are also issues that can be discussed. Students are expected to read all the primary texts listed in the two papers. Teachers should encourage students to read a history of Indian English Literature and some critical works/commentaries on each text and author.

ICT-based teaching, amply supported by classroom interaction, is strongly recommended. A careful use of PPTs should help learners prepare notes on the various themes of the texts and the characteristic features of the writings of the authors prescribed for study. Depending on the availability of time, film versions of the novels and plays (downloaded from YouTube, etc.) may be shown to students. Readings of poems, sometimes by the poets themselves, may also be played/shown.

Seminars, discussions and presentations in the classroom can be adopted as means to enhance the critical skills of learners. Each teacher is expected to be a teacher-researcher in the sense that s/he would be consistently monitoring her/his own teaching in order to identify the most suitable method(s) for her/his students in particular classrooms.

Evaluation Procedures:
The assessment of students' performance in tests, examinations, etc. will be done according to the guidelines issued by Savitribai Phule Pune University. The pattern of the question papers for semester-end examinations is attached separately to this document.

Select Bibliography:

Standard and recognized editions of textbooks and reference books may be used as bibliography for the course contents.

Paper-3.4: Indian Literatures in English Translation

Rationale:
India has witnessed many socio-political and cultural changes since she won independence in 1947. The languages of India also have made significant progress by producing literary works that can compete with their counterparts in various parts of the world. However, these works appearing in Indian *Bhashas* did not receive much importance because of the lack of translations. Although English continued to be a prominent language in India, a Second Language, many of the outstanding works published in Indian languages were not translated into that language which already had the status of a world language. At the same time, some of the Indian writers, like Mulk Raj Anand, RK Narayan and many others, received fame in the western world since they were able to write their fictional/non-fictional works in English. As it is well-known, Indian Writing in English has for long been a much sought-after course both in Indian and western universities alike.

The evolution of poststructuralist theories in the last few decades brought about notable changes in the approach of teachers and scholars towards literatures of the world and the cultures they represent. The long-established status of English/British Literature as a monolith began to be challenged by the new theories. Consequently, the nomenclature changed to 'literatures in English'; the legitimate worth of non-British literatures began to be acknowledged. Discussions about translation studies in scholarly circles and at Indian universities gave an impetus to the prospect of translating literary works from Indian languages into English. Prestigious publishers now vie with one another for the right to bring out such works. Consequently, one comes across an array of literary creations—depicting the cultural complexities of a multi-ethnic, multi-religious and multi-caste country like India—translated into English from many languages in the country. The rich diversity of India is sharply reflected in the themes of these works. They include, among many others, India's Bhakti tradition, her colonial experience, her freedom struggle, Independence and partition, evolution of Indian identities, the idea of a nation and its contradictions, the Dalit experience, etc. The selections made for the present course subsumes some of these themes and the ideologies they project. It is hoped that the reading of these texts in translation will help students discern the historical, socio-cultural and political impact of various events on the regional literatures of India. Students will also get a glimpse of the vibrancies of *Bhasha* literatures and how much of the vitalities have been retained/lost in translation. Most importantly, students will get a chance to gain an idea about the cultural diversity of their own country through a variety of texts representing a very long period extending from 1st century BC.

Objectives:

1. To introduce students to some of the significant Indian regional language writers of various periods and to their works.
2. To acquaint students with the major ancient, medieval and modern literary movements in India and their influence on literature.
3. To enable students to compare the features and peculiarities of Indian societies, cultures and languages.
4. To acquaint students with the different literary techniques employed by various Indian regional language writers.

5. To help students understand how English gets Indianised in translation.
6. To make students understand the vast possibilities of translating literary texts from their own languages into English and the necessity of undertaking multidisciplinary research projects focusing on the literary-cultural varieties of India.

Allotment of Credits: One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours).

Semester-III

Course content-

Unit-I: Poetry **15 clock hours**

Thiruvalluvar, From *Thirukkural*, Chapter 5 ("Family Life") & Chapter 79 ("On Friendship")

Akkamahadevi, "Would a circling surface vulture"

Kabirdas, i) "Hey Brother, Why do you Want me to Talk?" ii) "I won't Come"

Mirabai, i) "Life in the World", ii) "Strange is the Path when you Offer Love"

Atukuri Molla , From *Molla Ramayanam* "My Father Kesava", "I am no Scholar"

Sant Tukaram, From Dilip Chitre's *Says Tuka* Part IV, Section1, Poem 1 "Being in Turmoil"

Jogeshwari, "If fortune has brought you my way at last"

Unit-II:Short story **15 clock hours**

Suresh Joshi, "The Patch"

Bashir Akhtar, "Some Poses, Some Snaps"

Binodini Devi MK, "Tune"

Unit III: Novel

Gopinath Mohanty, *Paraja* **15 clock hours**

Unit IV: Drama

Vijay Tendulkar, *Vultures* **15 clock hours**

Paper-4.4: Indian Literatures in English Translation

Semester-IV

Unit-I: Poetry **20 clock hours**

Mary John Thottam (Sr. Mary Benigna) "Farewell to the world" (Stanzas 1-10)

Mohammad Iqbal "Man and God"

Sutapa Bhattacharya "Draupadi"

Nara (VN Rao) "White Paper"

Paper-3.6: American Literature

Rationale:

American literature is considered to be one of the most important non-British branches of English literature. As one of the first colonies of Britain, with a large group of immigrants from the same country, America could not really separate itself, at least for the first several decades, from the influence of British literature. However, what is significant is that this kind of literary dependence did not become a permanent feature and America succeeded in producing a kind of literature that was distinctly American. The Americanness of the literature began to be felt from the 18th century onwards and that originality has progressively continued till date. The rise of American literature to its independent identity coincides with that of its political and economic freedom. The democratic form of government that America adopted with its freedom in 1776 has special significance for India which is the other largest democracy in the world. American literature has always found its place in the English literature syllabi of Indian universities, particularly from the late 1950s to the 80s. Even in the present times the study of American literature has significance because this is a time when we in India redefine the scope of political and literary democracy. As it is well-known, America has its own much varied native and non-native ethnicities. How America has redefined democracy in the context of a vast variety of cultures is significant because India, too, has been a land of vast linguistic, religious and cultural diversities. Yes, the nature of the diversities in the two countries varies but the differences have posed challenges to both the democracies. While, for example, the protests of the African-Americans for their equality in the US have been a burning issue, the voices of the marginalized in India have raised questions about its notions of equality. Obviously, the issues that such diversities raise have been themes in the literatures of both America and India. Students at the MA level in India, while doing a course in Indian writing in English or Indian literatures in English Translation, would get ample opportunities to know how local issues find expression in this country's literatures. Doing a course in American literature simultaneously with a course in Indian literatures would enable students to make comparisons between the writers of the two countries and how the writers dealt with various local and national themes in the two literatures.

Objectives:

1. To provide students a general introduction to the major texts that led to the evolution of American literature as an independent branch of literature in English.
2. To familiarize students with the issues and problems America has gone through and how they find expression in her literature.
3. To help students gain a broad historical view of the entire period from the time of the early settlers, through the westward movement to the contemporary period.
4. To provide students a general idea about the religious, socio-political, literary and cultural movements in America.
5. To acquaint students with some of the major conflicts, struggles and movements that are closely connected with the experiences of a group of people struggling to establish their space within the nation
6. To familiarize students with the rich diversity of American writing

7. To enable students to undertake research of a comparative nature to discover similarities between the socio-political, cultural and literary issues pertaining to America and India.

Allotment of Credits: One credit is equal to 15 clock hours and every semester is allotted four credits (60 clock hours).

Semester-III

Course content:

UNIT-I: Early writings **15 clock hours**

a) **Columbus**, From *Letter to Ferdinand and Isabella Regarding the Fourth Voyage* [Jamaica, July 7, 1503].

b) **John Heckewelder**, From *History, Manners, and Customs of the Indian Nations* (Chapter II &III) [Delaware Legend of Hudson's Arrival **OR** Indian account of the first arrival of the Dutch at New York Island (Ch. II).] [Indian relations of the conduct of the Europeans towards them (Ch.III).]

c) **J Hector St. John De Crevecoeur,** From *Letter IX. Description of Charles-Town; Thoughts on Slavery; on Physical Evil; A Melancholy Scene*

UNIT-II: Poetry **15 clock hours**

a) **Anonymous-** "Lenape War Song"
b) **Philip Freneau-** i) "On Mr. Paine's Rights of Man" ii) "On the Religion of Nature"
c) **Anne Bradstreet-** i) "The Author to Her Book" ii) "In Memory of My Dear Grandchild Anne Bradstreet, Who Deceased June 20, 1669, Being Three Years and Seven Months Old"
d) **Paul Laurence Dunbar-** i) "We Wear the Mask", ii) "Harriet Beecher Stowe"

UNIT-III: Novel

James Fennimore Cooper- *The Last of the Mohicans* **15 clock hours**

UNIT-IV: Autobiography

Benjamin Franklin- *Autobiography.* **15 clock hours**

Paper-4.6: American Literature

Semester-IV

UNIT-I: Prose &speech **15 clock hours**

a) **Ralph Waldo Emerson-** From *Nature*: i) "Introduction", ii) Chapter 1("Nature") & iii) Ch. 3 ("Beauty")
b) **Henry David Thoreau-** From *Walden*, the chapters titled "Economy" & "Where I Lived, and What I Lived For"
c) **Abraham Lincoln-** "Second Inaugural Address, March 4, 1865"

UNIT-II: Poetry **20 clock hours**

Paper-3.8: World Literature in English

Rationale:

The advancement in information and communication technology has made the world a much smaller place than it used to be. Gathering information about or getting in touch with regions located at the extreme ends of the globe is not so difficult a task now. Certainly, the evolution of English as a world language has eased the complexity of the task further. The language, even as it acts as a lingua franca of the world and a medium for information, has recently become a coveted means for the authors of many countries to present themselves and their works to the world outside their own regions. Fortunately for the serious readers and students of the world, getting access to the great writers and their texts has become a much easier engagement. The present course attempts to showcase some of the texts of world renowned authors which are available in English. It is hoped that the course will offer students glimpses of the representations of cultural diversities and technical experiments that the authors try to project in the selected works. The focus has been mainly on the writers other than the ones with whom our students are familiar so that students will get introduced to them and the cultures they depict through their works.

Objectives:

1. To introduce students to some of the important literary texts of the world
2. To help them in gaining some insights into the socio-cultural aspects of the regions from where the texts are chosen.
3. To enable students to compare the authors of the world with Indian writers in English or the writers in their own languages.
4. To introduce students to the various techniques employed by the authors and how the techniques are adapted/adopted by Indian authors.
5. To help the students undertake research in comparative literature

Semester-III

Course Content- **15 clock hours**

Unit -I: Drama

Sophocles- *Antigone* **15 clock hours**

Unit-II: Poetry

Geoffrey Chaucer- "The Canterbury Tales: General Prologue"
Aleksandr Pushkin- "To a Poet"
Lucy Maud Montgomer-"Come, Rest Awhile"
Gabriela Mistral- "Song of death"
Doris Lessing- i) "Fable", ii) "Dark Girl's Song"
Margaret Atwood- "Marrying the Hangman", "A Sad Child" **15 clock hours**

Unit-III: Fiction

Nadine Gordimer- *My Son's Story*

Unit-IV: Biography **15 clock hours**

Anne Frank- *The Diary of a Young Girl*

Paper-4.8: World Literature in English

Semester-IV

Unit-I: Drama **15 clock hours**

Bertolt Brecht, *TheGood Woman of Setzuan*

Unit-II: Poetry **15 clock hours**

Bian Zhilin, "Long is"

Dennis Brutus, "A Common Hate Enriched Our Love and Us"

Gabriel Okara , i) "You Laughed and Laughed and Laughed", ii)"The Mystic Drum"

NgugiwaThiongo, "The Dawn of Darkness"

ParveenShakir, "A Special Laborer of Steel Mills"

Unit-III: Fiction **15 clock hours**

V. S. Naipaul 'A *House for MrBiswas'*

Unit-IV: Autobiography **15 clock hours**

Maxine Hong Kingston, *The Woman Warrior: Memoirs of a Girlhood Among Ghosts*

Suggestions for teachers:

Teachers are expected to briefly discuss the literary background, movements, important writers and their works while teaching each of the texts listed in the course. There will be a separate question on the socio-cultural and literary background of the period during which the texts were written. The questions may include the cultural and literary influences on the author, the authors' distinct contribution to the literary world, the social background of a region as it is reflected in a particular work, etc. These topics for questions are suggested as examples only; teachers may discuss other relevant topics as well. Needless to say, every teacher should briefly introduce their class to the socio-political, historical and literary conditions that prevailed in each of the countries to which the writers belonged. The dominant literary tendencies and trends, the stylistic features of the authors prescribed for study, the major thematic concerns in the texts, etc. are also issues that can be discussed. Students are expected to read all the primary texts listed in the paper. Teachers should

2019 pattern

List of Coureses Addresses Crosscutting Issues as per Syllabus.

Sr. No.	Programme Name	Course Code	Name of Course	Addressed Issue (Professional Ethics, Gender, Human Values, Environment)
1.	F.Y.B.A.	IA/	Vaiklpik Hindi-sahitya Vividha.	Human Values, Environment
	F.Y.B.A.	IB	Vaiklpik Hindi-sahitya Vividha	Human Values, Environment
2.	F.Y.B.Com.	IA/	Vaiklpik Hindi-sahitya Saurabh	Human Values, Environment
	F.Y.B.Com	IB	Vaiklpik Hindi-sahitya Saurabh	Human Values, Environment
3.	S.Y.B.A.	MIL	Hindi Bhasha Shikshan	Gender, Human Values, Environment
4.	S.Y.B.A. Gen.	CC-1C (G-2)	Adhunik Kavya Tatha Vayvaharik Hindi	Human Values,
	S.Y.B.A. Gen.	CC-1D (G-2)	Adhunik Kavya Tatha Vayvaharik Hindi	Human Values, Environment
5.	S.Y.B.A. S-1	DSE-1A	Kavyashastra.	Human Values,
		DSE-1B (S-1)	Sahitya Ke Bhed	Professional Ethics
6.	S.Y.B.A. S-1	DSE-1A	Madhyayugin Kavya Tatha Upanyas.	Human Values,
		DSC-2B (S-2)	Madhyayugin Kavya Tatha Natak Sahitya.	Human Values
7.	S.Y.B.A	SEC-2A	Anuvad Swarup Evam Vyavhar.	Gender
8.	S.Y.B.A	SEC-2B	Madhyam Lekhan	(Professional Ethics
9.	T.Y.B.A. S-3	DSE 1 C (S3)	Hindi Sahitya Ka Itihas.	Gender, Human Values, Environment
		DSE 1 D (S3)	Hindi Sahitya Ka Itihas.- Adhunik Kal	Human Values, Environment
10.	T.Y.B.A. S-4	Elective 2 C (S4)	Bhashavigyan	Gender,
11.	T.Y.B.A.	Core Course -1E (G-3)	Kathetter Vidhaye	Gender, Human Values, Environment
12.	T.Y.B.A.	Core Course -1F (G-3)	Gazal Vidha.	Gender, Human Values
13.	M.A.	1	Madhyayugin Kavya	Gender, Human Values, Environment
14.	M.A.	2	Kathasahitya	Gender, Human Values, Environment
15.	M.A.	3	Bhartiya Kavyshastra	Gender

16.	M.A.	4	Natakkar Mohan Rakesh.	Gender, Human Values,
17.	M.A.	5.	Kathetter Gadya Sahitya.	Gender, Human Values, Environment
18.	M.A.	6.	Shodh Pravidhi	Professional Ethics
19.	M.A.	7.	Pachyatya Kavyshstra	Gender,
20.	M.A.	8.	Hindi Upnyas Sahitya.	Gender, Human Values, Environment
21.	M.A.	9.	Adhunik Kavya	Gender, Human Values, Environment
22.	M.A.	10.	Bhasha Vigyan	Gender,
23.	M.A.	11.	Hindi Sahitya Ka Itihas.	Gender, Human Values, Environment
24.	M.A.	12.	Sanchar Madhyam.	Gender,
25.	M.A.	13.	Adhunik Kavita	Gender, Human Values, Environment
26.	M.A.	14.	Hindi Bhasha Ka Vikas	Gender.
27.	M.A.	15.	Hindi Sahitya ka Vikas	Gender, Human Values,
28.	M.A.	16.	Bhartiya Loksahitya.	Gender, Human Values, Environment

Head
Head Of Department
Department of Hindi
K. J. Somaiya College, Kopargaon

IQAC Coordinator
Co-ordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

प्रथम वर्ष कला (F.Y.B.A.) (सामान्य)
(द्वितीय अयन)

पाठ्यचर्या : वैकल्पिक हिंदी प्रश्नपत्र – 1 B

3 कर्मांक

उद्देश्य :

1. छात्रों को हिंदी काव्य साहित्य का परिचय देना।
2. हिंदी कहानी साहित्य से अवगत कराना।
3. निबंध लेखन कौशल को विकसित करना।
4. छात्रों को विज्ञापन लेखन से अवगत करना।

	द्वितीय सत्र / द्वितीय अयन
इकाई– **I**	काव्य साहित्य : आदमी को प्यास लगती है – ज्ञानेंद्रपति रोशनी के उस पार – ओमप्रकाश वाल्मीकि उतनी दूर मत ब्याहना बाबा – निर्मला पुत्तुल किताबें झाँकती हैं – गुलज़ार नींव की ईंट हो तुम दीदी – उद्यप्रकाश
इकाई –**II**	गद्य विधा : सरजू भैया – रामवृक्ष बेनीपुरी (रेखाचित्र) भय – आ. रामचंद्र शुक्ल (निबंध) एक बूंद सहसा उछली – अज्ञेय (यात्रा वर्णन) अकबरी लौटा – अन्नपूर्णानंद वर्मा (व्यंग्य) प्रतिशोध – डॉ. रामकुमार वर्मा (एकांकी)
इकाई –**III**	साहित्येतर पाठ्यक्रम : लेखन कौशल : स्ववृत्त लेखन निबंध लेखन विज्ञापन लेखन : (दैनिक पत्र–पत्रिकाओं के लिए) वाक्य शुद्धिकरण (संज्ञा, सर्वनाम, विशेषण क्रिया के संबंध में)

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा – 20, शोध परियोजना / समूह परियोजना / मौखिक प्रस्तुति / क्षेत्रीय अध्ययन– 10)

सत्रांत परीक्षा – 70

प्रथम वर्ष वाणिज्य (F.Y.B.com) (सामान्य)

(प्रथम अयन)

पाठ्यचर्या : वैकल्पिक हिंदी प्रश्नपत्र – 1 A

3 कर्मांक

उद्देश्य :

1. छात्रों को हिंदी काव्य साहित्य का परिचय देना।
2. हिंदी कहानी साहित्य से अवगत कराना।
3. हिंदी भाषा द्वारा संवाद कौशल विकसित करना।
4. मौलिक लेखन की ओर रूझान बढ़ाना।
5. विज्ञापन लेखन कौशल विकसित करना।
6. हिंदी कंप्यूटिंग का परिचय देना।

	प्रथम सत्र/प्रथम अयन
इकाई – I	काव्य साहित्य : स्वदेश के प्रति – सुभद्राकुमारी चौहान हो गई पीर – दुष्यंत कुमार पिता के जूते – अशोक वाजपेयी पेड़ की पुकार – शंभुनाथ सिंह उदास तुम – धर्मवीर भारती
इकाई – II	कहानी साहित्य : भोलराम का जीव – हरिशंकर परसाई उसने कहा था – चंद्रधर शर्मा गुलेरी व्यथा का सरगम् – अमृतराय जंगल दाह – स्वयंप्रकाश सबसे कठिन काम – मधु कांकरिया
इकाई – III	साहित्येतर पाठ्यक्रम : अंक तथा गणितीय चिह्नों का देवनागरी में लेखन हिंदी कंप्यूटिंग : यूनिकोड (Unicode) की जानकारी। इंटरनेट की सामान्य जानकारी हिंदी सॉफ्टवेयर की जानकारी।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा – 20, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10)

सत्रांत परीक्षा – 70

प्रथम वर्ष वाणिज्य (F.Y.B.com) (सामान्य)
(द्वितीय अयन)

पाठ्यचर्या : वैकल्पिक हिंदी प्रश्नपत्र – 1 B

3 कर्माक

1. छात्रों को हिंदी काव्य साहित्य का परिचय देना।
2. हिंदी कहानी साहित्य से अवगत कराना।
3. हिंदी भाषा द्वारा संवाद कौशल विकसित करना।
4. विज्ञापन लेखन के प्रकारों को अवगत करना।
5. अनुवाद का स्वरूप से अवगत करना।
6. पारिभाषिक शब्दावली से अवगत कराना।

	द्वितीय सत्र / द्वितीय अयन
इकाई – I	काव्य साहित्य : अब की लौटा तो – कुंवरनारायण कलगी बाजरे की – अज्ञेयए माँझी का पूल – केदारनाथ सिंह बापू के प्रति –सुमित्रानंदन पंत माँ के लिए एक कविता – कात्यायनी
इकाई – II	कहानी साहित्य : पहलवान की ढोलक – फणीश्वरनाथ रेणु सलाम – ओमप्रकाश वाल्मीकि बच्चे का सपना – शेखर जोशी बोलनेवाली औरत – ममता कालिया चिट्ठी – अखिलेश
इकाई – III	साहित्येतर पाठ्यक्रम : संवाद कौशल अनुवादः स्वरूप, परिभाषा, व्यावहारिक पक्ष पारिभाषिक (कार्यालयीन) 100 शब्दावली।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा – 20, शोध परियोजना / समूह परियोजना / मौखिक प्रस्तुति / क्षेत्रीय अध्ययन– 10)

सत्रांत परीक्षा – 70

अनुक्रम

बी. ए.द्वितीय वर्ष कला/बी. एस्सी. द्वितीय वर्ष विज्ञान

तृतीय एवं चतुर्थ अयन (Third & Fourth Semester)

शैक्षिक वर्ष 2020–21 से

कोर्स नं.	तृतीय एवं चतुर्थ अयन	क्रेडिट	पृष्ठ क्रमांक
बी. ए. द्वितीय वर्ष कला			
CC-1C (G-2)	आधुनिक काव्य, कहानी तथा व्यावहारिक हिंदी (तृतीय अयन)	3	03
CC-1D (G-2)	आधुनिक हिंदी व्यंग्य साहित्य तथा व्यावहारिक हिंदी (चतुर्थ अयन)	3	05
बी. ए. द्वितीय वर्ष कला –प्रयोजनमूलक हिंदी (वैकल्पिक)			
CC-1C (G-2)	प्रयोजनमूलक हिंदी : अनुप्रयोग (तृतीय अयन)	3	07
CC-1D (G-2)	जनसंचार माध्यम और हिंदी (चतुर्थ अयन)	3	09
बी. ए. द्वितीय वर्ष कला (हिंदी विशेष)			
SEC-2A	अनुवाद स्वरूप एवं व्यवहार (तृतीय अयन)	2	11
SEC-2B	माध्यम लेखन (चतुर्थ अयन)	2	12
बी. ए. द्वितीय वर्ष कला (हिंदी विशेष)			
DSE-1A (S-1)	काव्यशास्त्र (सामान्य) (तृतीय अयन)	3	14
DSE-1B (S-1)	साहित्य के भेद (चतुर्थ अयन)	3	16
DSC-2A (S-2)	मध्ययुगीन काव्य तथा उपन्यास साहित्य (तृतीय अयन)	3	18
DSC-2B (S-2)	मध्ययुगीन काव्य तथा नाटक साहित्य (चतुर्थ अयन)	3	21
बी. एस्सी. द्वितीय वर्ष विज्ञान (सामान्य)General			
AECC-2A	हिंदी काव्य तथा कहानी साहित्य (तृतीय अयन)	2	26
AECC-2B	हिंदी काव्य तथा कहानी साहित्य (चतुर्थ अयन)	2	28

***

बी. ए.द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

तृतीय अयन **(Third Semester)**

पाठ्यचर्या : **CC-1C (G-2)** आधुनिक काव्य, कहानी तथा व्यावहारिक हिंदी

3 कर्मांक **(Credit)**

उद्देश्य :

1. छात्रों को काव्य साहित्य से परिचित कराना।
2. छात्रों को कहानी साहित्य से परिचित कराना।
3. छात्रों को हिंदी कारक–व्यवस्था समझाना।
4. शब्द युग्म का अर्थ लिखकर प्रत्यक्ष वाक्य में प्रयोग समझाना।
5. संक्षेपण लेखन का प्रत्यक्ष बोध कराना।
6. सर्जनात्मकता का विकास कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	काव्य साहित्य : 1) नाच – अज्ञेय 2) देश कागज पर बना नक्शा नहीं होता – सर्वेश्वरदयाल सक्सेना 3) एकलव्य से संवाद – अनुज लुगुन 4) हॉकी खेलती लडकियाँ – कात्यायनी 5) कूड़ा बीनते बच्चे– अनामिका। उक्त रचनाओं का, कथ्यगत एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई–**II**	कहानी साहित्य : 1) धरती अब भी घूम रही है–विष्णु प्रभाकर 2) दूसरे – कमलेश्वर 3) सजा – मन्नू भंडारी 4) सलाम – ओमप्रकाश वाल्मीकि 5) छावनी में बेघर– अल्पना मिश्र उक्त रचनाओं का, कथ्यगत एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई–**III**	साहित्येतर पाठ्यक्रम : 1) हिंदी कारक व्यवस्था। 2) शब्द युग्म (50) अर्थ लिखकर वाक्य में प्रयोग। 3) संक्षेपण।	15 तासिकाएँ

बी. ए. द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

चतुर्थ अयन **(Fourth Semester)**

पाठ्यचर्या : **CC-1D (G-2)** आधुनिक हिंदी व्यंग्य साहित्य तथा व्यावहारिक हिंदी

3 कर्मांक **(Credit)**

उद्देश्य :

1. छात्रों को व्यंग्य पाठ से परिचित कराना।
2. छात्रों को कहानी व्यंग्य पाठ का बोध कराना।
3. साक्षात्कार कला से अवगत कराना।
4. भाषा का मोबाइल तंत्र समझाना।
5. पल्लवन कला से अवगत करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–I	काव्य पाठ (व्यंग्य) : 1) तीनों बंदर बापू के – नागार्जुन 2) बात बतंगड – काका हाथरसी 3) विद्वान लोग – उदय प्रकाश 4) कितनी रोटी – अशोक चक्रधर 5) देश के लिए नेता – शैल चतुर्वेदी। उक्त रचनाओं का, कथ्यगत एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई–II	कहानी पाठ (व्यंग्य) : 1) प्रेम की बिरादरी – हरिशंकर परसाई 2) अफसर – शरद जोशी 3)सावधान! हम इमानदार हैं – लतिफघोंघी 4) मुख्यमंत्री का डंडा – सुदर्शन मजीठिया 5) झोले – सुभाष काबरा उक्त रचनाओं का, कथ्यगत एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई–III	साहित्येतर पाठ्यक्रम : 1) साक्षात्कार।	15 तासिकाएँ

बी. ए. द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

चतुर्थ अयन **(Fourth Semester)**

पाठ्यचर्या : **SEC- 2B** माध्यम लेखन

2कर्मांक **(Credit)**

उद्देश्य :

1. छात्रों को माध्यम लेखन से परिचित कराना।
2. सृजनात्मक लेखन कौशल विकसित कराना।
3. माध्यम लेखन से अवगत कराना।
4. श्रव्य–दृश्य माध्यमों की भाषा से अवगत कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–I	माध्यम लेखन – सैद्धांतिक पक्ष 1. माध्यम का स्वरूप 2. अवधारणा 3. महत्व एवं उद्देश्य 4. माध्यम एवं विधा परिचय : i) मुद्रित माध्यम ii) श्रव्य माध्यम iii) दृश्य–श्रव्य माध्यम iv) नव–माध्यम : कंटेंट लेखन, ब्लॉग लेखन।	15 तासिकाएँ
इकाई–II	माध्यम लेखन : फीचर लेखन 1. फीचर की परिभाषा एवं अवधारणा। 2. सामग्री संकलन स्त्रोत। 3. फीचर के तत्व – विषय वस्तु, प्रस्तावना, शीर्षक, विवेचन, छायांकन। 4. फीचर लेखन के गुण : i) विश्वसनीयता ii) सरसता एवं सहजता iii) रोचकता एवं संक्षिप्तता iv) प्रासंगिकता v) प्रचलित शब्दावली का प्रयोग। 5. फीचर और अन्य विधा में भेद : समाचार, आलेख। 6. फीचर के विभिन्न प्रकार : समाचार फीचर, घटना परक फीचर, सांस्कृतिक फीचर, चिंतन परक फीचर, साहित्यिक फीचर, फोटो फीचर। 7. रेडियो फीचर, टेलीविजन फीचर।	15 तासिकाएँ

बी. ए.द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

तृतीय अयन **(Third Semester)**

पाठ्यचर्या : **DSC – 1A (S-1)** काव्यशास्त्र (सामान्य)

3कर्मांक **(Credit)**

उद्देश्य :

1. भारतीय काव्यशास्त्र का परिचय देना।
2. काव्य परिभाषा, तत्व आदि अवगत कराना।
3. काव्य के तत्व, शब्द–शक्तियों का परिचय देना।
4. रस का स्वरूप समझाना।
5. भारतीय काव्यशास्त्र में रुचि पैदा करना तथा आलोचनात्मक दृष्टि को विकसित कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	काव्य परिभाषा (संस्कृत, हिंदी, अंग्रेजी) काव्य हेतु– प्रतिभा, व्युत्पत्ति, अभ्यास, समाधि। काव्य प्रयोजन (भारतीय)	15 तासिकाएँ
इकाई–**II**	काव्य के तत्व– भाव तत्व, बुद्धि तत्व, कल्पना तत्व, शैली तत्व। शब्द–शक्ति– परिभाषा स्वरूप, शब्द–शक्तियों का सोदाहरण परिचय – अभिधा, लक्षणा, व्यंजना।	15 तासिकाएँ
इकाई–**III**	रस– परिभाषा, स्वरूप रस के अंग– स्थायी भाव, विभाव, अनुभाव, संचारी भाव। रसों का सोदाहरण परिचय – शृंगार, वीर, हास्य, करुण।	15 तासिकाएँ

पूर्णांक : 75

आंतरिक मूल्यांकन : 23 अंक (लघुत्तरी परीक्षा– 13 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन – 10 अंक)

सत्रांत परीक्षा : 52 अंक

प्रश्न पत्र का प्रारूप (शैक्षिक वर्ष 2020–21 से आगे)

समय : 3 घंटे अंक : 52

प्रश्न 1. प्रथम इकाई पर चार में से कोई दो प्रश्न। 14 अंक

बी. ए. द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

चतुर्थ अयन **(Fourth Semester)**

पाठ्यचर्या : **DSC-1B (S-1)** साहित्य के भेद

3कर्मांक **(Credit)**

उद्देश्य :

1. छात्रों को साहित्य के भेद से अवगत कराना।
2. छात्रों को पद्य भेद से अवगत कराना।
3. महाकाव्य, खंडकाव्य और मुक्तक काव्य का परिचय कराना।
4. नाटक का स्वरूप समझाना।
5. छात्रों में नाट्य अभिनय की रुचि विकसित करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–I	काव्य के विविध भेद। पद्य के भेद : प्रबंधकाव्य और मुक्तकाव्य का स्वरूप। प्रबंध काव्य के भेद : महाकाव्य और खंडकाव्य, मुक्तक काव्य का परिचय।	15 तासिकाएँ
इकाई–II	गद्य के भेद : कहानी, उपन्यास, निबंध का तात्विक परिचय। कहानी और उपन्यास में अंतर।	15 तासिकाएँ
इकाई–III	दृश्य काव्य : नाटक की परिभाषा और तत्व। एकांकी : परिभाषा और तत्व। नाटक के भेद : रेडियो, दूरदर्शन नाटक, मंचीय नाटक।	15 तासिकाएँ

पूर्णांक : 75

आंतरिक मूल्यांकन : 23 अंक (लघुत्तरी परीक्षा– 13 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन – 10 अंक)

सत्रांत परीक्षा : 52 अंक

प्रश्न पत्र का प्रारूप (शैक्षिक वर्ष 2020–21 से आगे)

समय : 3 घंटे अंक : 52

प्रश्न 1. प्रथम इकाई पर चार में से कोई दो प्रश्न। 14 अंक

प्रश्न 2. द्वितीय इकाई पर चार में से कोई दो प्रश्न। 14 अंक

बी. ए.द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

तृतीय अयन **(Third Semester)**

पाठ्यचर्या : **DSC – 2 A (S-2)** मध्ययुगीन काव्य तथा उपन्यास साहित्य

3कर्मांक **(Credit)**

उद्देश्य :

1. कबीर के साहित्य का परिचय देना।
2. मीराबाई के काव्य से अवगत कराना।
3. भारतीय उपन्यास की अवधारणा समझाना।
4. उपन्यास कृति का मूल्यांकन कला विकसित करना।
5. साहित्य कृतियों प्रस्तुत जीवनमूल्यों को आत्मविस्तृत करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–I	कबीर के 20 दोहे **i) गुरुदेव को अंग** 1. सतगुर की महिमा अनँत, अनँत किया उपगार। लोचन अनँत उघाड़िया, अनँत दिखावणहार।। 2. पीछैं लागा जाइ था, लोक वेद के साथी। आगैं थै सतगुर मिल्या, दीपक दिया हाथी। 3. जाका गुर भी अंधला, चेला खरा निरंध। अंधा अंधा ठेलिया, दून्यूँ कूप पडंत।। 4. माया दीपक नर पतँग, भ्रमि भ्रमि इवै पडंत। कहै कबीर गुर ग्यान थै, एक आध उबरंत।। 5. सतगुर हम सूँ रीझि करि, एक कहया प्रसंग। बरस्या बादल प्रेम का, भीजि गया सब अंग।। **ii) विरह को अंग** 1. बहुत दिनन की जोवती, बाट तुम्हारी राम। जिव तरसै तुझ मिलन कूँ मनि नाहीं विश्राम।। 2. यहु तन जालौं मसि करौं, लिखौं राम का नाउँ। लेखणिं करूँ करंक की, लिखि लिखि राम पठाउँ।। 3. अंषड़ियाँ झाईं पड़ी, पंथ निहारि निहारि। जीभड़ियाँ छाला पड़या, राम पुकारि पुकारि।। 4. परबति, परबति मैं फिरया, नैंन गँवाये रोइ। सो बूटी पाऊँ नहीं, जातैं जीवनि होइ।। 5. सुखिया सब संसार है, खायैं अरू सोवै। दुखिया दास कबीर है, जागै अरू रोवै।।	15 तासिकाएँ

	iii) माया को अंग 1. कबीर माया पापणीं, फंध लै बैठि हाटि। सब जग तौ फंधै पड़या, गया कबीरा काटि।। 2. कबीर माया मोहनी, जैसी मीठी खाँड। सतगुर की कृपा भई, नहीं तौ करती भांड़।। 3. माया मुईन मन मुवा, मरि मरि गया सरीर। आसा तिष्णाँ नाँ मुई, यौं कहि गया कबीरा।। 4. कबीर सो धन संचिए, जो आगैं कूँ होई। सीस चढ़ाए पोटली, ले जात न देख्या कोई।। 5. कबीर माया मोह की, भई अँधारी लोइ। जे सूते ते मुसि लिये, रहे बसत कूँ रोइ।। **iv) निंद्या को अंग** 1. निंदक नेड़ा राखिये, आँगणि कुटी बँधाइ। बिन साबण पाँणीं बिना, निरमल करै सुभाइ।। 2. कबीर आप ठगाइये, और न ठगिये कोइ। आप ठग्याँ सुख ऊपजैं, और ठग्या दुख होइ।। **v) कथनी बिना करनी को अंग** 1. पोथी पढ़ि पढ़ि जग मुवा, पंडित भया न कोइ। एकै अषिर पीव का, पढै सु पंडित होइ।। **vi) भेष को अंग** 1. तन को जोगी सब करै, मन कों बिरला कोइ। सब सिधि सहजै पाइए, जे मन जोगी होइ।। 2. माला फेरत जुग भया, पाय न मन का फेर। कर का मनका छाँड़ि दे, मन का मनका फेर।। **अध्यनार्थ विषय :** • कबीर का व्यक्तित्व • कबीर की प्रगतिशीलता • कबीर की भक्तिभावना • कबीर का समाजसुधार • कबीर की भाषा • भावपक्ष, शिल्पपक्ष का अध्ययन।	
इकाई–II	**मीराबाई के 10 पद (आरंभ के 10 पद)** 1. मण थें परस हरि रे चरण।। 2. तनक हरि चितवां म्हारी ओर।। 3. म्हारो गोकुल रो ब्रजवासी।। 4. हे मा बड़ी बड़ी अंखियान वारो, सांवरो मो तन हेरत हंसिके।। 5. हेरी मा नंद को गुमानी म्हारे मनड़े बस्यो।।	15 तासिकाएँ

	6. थारो रूप देख्यां अटकी।। 7. निपट बंकट छब अंटके।। 8. म्हा मोहणो रूप लुभाणी।। 9. संवरा नंद नंदन, दीठ पड्यां माई।। 10. आली री म्हारे णेणां बाण पड़ी।। **अध्यनार्थ विषय :** • मीराबाई का व्यक्तित्व, कृतित्व • मीराबाई की भक्ति • मीराबाई की प्रगतिशीलता • मीराबाई की भाषा • भावपक्ष, शिल्पपक्ष का अध्ययन।	
इकाई–III	उपन्यास : स्वरूप, तत्व। उपन्यास कृति :एक पत्नी के नोटस – ममता कालिया लेखक का व्यक्तित्व एवं कृतित्व कथ्यगत अध्ययन, शिल्पगत अध्ययन।	15 तासिकाएँ

पूर्णांक : 75

आंतरिक मूल्यांकन : 23 अंक (लघुत्तरी परीक्षा– 13 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन – 10 अंक)

सत्रांत परीक्षा : 52 अंक

प्रश्न पत्र का प्रारूप (शैक्षिक वर्ष 2020–21 से आगे)

समय : 3 घंटे **अंक : 52**

प्रश्न 1. प्रथम इकाई पर दो में से एक प्रश्न। 07 अंक

प्रश्न 2. द्वितीय इकाई पर दो में से एक प्रश्न। 07 अंक

प्रश्न 3. तृतीय इकाई पर दो में से एक प्रश्न। 07 अंक

प्रश्न 4. ससंदर्भ व्याख्या :

प्रथम इकाई में से संदर्भ (दो में एक) 07 अंक

द्वितीय इकाई में से संदर्भ (दो में एक) 07 अंक

तृतीय इकाई में से संदर्भ (दो में एक) 07 अंक

प्रश्न 5. तीनों इकाइयों पर बहुविकल्पि (इकाई–I : 3, इकाई–II : 4, इकाई–III: 3) 10 प्रश्न। 10 अंक

बी. ए. द्वितीय वर्ष कला (शैक्षिक वर्ष 2020–2021 से)

चतुर्थ अयन **(Fourth Semester)**

पाठ्यचर्या : **DSC -2B (S-2)** मध्ययुगीन काव्य तथा नाटक साहित्य

3कर्मांक **(Credit)**

उद्देश्य :

1. रहीम के काव्य का बोध कराना।
2. बिहारी की काव्य अभिव्यंजना समझाना।
3. हिंदी नाटक और रंगमंच से अवगत कराना।
4. छात्रों में अभिनय गुण विकसित कराना।
5. नाट्यालोचना से अवगत करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–I	रहीम के 20 दोहे **i) भक्ति** 1. समय दशा कुल देखि कै, सबै करत सनमान। रहिमन दीन अनाथ को, तुम बिन को भगवान।। 2. रहिमन को कोड का करै, ज्वारी, चोर, लबार। जो पति राखनहार है, माखन चाखनहार।। 3. जेहि रहीम तन मन लियो, कियो हिए बिचभौन। तासों दुख सुख कहन की, रही बात अब कौन।। 4. गहि सरनागति राम की, भव सागर की नाव। रहिमन जगत उधार कर, और न कछु उपाव।। **ii) संगति का प्रभाव** 1. जो रहीम उत्तम प्रकृति, का करि सकत कुसंग। चंदन विष व्यापत नहीं, लपटे रहत भुजंग।। 2. मूढ़ मंडली में सुजन, ठहरत नहीं बिसेषि। स्याम कंचन में सेत ज्यों, दूरि कीजिअत देखि।। 3. यह रहीम निज संग लै, जनमत जगत न कोय। बैर, प्रीति, अभ्यास, जस होत होत ही होय।। 4. रहिमन उजली प्रकृत को, नहीं नीच को संग	15 तासिकाएँ

करिया बासन कर गहे, कालिख लागत अंग।।

iii) दीनता और बड़प्पन

1. जे गरीब पर हित करैं, ते रहीम बड़ लोग।
   कहा सुदामा बापुरो, कृष्ण मिताई जोग।।
2. थोड़ो किए बड़ेन की, बड़ी बड़ाई होय।
   ज्यों रहीम हनुमंत को, गिरिधर कहत न कोय।।
3. दीन सबन को लखत है, दीनहिं लखै न कोय।
   जो रहीम दीनहिं लखैं, दीनबंधु सम होय।।
4. रहिमन देखि बड़ेन को, लघु न दीजिये डारि।
   जहाँ काम आवें सुई, कहा करे तरवारि।।

iv) नीति

1. खैर, खून खाँसी, खुसी, वैर, प्रीति, मद–पान।
   रहिमन दाबे न दबै, जानत सकल जहान।।
2. रूठें सुजन मनाइए, जो रुठें सो बार।
   रहिमन फिर फिर पोहिए, टूटे मुक्ताहार।।
3. दानों रहिमन एक से, जौ लौं बेलत नाहिं।
   जान परत हैं काक पिक, ऋतु बसंत के माहिं।
4. बिगरी बात बनै नहीं, लाख करो किन कोय।
   रहिमन फोट दूध को, मथे न माखन होय।।

v) संत महिमा

1. तरुवर फल नहिं खात हैं, सरवर पियहिं न पान।
   कहि रहीम, पर–काज हित, संपति संचहिं सुजान।।
2. मथत–मथत माखन, दही–मही बिलगाय।
   रहिमन सोई मीत है, भीर परे ठहराय।।
3. रहिमन वे नर मर चुके, जे कहुँ माँगन जाहिं।
   उनते पहले वे मरे, जिन मुख निकसत नाहिं।।
4. दुरदिन परे रहीम कहि, भूलत सब पहचानि।
   सोच नहीं वित–हानि को, जो न होय हित हानि।।

	अध्यनार्थ विषय : • रहीम का व्यक्तित्व, कृतित्व • रहीम की भाषा • रहीम की भक्तिभावना • रहीम के काव्य की प्रासंगिकता • भावपक्ष, शिल्पपक्ष का अध्ययन।	
इकाई–II	बिहारी के 20 दोहे **i) नायक–नायिका वर्णन** 1. मेरी भव बाधा हरौ राधानागरि सोई। जा तन की झाई परै स्याम हरित दुति होइ।। 2. कहत नटत रीझत खिजत मिलत लजियात। भरे भौन में करत हैं नैननि में सब बात।। 3. नभ लाली चाली निसा चटकाली धुनि कीन। रति पाली आळी अनत आये बनमाली न।। 4. सघन कुंज घन घन तिमिर अधिक अँधेरी राति। तऊन दुरिहै स्याम यह दीप सिखा सी जाति।। 5. सोहत ओढ़े पीत पट स्याम सलौने गात। मनौ नीलमनि सैल पर आतप परयौ प्रभात।। **ii) संयोग–श्रृंगार वर्णन** 1. प्रीतम दृग मिहिचत प्रिया पानि परस सुख पाय। जानि पिछानि अजान लौं नैकु न होति जनाय।। 2. लटकि लटकि लटकन चलत डटत मुकुट की छाँह। चटक भरयौ नट मिल गयौ अटक भटक मन माँह।। 3. चिरजीवौ जोरी जुरै क्यों न सनेह गंभीर। को घटि ये वृषभानजा वे हलधर के वीर।। 4. मन न धरति मेरौ कहयौ तू आपने सयान। अहे परनि परि प्रेम की परहथ पार न प्रान।। 5. लाल तिहारे विरह की अगनि अनूप अपार।	15 तासिकाएँ

अनुक्रम

बी. ए. तृतीय वर्ष कला

पंचम एवं षष्ठ अयन **(Fifth & Sixth Semester)**

शैक्षिक वर्ष 2021–22 से

कोर्स नं.	पंचम एवं षष्ठ अयन	क्रेडिट	पृष्ठ क्रमांक
बी. ए. तृतीय वर्ष कला			
Core Course -1E (G-3)	कथेतर विधाएँ (पंचम अयन)	3	
Core Course -1F (G-3)	गज़ल विधा और पत्राचार (षष्ठ अयन)	3	
बी. ए. तृतीय वर्ष कला – वैकल्पिक प्रयोजनमूलक हिंदी			
Core Course -1E (G-3)	प्रयोजनमूलक हिंदी : कार्यालयीन व्यवहार (पंचम अयन)	3	
Core Course -1F (G-3)	प्रयोजनमूलक हिंदी : माध्यम लेखन (षष्ठ अयन)	3	
बी. ए. तृतीय वर्ष कला (हिंदी विशेष)			
Discipline Specific Elective DSE 1 C (S3)	हिंदी साहित्य का इतिहास (आदिकाल, भक्तिकाल, रीतिकाल का सामान्य परिचय) (पंचम अयन)	3+1	
Discipline Specific Elective 2 C (S4)	भाषाविज्ञान (सामान्य परिचय) (पंचम अयन)	3+1	
Discipline Specific Elective 1 D (S3)	हिंदी साहित्य का इतिहास (आधुनिक काल सामान्य परिचय) (षष्ठ अयन)	3+1	
Discipline Specific Elective 2 D (S4)	हिंदी भाषा और उसका विकास (षष्ठ अयन)	3+1	
बी. ए. तृतीय वर्ष कला			
Skill Enhancement Course 2 C	पटकथा लेखन (पंचम अयन)	2	
Skill Enhancement Course SEC 2 D	साहित्य और फिल्मांतरण (षष्ठ अयन)	2	

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बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

पंचम अयन **(Fifth Semester)**

पाठ्यचर्या : **Core Course – 1E (G3)** पाठ्यचर्या : कथेतर विधाएँ

3 कर्मांक **(3 Credit)**

उद्देश्य :

1. छात्रों को संस्मरण साहित्य से अवगत करना।
2. छात्रों को रेखाचित्र साहित्य से अवगत करना।
3. छात्रों को मूल्यांकन की दृष्टि का विकास करना।
4. सभा–इतिवृत्त लेखन कौशल वृद्धि का विकास करना।
5. वार्ता–लेखन कौशल दृष्टि निर्माण करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– **I**	संस्मरण : 1. शरत् : एक याद – अमृतलाल नागर 2. प्रेमचंद : एक स्मरण – महादेवी वर्मा 3. हम हशमत – कृष्णा सोबती 4. त्यागमूर्ति 'निराला' – शिवपूजन सहाय	15 तासिकाएँ
इकाई– **II**	रेखाचित्र : 1. पीपल – सच्चिदानंद हीरानंद वात्स्यायन 'अज्ञेय' 2. डबली बाबू – विनय मोहन शर्मा 3. अमृत के स्रोत – जगदीश माथुर। 4. रजिया – रामवृक्ष 'बेनीपुरी'	15 तासिकाएँ
इकाई–**III**	पाठ्यपुस्तकेत्तर पाठ्यक्रम : 1. सभा–इतिवृतलेखन 2. वार्ता–लेखन	15 तासिकाएँ

पूर्णांक : 100

आंतरिक मूल्यांकन : 30 अंक (लघुत्तरी परीक्षा– 20 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10 अंक)

सत्रांत परीक्षा : 70 अंक

सत्रांत परीक्षा – प्रश्नपत्र का प्रारूप :

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

षष्ठ अयन **(Sixth Semester)**

पाठ्यचर्या : **Core Course – 1F (G3)** पाठ्यचर्या : गज़ल विधा और पत्राचार

3 कर्मांक **(3 Credit)**

उद्देश्य :

1. छात्रों को गज़ल साहित्य से अवगत करना।
2. छात्रों को गज़लकार के व्यक्तित्व से अवगत करना।
3. छात्रों में मूल्यांकन की दृष्टि का विकास करना।
4. छात्रों को सरकारी पत्र लेखन से अवगत करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	'साये में धूप' (गज़ल संग्रह) – दुष्यंत कुमार 1. गज़ल : अर्थ, परिभाषा, तत्व। 2. दुष्यंत कुमार का साहित्यिक परिचय। गज़ल रचनाएँ : (साये में धूप) 1. कहाँ तो तय था चिरागाँ हरेक घर के लिए, कहाँ चिराग मयस्सर नहीं शहर के लिए... 2. कैसे मंजर सामने आने लगे हैं, गाते–गाते लोग चिल्लाने लगे हैं... 3. इस नदी की धार में ठंडी हवा आती तो है, नाव जर्जर ही सही, लहरों से टकराती तो है... 4. भूख है तो सब्र कर, रोटी नहीं तो क्या हुआ, आजकल दिल्ली में है जेरे बहस ये मुद्दआ... 5. कहीं पे धूप की चादर बिछाके बैठ गए, कहीं ये शाम सिरहाने लगा के बैठ गए... 6. चाँदनी छत पे चल रही होगी, अब अकेली टहल रही होगी...	15 तासिकाएँ
इकाई–**II**	गज़ल रचनाएँ : (साये में धूप) 1. हो गई है पीर पर्वत–सी पिघलनी चाहिए, इस हिमालय से कोई गंगा निकलनी चाहिए... 2. आज सड़कों पर लिखे हैं सैकडों नारे न देख, घर अँधेरा देख तू, आकाश के तारे न देख... 3. मेरे गीत तुम्हारे पास सहारा पाने आएँगे, मेरे बाद तुम्हें ये मेरी याद दिलाने आएँगे... 4. ये सच है कि पाँवों ने बहुत कष्ट उठाए, पर पाँव किसी तरह राहों पे तो आए... 5. बाढ़ की संभावनाएँ सामने हैं, और नदियों के किनारे घर बने हैं...	15 तासिकाएँ

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

पंचम अयन **(Fifth Semester)**

पाठ्यचर्या : **Discipline Specific Elective 1 C (S3)** हिंदी साहित्य का इतिहास (आदिकाल, भक्तिकाल, रीतिकाल का सामान्य परिचय) 3 कर्मांक **(3 Credit) + 1***

उद्देश्य :

1. हिंदी साहित्येतिहास लेखन का परिचय देना।
2. हिंदी साहित्येतिहास के कालविभाजन तथा नामकरण का परिचय देना।
3. आदिकालीन, भक्तिकालीन, रीतिकालीन प्रमुख साहित्यिक प्रवृत्तियों, रचनाकारों और रचनाओं से परिचित कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	हिंदी साहित्य का कालविभाजन और नामकरण। आदिकाल की पृष्ठभूमि, रासो साहित्य : पृथ्वीराज रासो और कवि चंदबरदायी का परिचय। सिद्ध और नाथ साहित्य : गोरखनाथ का साहित्यिक परिचय। अमीर खुसरो की हिंदी कविता। आदिकालीन साहित्य की विशेषताएँ।	15 तासिकाएँ
इकाई–**II**	भक्तिकाल के उदय के सामाजिक, सांस्कृतिक कारण। भक्ति आंदोलन का महत्व, पृष्ठभूमि। निर्गुण काव्य : संत काव्य की विशेषताएँ। संत कबीर का सामान्य परिचय। सूफी काव्य की विशेषताएँ। कवि जायसी का सामान्य परिचय। सगुण काव्य : राम काव्य की विशेषताएँ। कवि तुलसीदास का सामान्य परिचय। कृष्ण काव्य की विशेषताएँ। कवि सूरदास का सामान्य परिचय।	15 तासिकाएँ
इकाई–**III**	रीतिकाल की सामाजिक, राजनीतिक, सांस्कृतिक पृष्ठभूमि। रीतिकाल की प्रमुख प्रवृत्तियों का (रीतिबद्ध, रीतिसिद्ध, रीतिमुक्त) सामान्य परिचय। रीतिबद्ध कवि केशवदास का सामान्य परिचय। रीतिसिद्ध कवि बिहारी का सामान्य परिचय। रीतिमुक्त कवि घनानंद का सामान्य परिचय।	15 तासिकाएँ
Research Project	1* One Credit for Research Project, field work etc.	

पूर्णांक : 100

आंतरिक मूल्यांकन : 30 अंक (लघुत्तरी परीक्षा– 20 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10 अंक)

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

पंचम अयन **(Fifth Semester)**

पाठ्यचर्या : **Discipline Specific Elective 2 C (S4)** भाषाविज्ञान (सामान्य परिचय)

3 कर्मांक **(3 Credit) + 1***

उद्देश्य :

1. भाषाविज्ञान के स्वरूप का परिचय देना।
2. छात्रों को भाषाविज्ञान की व्याप्ति समझाना।
3. भाषाविज्ञान के अध्ययन की दिशाओं का परिचय देना।
4. भाषाविज्ञान के अनुप्रयोगात्मक पक्ष को समझाना।
5. साहित्य–अध्ययन में भाषाविज्ञान की उपयोगिता समझाना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	भाषा विज्ञान का नामकरण और परिभाषा, भाषाविज्ञान की शाखाएँ। भाषा विज्ञान का अन्य शाखाओं से संबंध : भाषा विज्ञान और व्याकरण, भाषा विज्ञान और साहित्य, भाषा विज्ञान और मनोविज्ञान, भाष विज्ञान और भूगोल।	15 तासिकाएँ
इकाई–**II**	ध्वनि विज्ञान : ध्वनि का अर्थ और परिभाषा। ध्वनि यंत्र। ध्वनि गुण : मात्रा, स्वराघात, बलाघात। ध्वनि परिवर्तन के कारण। रूप विज्ञान : अर्थ और परिभाषा। रूप और रूपिम में अंतर रुपिम के भेद : मुक्त रुपिम, बद्ध रुपिम, मुक्तबद्ध रुपिम, रूप परिवर्तन के कारण।	15 तासिकाएँ
इकाई–**III**	अर्थ विज्ञान : परिभाषा। अर्थ परिवर्तन की दिशाएँ। अर्थ परिवर्तन के कारण।	15 तासिकाएँ
Research Project	1* One Credit for Research Project, field work etc.	

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा– 20, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10)

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

षष्ठ अयन **(Sixth Semester)**

पाठ्यचर्या : **Discipline Specific Elective 1 D (S3)** हिंदी साहित्य का इतिहास

(आधुनिक काल सामान्य परिचय)

3 कर्मांक **(3 Credit) + 1***

उद्देश्य :

1. आधुनिक काल की पृष्ठभूमि से छात्रों अवगत कराना।
2. भारतेंदु युगीन, द्विवेदी युग के काव्य की विशेषताओं से छात्रों को अवगत कराना।
3. आधुनिक काल के रचनाकारों और रचनाओं से परिचित कराना।
4. हिंदी गद्य के उद्भव और विकास से छात्रों को अवगत कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	आधुनिक काल की पृष्ठभूमि भारतेंदुयुगीन काव्य की सामान्य विशेषताएँ। प्रमुख कवि – भारतेंदु हरिश्चंद्र, बद्रिनारायण चौधरी 'प्रेमघन'। द्विवेदी युगीन काव्य की सामान्य विशेषताएँ। प्रमुख कवि – मैथिलीशरण गुप्त, अयोध्यासिंह उपाध्याय 'हरिऔध'	15 तासिकाएँ
इकाई–**II**	छायावादी काव्य की सामान्य विशेषताएँ। छायावाद के प्रमुख कवि – जयशंकर प्रसाद, सुमित्रानंदन पंत, सूर्यकांत त्रिपाठी 'निराला', महादेवी वर्मा का सामान्य परिचय। प्रगतिवादी काव्य और प्रमुख कवि – रामधारी सिंह 'दिनकर', नागार्जुन का सामान्य परिचय। प्रयोगवादी काव्य और प्रमुख कवि – सच्चिदानंद हीरानंद वात्स्यायन 'अज्ञेय' का सामान्य परिचय।	15 तासिकाएँ
इकाई–**III**	हिंदी गद्य का उद्भव और विकास फोर्ट विलियम कॉलेज का योगदान हिंदी उपन्यास साहित्य का विकासक्रम (सामान्य परिचय) हिंदी कहानी साहित्य का विकासक्रम (सामान्य परिचय) हिंदी नाटक साहित्य का विकासक्रम (सामान्य परिचय)	15 तासिकाएँ
Research Project	1* One Credit for Research Project, field work etc.	

पूर्णांक : 100

आंतरिक मूल्यांकन : 30 अंक (लघुत्तरी परीक्षा– 20 अंक, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10 अंक)

सत्रांत परीक्षा : 70 अंक

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

षष्ठ अयन **(Sixth Semester)**

पाठ्यचर्या : **Discipline Specific Elective 2 D (S4)** हिंदी भाषा और उसका विकास

3 कर्मांक **(3 Credit) + 1***

उद्देश्य :

1. भाषाविज्ञान के स्वरूप का परिचय देना।
2. छात्रों को भाषाविज्ञान की व्याप्ति समझाना।
3. भाषाविज्ञान के अध्ययन की दिशाओं का परिचय देना।
4. भाषाविज्ञान के अनुप्रयोगात्मक पक्ष को समझाना।
5. साहित्य–अध्ययन में भाषाविज्ञान की उपयोगिता समझाना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	भाषा की परिभाषा और भाषा की विशेषताएँ। भाषा के विविध रूप : बोली, भाषा, परिनिष्ठित भाषा, साहित्यिक भाषा, राजभाषा, राष्ट्रभाषा, संपर्क भाषा, अंतर्राष्ट्रीय भाषा।	15 तासिकाएँ
इकाई–**II**	हिंदी की बोलियाँ : पश्चिमी हिंदी, पूर्वी हिंदी, बिहारी हिंदी, पहाडी हिंदी, राजस्थानी हिंदी। हिंदी का शब्द भंडार : तत्सम शब्द, तद्भव शब्द, देशज शब्द, आगत या विदेशी शब्दों का परिचय।	15 तासिकाएँ
इकाई–**III**	नगरीलिपि का उद्भव और विकास। नागरी लिपि की विशेषताएँ। नागरी लिपि में सुधार की संभावनाएँ।	15 तासिकाएँ
Research Project	1* One Credit for Research Project, field work etc.	

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा– 20, शोध परियोजना/समूह परियोजना/मौखिक प्रस्तुति/क्षेत्रीय अध्ययन– 10)

सत्रांत परीक्षा – 70

बी. ए. तृतीय वर्ष कला (शैक्षिक वर्ष 2021–2022 से)

पंचम अयन **(Fitth Semester)**

पाठ्यचर्या : **Skill Enhancement Course 2 C** पाठ्यचर्या : पटकथा लेखन

2 कर्मांक **(2 Credit)**

उद्देश्य :

1. छात्रों को स्क्रिप्ट लेखन, अर्थ, परिभाषा से अवगत कराना।
2. छात्रों को कथा, पटकथा और संवाद से परिचित कराना।
3. छात्रों को ड्राफ्ट बनाने से परिचित कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई–**I**	पटकथा (स्क्रिप्ट) लेखन, अर्थ, परिभाषा और सामान्य परिचय। पटकथा (स्क्रिप्ट) के तीन अंग– कथा, पटकथा और संवाद। उदाहरण सहित संक्षिप्त जानकारी। तीनों की परस्परावलंबिता और दृश्य–श्रव्य माध्यम में महत्व। पटकथा (स्क्रिप्ट) लेखन की प्रक्रिया। विचार (आइडिया) – वन लाइनर या लॉग लाइन – सारांश (शीर्षक, कथावस्तु, पात्रों की सूची।) प्लॉट बनाना – पात्रों का परिचय और उन्हें स्थापित करना, पात्रों का विकास। ड्राफ्ट बनाना – इनडोर/आउटडोर, समय, स्थान, संवाद, पात्र की क्रिया और प्रतिक्रिया।	15 तासिकाएँ
इकाई–**II**	दृश्य–श्राव्य माध्यम के विभिन्न प्रकारों के लिए स्क्रिप्ट लेखन। (सामान्य दिशा निर्देश) वृत्तचित्र – टेलिफिल्म, शॉर्टफिल्म, विज्ञापन, फिल्म– वॉक थ्रू एवं अन्य – चलचित्र। शॉर्ट फिल्म के लिए स्क्रिप्ट लेखन का विशेष परिचय। पटकथा के प्रारूप और मुख्य सॉफ्टवेयरों की जानकारी।	15 तासिकाएँ

MIL-2 हिंदी भाषा शिक्षण

इकाई	पाठ्यविषय
I	**वर्ण विचार :** १) हिंदी वर्णमाला – परिचय २) लिपि – परिचय ३) वर्णों का उच्चारण और वर्गीकरण ४) स्वराघात ५) संधि : स्वर संधि, व्यंजन संधि, विसर्ग संधि।
II	**भाषा कौशल शिक्षण : लघुकथाओं द्वारा भाषा कौशल शिक्षण (श्रवण, संवाद, वाचन, लेखन)** १) शिक्षा – ज्योति जैन २) पानी के पेड़ – ज्योति जैन ३) पशुभाषा – ज्योति जैन ४) अपशगुन – ज्योति जैन ५) ममता – डॉ. लता अग्रवाल ६) गरीब का लंच बॉक्स – डॉ. लता अग्रवाल ७) मैं ही कृष्ण हूँ – डॉ. लता अग्रवाल ८) सत्य की अग्नि परीक्षा – डॉ. लता अग्रवाल

III	**वाक्य विचार : वाक्य और वाक्य के भेद** १) साधारण वाक्य २) मिश्र वाक्य ३) संयुक्त वाक्य ४) संक्षिप्त वाक्य ५) विशेष प्रकार के वाक्य (विधानार्थक, प्रश्नार्थक, निषेधवाचक, आज्ञार्थक, विस्मयादिबोधक, इच्छाबोधक, संदेशसूचक, संकेतार्थक) ६) विरामचिह्न।
IV	**भाषा कौशल शिक्षण : गोपालदास : 'नीरज' के काव्य–गीत (०८ गीत) द्वारा श्रवण, संवाद, वाचन, लेखन कौशल शिक्षण।** १) आदमी हूँ आदमी से प्यार करता हूँ २) राधा ने माला जपी श्याम की ३) फूलों के रंग से ४) खिलते हैं गुल यहाँ ५) जीवन की बगिया महकेगी ६) लिखे जो खत तुझे ७) आज मदहोश हुआ जारे ८) कारवाँ गुजर गया, गुबार देखते रहे।

प्रथम वर्ष कला/वाणिज्य
प्रथम अयन एवं द्वितीय अयन

कोर्स न.	प्रथम अयन/द्वितीय अयन
प्रथम वर्ष कला (**F.Y.B.A.**) (सामान्य)	
I A	हिंदी पाठ्यचर्या (सामान्य)
I B	हिंदी पाठ्यचर्या (सामान्य)
प्रथम वर्ष वाणिज्य (**F.Y.B.com**) (सामान्य)	
I A	हिंदी पाठ्यचर्या (सामान्य)
I B	हिंदी पाठ्यचर्या (सामान्य)
प्रथम वर्ष कला (**F.Y.B.A.**) (सामान्य)	
I A	प्रयोजनमूलक हिंदी (सामान्य)
I B	प्रयोजनमूलक हिंदी (सामान्य)

प्रथम वर्ष कला (F.Y.B.A.) (सामान्य)
(प्रथम अयन)

पाठ्यचर्या : वैकल्पिक हिंदी प्रश्नपत्र – I A

3 कर्मांक

उद्देश्य :

1. छात्रों को हिंदी काव्य साहित्य का परिचय देना।
2. हिंदी कहानी साहित्य से अवगत कराना।
3. हिंदी भाषा द्वारा संवाद कौशल विकसित करना।
4. मौलिक लेखन की ओर रूझान बढ़ाना।
5. विज्ञापन लेखन कौशल विकसित करना।
6. अनुवाद संबंधी जानकारी देना।
7. हिंदी कंप्यूटिंग का परिचय देना।

	प्रथम सत्र / प्रथम अयन
इकाई – I	काव्य साहित्य : जूही की कली – निराला मैं नीर भरी दुख की बदली – महादेवी वर्मा कालिदास – नागार्जुन रोटी और संसद – धूमिल धार – अरुण कमल
इकाई – II	कहानी साहित्य : एक टोकरी भर मिट्टी – माधवराव सप्रे ईदगाह – प्रेमचंद जिंदगी और गुलाब के फुल – उषा प्रियंवदा युद्ध – शानी मिसेस डिसूजा के नाम पत्र – अलका सरावगी
इकाई – III	साहित्येतर पाठ्यक्रम : संवाद कौशल, सूत्रसंचालन, समूह चर्चा हिंदी कंप्यूटिंग : यूनिकोड (Unicode) की जानकारी। इंटरनेट की सामान्य जानकारी हिंदी सॉफ्टवेअर की जानकारी।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 30 (लघुत्तरी परीक्षा – 20, शोध परियोजना / समूह परियोजना / मौखिक प्रस्तुति / क्षेत्रीय अध्ययन– 10)

सत्रांत परीक्षा – 70

एम. ए. हिंदी साहित्य

प्रथम अयन :

पाठ्यचर्या : 1 मध्ययुगीन काव्य

4 : क्रमांक

उद्देश्य :

1. हिंदी की मध्ययुगीन काव्य प्रवृत्तियों का परिचय देना।
2. मध्ययुगीन काव्य प्रवृत्तियों की पृष्ठभूमि पर कवि विशेष की रचनाओं का परिचय कराना।
3. तत्कालीन काव्यभाषा की प्रवृत्तियों का परिचय देना।
4. पाठ्यकृतियों के आधार पर काव्य मूल्यांकन की क्षमता का विकास करना।
5. सर्जनात्मक कौशल विकसित करना।

पाठ्यविषय :	
इकाई– **I**	पूर्वमध्यकालीन काव्य (कबीर/जायसी) कबीर – सं. हजारीप्रसाद द्विवेदी – (पदसंख्या 160 से 170) कबीर की काव्यकला, भाषा, समन्वय, मानवता, लोकमंगल जायसी – पद्मावत नागमती वियोग खण्ड (आरंभ के 10 पद) जायसी की काव्यकला, भाषा, समन्वय, विरह वर्णन, लोकतत्व
इकाई– **II**	पूर्वमध्यकालीन काव्य (सूरदास/तुलसीदास) सूरदास – भ्रमरगीत सार – सं. रामचंद्र शुक्ल (पद – 21 से 30) सूरदास की काव्यकला, भाषा, समन्वय, लोकमंगल, विरह वर्णन तुलसीदास – रामचरितमानस – उत्तरकाण्ड (आरंभ के 25 दोहे) तुलसीदास की काव्यकला, भाषा, लोकमंगल, समन्वय, भक्ति, आदर्श कल्पना।
इकाई – **III**	पूर्वमध्यकालीन काव्य (मीरा/रहीम) मीरा – सं. विश्वनाथ त्रिपाठी – (आरंभ के 10 पद) मीरा की काव्यकला, भाषा, प्रेमतत्व, प्रगतिशीलता, विरह वर्णन, रहीम की काव्यकला, भाषा, नीतितत्व, समन्वय, प्रेमतत्व रहीम (दोहे : 01 से 25)
इकाई– **IV**	उत्तरमध्यकालीन काव्य (बिहारी/घनानंद) बिहारी – बिहारी सतसई – सं. जगन्नाथदास रत्नाकर (दोहा संख्या 01 से 25) बिहारी की काव्यकला, भाषा, प्रेमतत्व, बहुज्ञता घनानंद – कवित्त सं. विश्वनाथ मिश्र, (कवित्त संख्या 01 से 15) घनानंद की काव्यकला, भाषा, प्रेमतत्व।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन– 50 (लघुत्तरी परीक्षा – 20, शोध परियोजना – 20, प्रस्तुतिकरण – 10)

सत्रांत परीक्षा – 50

प्रथम अयन :

पाठ्यचर्या : 2 कथा साहित्य

4 कर्मांक

उद्देश्य :

1. उपन्यास विधा से अवगत कराना।
2. कहानी विधा से अवगत कराना।
3. पाठ्य रचनाओं में अभिव्यक्त मूल्यों का संप्रेषण करना।
4. आलोचनात्मक दृष्टि का विकास करना।
5. सर्जनात्मक कौशल का विकास करना।

पाठ्यविषय	
इकाई–I	प्रेमचंदोत्तर के परवर्ती उपन्यास का विकासक्रम (2000 तक) बीसवीं सदी की हिंदी कहानी का विकासक्रम (2000 तक)
इकाई –II	उपन्यास साहित्य : आपका बंटी – मन्नू भंडारी तात्विक विवेचन, संवेदना एवं शिल्पगत अध्ययन।
इकाई –III	कहानी साहित्य : उसने कहा था – चंद्रधर शर्मा गुलेरी आकशदीप – जयशंकर प्रसाद गैंग्रीन – अज्ञेय दुनिया का अनमोल रत्न – प्रेमचंद सिक्का बदल गया – कृष्णा सोबती संवेदना एवं शिल्पगत अध्ययन।
इकाई –IV	कहानी साहित्य : साजिश – सूरपाल चौहान जंगल गाने लगा – अंकुश्री पक्षी और दीमक – ग. मा. मुक्तिबोध दूसरा ताजमहल – नासिरा शर्मा दुख – यशपाल संवेदना एवं शिल्पगत अध्ययन।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 50 (लघुत्तरी परीक्षा – 20, शोध परियोजना – 20, प्रस्तुतिकरण – 10)

सत्रांत परीक्षा – 50

एम. ए. हिंदी साहित्य

प्रथम अयन : वैकल्पिक

पाठ्यचर्या : 4 (ख) नाटककार मोहन राकेश

4 कर्मांक

उद्देश्य :

1. नाटक के स्वरूप एवं संरचना से परिचय कराना।
2. नाटक के रचनाविधान और रंगमंच से परिचय कराना।
3. हिंदी नाटक और रंगमंच के विकास का परिचय देना।
4. मोहन राकेश के नाटकों के द्वारा नाट्यास्वादन और मूल्यांकन की दृष्टि विकसित करना।
5. नाट्याभिनय कौशल को विकसित करना।

पाठ्यविषय	
इकाई–I	नाटक और रंगमंच, स्वरूप एवं संरचना हिंदी रंगमंच का विकासक्रम रंगमंच की विभिन्न शैलियाँ नाटक की पाश्चात्य परंपरा पारसी थिएटर, रंगभाषा
इकाई–II	निर्धारित नाटक आषाढ़ का एक दिन कथ्यगत अध्ययन, रंगमंचीय अध्ययन, तात्विक मूल्यांकन।
इकाई –III	निर्धारित नाटक लहरों के राजहंस कथ्यगत अध्ययन, रंगमंचीय अध्ययन, तात्विक मूल्यांकन।
इकाई –IV	निर्धारित नाटक आधे अधूरे कथ्यगत अध्ययन रंगमंचीय अध्यन तात्विक मूल्यांकन।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 50 (लघुत्तरी परीक्षा – 20, शोध परियोजना – 20, प्रस्तुतिकरण – 10)

सत्रांत परीक्षा – 50

द्वितीय अयन :

पाठ्यचर्या : 5 कथेतर गद्य साहित्य

4 : कर्मांक

उद्देश्य :

1. व्यंग्य, निबंध, रेखाचित्र और संस्मरण विधा से अवगत करना।
2. पाठ्य विधाओं का भाषिक अध्ययन करवाना।
3. मौलिक लेखन कौशल विकसित करना।

पाठ्यविषय	
इकाई –I	आत्मकथा साहित्य : मुर्दहिया – तुलसीराम आलोचनात्मक अध्ययन, अंर्तवस्तु / भाषागत अध्ययन।
इकाई –II	निबंध साहित्य : कविता क्या है ? – रामचंद्र शुक्ल लेखक और जनता – डॉ. रामविलास शर्मा मेरे राम का मुकुट भीग रहा है – विद्यानिवास मिश्र संस्कृति और सौंदर्य – नामवर सिंह कुटज – हजारीप्रसाद द्विवेदी पानी है अनमोल – श्रीराम परिहार विशेषताएँ, आलोचनात्मक अध्ययन, अंर्तवस्तु, भाषागत अध्ययन।
इकाई –III	रेखाचित्र साहित्य : माटी की मूरतें – रामवृक्ष बेनीपुरी स्वरूपगत अध्ययन आलोचनात्मक अध्ययन अंर्तवस्तु, भाषागत अध्ययन।
इकाई –IV	व्यंग्य साहित्य : भोलाराम का जीव – हरिशंकर परसाई स्वरूपगत अध्ययन, आलोचनात्मक अध्ययन, अंतर्वस्तु, भाषागत अध्ययन संस्मरण साहित्य : याद हो की न हो – काशीनाथ सिंह। स्वरूपगत अध्ययन, आलोचनात्मक अध्ययन, अंर्तवस्तु, भाषागत अध्ययन।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 50 (लघुत्तरी परीक्षा – 20, शोध परियोजना – 20, प्रस्तुतिकरण – 10)

सत्रांत परीक्षा – 50

द्वितीय अयन :

पाठ्यचर्या : 6 शोध प्रविधि

4 : क्रमांक

उद्देश्य :

1. छात्रों को शोध प्रविधि से अवगत कराना।
2. शोध दृष्टि का विकास करना।
3. नये शोध–प्रावाहों से परिचय कराना।
4. शोध प्रक्रिया एवं शोधप्रबंध लेखन कौशल विकसित करना।

पाठ्यविषय	
इकाई – I	**शोध का स्वरूप :** शोध के लिए प्रयुक्त विभिन्न शब्द एवं उनका औचित्य शोध की विभिन्न परिभाषाएँ और उनका विश्लेषण शोध के उद्देश्य, शोध की विवेचन पद्धति वस्तुनिष्ठ, तर्कसंगति, प्रमाणबद्धता।
इकाई – II	शोध के मूलतत्व : शोध और आलोचना शोध के भेद : साहित्यिक,साहित्येत्तर साहित्यिक शोध के भेद : वर्णनात्मक, ऐतिहासिक, तुलनात्मक, अंतर्विद्याशाखीय।
इकाई – III	शोध प्रक्रिया : विषय चयन,सामग्री संकलन के स्रोत मूल, सहायक, हस्तलेख संकलन एवं उपयोगिता, तर्क पद्धति : निगमनात्मक पद्धति (Deductive Method) और आगमनात्मक पद्धति (Inductive Method)। विवेचन, निष्कर्ष, स्थापना।
इकाई – IV	**शोध–प्रबंध लेखन प्रणाली :** शोध प्रबंध, शीर्षक निर्धारण, रूपरेखा, भूमिका लेखन, अध्याय विभाजन, संदर्भ, संदर्भ सूची, MLAपद्धति (Modern language Association), सहायक ग्रंथ सूची, परिशिष्ट, वर्तनी सुधार, टंकण, यूनिकोड परिचय।

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन – 50 (लघुत्तरी परीक्षा – 20, शोध परियोजना – 20, प्रस्तुतिकरण – 10)

सत्रांत परीक्षा – 50

द्वितीय अयन : वैकल्पिक

पाठ्यचर्या : 8 (घ) हिंदी उपन्यास साहित्य

4 : क्रमांक

उद्देश्य :

1. हिंदी उपन्यास साहित्य के विकासक्रम एवं प्रवृत्तियों से परिचित कराना।
2. उपन्यासों के आस्वादन, अध्ययन की क्षमता विकसित करना।
3. पाठ्य रचनाओं में प्रस्तुत साहित्यिक मूल्यों का संप्रेषण करना।
4. मूल्यांकन की दृष्टि का विकास करना।

पाठ्यविषय	
इकाई –I	तमस – भीष्म साहनी संवेदना एवं शिल्पगत अध्ययन।
इकाई –II	छप्पर – जयप्रकाश कर्दम संवेदना एवं शिल्पगत अध्ययन।
इकाई –III	गिलीगडू – चित्रामुद्गल संवेदना एवं शिल्पगत अध्ययन।
इकाई –IV	ग्लोबल गांव के देवता – रनेंद्र संवेदना एवं शिल्पगत अध्ययन।

अंक विभाजन – पूर्णांक : 100

आंतरिकमूल्यांकन – 50 (लघुत्तरी परीक्षा–20, शोध परियोजना–20, प्रस्तुतिकरण–10)

सत्रांत परीक्षा – 50

सत्रांत परीक्षा – प्रश्नपत्र का प्रारूप :

(शैक्षिक वर्ष 2019–20 से आगे)

समय 3 घंटे — अंक 50

प्रश्न : 1	इकाई एक पर दीर्घोत्तरी प्रश्न (दो में से एक)	अंक 10
प्रश्न : 2	इकाई दो पर दीर्घोत्तरी प्रश्न (दो में से एक)	अंक 10
प्रश्न : 3	इकाई तीन पर दीर्घोत्तरी प्रश्न (दो में से एक)	अंक 10
प्रश्न : 4	इकाई चार पर दीर्घोत्तरी प्रश्न (दो में से एक)	अंक 10
प्रश्न : 5	बहुविकल्पीय प्रश्न – 12 में से 10 (चार में से एक सही विकल्प का चयन कीजिए।)	

अनुक्रम

कोर्स नं.	एम. ए. हिंदी द्वितीय वर्ष (तृतीय अयन)	क्रेडिट	पृष्ठ क्रमांक
9	आधुनिक काव्य (आदर्शवादी, छायावादी तथा अन्य काव्य)	4	03
10	भाषाविज्ञान	4	05
11	हिंदी साहित्य का इतिहास (आदिकाल, भक्तिकाल, रीतिकाल)	4	07
12	वैकल्पिक		
	क) हिंदी आलोचना	4	09
	ख) संचार माध्यम : सिद्धांत और स्वरूप	4	11
कोर्स नं.	एम. ए. हिंदी द्वितीय वर्ष (चतुर्थ अयन)	क्रेडिट	पृष्ठ क्रमांक
13	आधुनिक कविता	4	14
14	हिंदी भाषा का विकास	4	16
15	हिंदी साहित्य का इतिहास (आधुनिककाल)	4	18
16	वैकल्पिक		
	क) भारतीय लोकसाहित्य	4	20
	ख) भारतीय साहित्य	4	22

एम. ए. हिंदी साहित्य द्वितीय वर्ष

तृतीय अयन (Third Semester)

पाठ्यचर्या : 9 आधुनिक काव्य (आदर्शवादी, छायावादी तथा अन्य काव्य)

4 कर्मांक (Credit)

उद्देश्य :

1. छात्रों को आधुनिक काव्य से अवगत कराना।
2. छात्रों में आधुनिक काव्य–अध्ययन की दृष्टि विकसित करना।
3. काव्य मूल्यांकन–दृष्टि विकसित करना।
4. काव्य–संवेदना एवं शिल्पगत अध्ययन से छात्रों को अवगत करना।
5. छात्रों में काव्य–सर्जन कला का विकास करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– I	साकेत (नवम् सर्ग) – मैथिलीशरण गुप्त संवदेना एवं शिल्पगत अध्ययन	15 तासिकाएँ
इकाई– II	कामायनी (लज्जा सर्ग) – जयशंकर प्रसाद संवदेना एवं शिल्पगत अध्ययन	15 तासिकाएँ
इकाई– III	1) बीन भी हूँ मैं तुम्हारी रागिनी भी हूँ – महादेवी वर्मा 2) पहाडी बच्चा – निर्मल पुतुल 3) कूडा बीनते बच्चे – अनामिका 4) जिंदगी का नमक – निर्मला गर्ग 5) अंधेरे में बुद्ध – गगन गिल उक्त रचनाओं का, संवदेना एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई– IV	1) बात बोलेगी – शमशेर बहादुर सिंह 2) एक पीली शाम – शमशेर बहादुर सिंह 3) भारत की आरती – शमशेर बहादुर सिंह 4) रोटी और संसद – धूमिल 5) मोचीराम – धूमिल उक्त रचनाओं का, संवदेना एवं शिल्पगत अध्ययन।	15 तासिकाएँ

तृतीय अयन : **(Third Semester)**

पाठ्यचर्या : 11 हिंदी साहित्य का इतिहास (आदिकाल, भक्तिकाल, रीतिकाल)

4 कर्मांक **(Credit)**

उद्देश्य :

1. हिंदी साहित्येतिहास लेखन का परिचय देना।
2. हिंदी साहित्येतिहास के कालविभाजन तथा नामकरण का परिचय देना।
3. आदिकालीन, भक्तिकालीन, रीतिकालीन प्रमुख साहित्यिक प्रवृत्तियों, रचनाकारों और रचनाओं से परिचित कराना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– **I**	हिंदी साहित्येतिहास दर्शन, हिंदी साहित्येतिहास लेखन की पद्धतियाँ, हिंदी साहित्य का इतिहास : काल विभाजन और नामकरण।	15 तासिकाएँ
इकाई– **II**	आदिकाल की विशेषताएँ एवं साहित्यिक प्रवृत्तियाँ, रासो साहित्य, जैन साहित्य, सिद्ध और नाथ साहित्य। अमीर खुसरो की हिंदी कविता।	15 तासिकाएँ
इकाई– **III**	भक्ति आंदोलन का अखिल भारतीय स्वरूप, आलवार संत, भक्तिकाल का प्रमुख संप्रदाय और उनका वैचारिक आधार। निर्गुण–सगुण कवि और उनका काव्य। निर्गुण धारा के कवि : कबीर, रैदास, दादू, नामदेव, जायसी, कुतुबन, मंझन। सगुण धारा के कवि : सूरदास, मीराबाई, रसखान, नंददास, तुलसीदास, नाभादास।	15 तासिकाएँ
इकाई– **IV**	रीतिकाल की सामाजिक–सांस्कृतिक पृष्ठभूमि, रीतिकाल की प्रमुख प्रवृत्तियाँ– रीतिबद्ध, रीतिसिद्ध और रीतिमुक्त। रीतिकाल के प्रमुख कवि और उनका काव्य। बिहारी, केशव, घनानंद, देवा, भूषण, बोधा, आलम, ठाकुर।	15 तासिकाएँ

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन –50 (लघुत्तरी परीक्षा–20, शोध परियोजना–20, प्रस्तुतिकरण–10)

सत्रांत परीक्षा – 50

सत्रांत परीक्षा – प्रश्नपत्र का प्रारूप :

तृतीय अयन : **(Third Semester)** वैकल्पिक

पाठ्यचर्या : 12 (ख) संचार माध्यम : सिद्धांत और स्वरूप

4 कर्मांक **(Credit)**

उद्देश्य :

1. संचार माध्यम और संप्रेषण अवधारणाओं का परिचय देना।
2. संचार माध्यम की अवधारणा और स्वरूप का परिचय देना।
3. संचार माध्यम की बहुआयामी भूमिका का परिचय देना।
4. संचार माध्यम कौशल विकसित करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– **I**	संचार, जनसंचार तथा संप्रेषण : अवधारणा और स्वरूप। संचार माध्यम : सिद्धांत और स्वरूप। संचार के संघटक तत्व। संचार–माध्यमों से लाभ–हानि।	15 तासिकाएँ
इकाई– **II**	सूचना क्रांति बनाम सूचना–उद्योग। संचार माध्यम के प्रकार : 1) परंपरागत, 2) मौखिक, 3) लिखित, 4) आधुनिक।	15 तासिकाएँ
इकाई– **III**	आधुनिक संचार माध्यम : 1) मुद्रित, 2) रेडियो, 3) चलचित्र, 4) विद्युतीय, 5) बहुमाध्यम, 6) हाइपर मीडिया संचार माध्यमों द्वारा संप्रेषित संदेश की भाषिक प्रकृति।	15 तासिकाएँ
इकाई– **IV**	संचार माध्यमों की बहुआयामी भूमिका : 1) जन संपर्क, 2) जन शिक्षण, 3) जन प्रबोधन, 4) जन निर्माण, 5) जन समस्या का समाधान, 6) जन रंजन। वर्तमान सूचना क्रांति के विविध आयाम।	15 तासिकाएँ

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन –50 (लघुत्तरी परीक्षा–20, शोध परियोजना–20, प्रस्तुतिकरण–10)

सत्रांत परीक्षा – 50

सत्रांत परीक्षा – प्रश्नपत्र का प्रारूप : (शैक्षिक वर्ष 2020–21 से आगे)

समय : 3 घंटे — अंक 50

प्रश्न : 1 इकाई एक पर दीर्घोत्तरी प्रश्न (दो में से एक)। — 10 अंक

प्रश्न : 2 इकाई दो पर दीर्घोत्तरी प्रश्न (दो में से एक)। — 10 अंक

एम. ए. हिंदी साहित्य द्वितीय वर्ष

चतुर्थ अयन : (Fourth Semester)

पाठ्यचर्या : 13 आधुनिक कविता

4 कर्मांक (Credit)

उद्देश्य :

1. छात्रों को आधुनिक काव्य से अवगत कराना।
2. छात्रों में आधुनिक काव्य–अध्ययन की दृष्टि विकसित करना।
3. सर्जनात्मक कौशल से अवगत करना।
4. आलोचानात्मक दृष्टि विकासित करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– I	1) बादल को घिरते देखा – नागार्जुन 2) शासन की बंदूक – नागार्जुन 3) मेरी आभा है इसी में – नागार्जुन 4) जन जन का चेहरा एक – मुक्तिबोध 5) भूल गलती – मुक्तिबोध उक्त रचनाओं का, संवदेना एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई– II	1) असाध्य वीणा – अज्ञेय 2) हीरोसिमा – अज्ञेय 3) कनुप्रिया अंश – धर्मवीर भारती 4) ठंडा लोहा – धर्मवीर भारती 5) फिरोजी होंठ – धर्मवीर भारती उक्त रचनाओं का, संवदेना एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई– III	1) आदिवासी स्त्रियाँ – निर्मला पुतुल 2) बूढी पृथ्वी का दुख – निर्मला पुतुल 3) दरवाजा – अनामिका 4) जनम ले रहा है नया पुरुष – अनामिका 5) नमक – अनामिका उक्त रचनाओं का, संवदेना एवं शिल्पगत अध्ययन।	15 तासिकाएँ
इकाई– IV	1) पेड़ का नाच – लीलाधर मंडलोई 2) जानती है सिर्फ नदी – लीलाधर मंडलोई 3) गुंगा नहीं था मैं – जयप्रकाश कर्दम 4) बेमानी है आजादी – जयप्रकाश कर्दम	15 तासिकाएँ

एम. ए. हिंदी साहित्य द्वितीय वर्ष

चतुर्थ अयन : **(Fourth Semester)**

पाठ्यचर्या : 15 हिंदी साहित्य का इतिहास (आधुनिक काल)

4 कर्मांक **(Credit)**

उद्देश्य :

1. हिंदी गद्य के उद्भव और विकास से छात्रों को अवगत कराना।
2. द्विवेदी युग, छायावाद, प्रगतिवाद, प्रयोगवाद और नई कविता के प्रमुख साहित्यिक प्रवृत्तियों, रचनाकारों और रचनाओं से परिचित कराना।
3. ऐतिहासिक दृष्टि विकसित करना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– **I**	हिंदी गद्य का उद्भव और विकास : भारतेंदु पूर्व हिंदी गद्य : 1957 की क्रांति और सांस्कृतिक पुनर्जागरण : भारतेंदु युग, 19 वीं शताब्दी की हिंदी पत्रकारिता।	15 तासिकाएँ
इकाई– **II**	द्विवेदी युग : महावीरप्रसाद द्विवेदी और उनका युग, हिंदी नवजागरण और स्वरस्वती पत्रिका, राष्ट्रीय काव्यधारा के प्रमुख कवि, स्वच्छंदतावाद और उसके प्रमुख कवि।	15 तासिकाएँ
इकाई– **III**	छायावाद, प्रगतिवाद : छायावादी काव्य की प्रमुख विशेषताएँ, छायावाद के प्रमुख कवि। प्रगतिवादी काव्य और प्रमख कवि, प्रगतिवादी काव्य की विशेषताएँ।	15 तासिकाएँ
इकाई– **IV**	प्रयोगवाद, नई कविता : प्रयोगवाद के प्रमुख कवि, प्रयोगवाद की विशेषताएँ, नई कविता की विशेषताएँ, नई कविता के प्रमुख कवि।	15 तासिकाएँ

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन –50 (लघुत्तरी परीक्षा–20, शोध परियोजना–20, प्रस्तुतिकरण–10)

एम. ए. हिंदी साहित्य द्वितीय वर्ष

चतुर्थ अयन : **(Fourth Semester)** वैकल्पिक

पाठ्यचर्या : 16 (क) भारतीय लोकसाहित्य

4 कर्मांक **(Credit)**

उद्देश्य :

1. लोकसाहित्य के स्वरूप एवं महत्व से परिचित कराना।
2. लोकसाहित्य के विविध प्रकारों से परिचित कराना।
3. लोक साहित्य की व्यापकता से परिचित कराना।
4. महाराष्ट्र के लोक साहित्य का परिचय देना।

इकाई	पाठ्यविषय	तासिकाएँ
इकाई– **I**	लोकसाहित्य की परिभाषा, स्वरूप एवं विशेषताएँ, लोक संस्कृति और साहित्य, भारत में लोकसाहित्य के अध्ययन का इतिहास।	15 तासिकाएँ
इकाई– **II**	लोक–साहित्य संकलन : उद्देश्य, संकलन की पद्धतियाँ, संकलन कर्ता की समस्याएँ तथा समाधान।	15 तासिकाएँ
इकाई– **III**	लोक–गीत : संस्कार, व्रत, श्रम, ऋतु, जाति। लोकनाट्य : रामलीला, रासलीला, कीर्तनिया, स्वांग, यक्षगान, भवाई, जात्रा। महाराष्ट्र का लोकनाट्य : तमाशा, गोंधळ, लावणी, पोतराज, सुंबरन, वासुदेव, भारुड, लळित, दशावतार, पोवाडा, कीर्तन।	15 तासिकाएँ
इकाई– **IV**	लोक–कथा : व्रत कथा, परी कथा, नाग कथा, बोध कथा, कथानक रूढ़ियाँ। लोक संगीत : लोकवाद्य तथा विशिष्ट लोक धुनें। लोकभाषा : लोक सुभाषित, मुहावरे, कहावतें, पहेलियाँ।	15 तासिकाएँ

अंक विभाजन – पूर्णांक : 100

आंतरिक मूल्यांकन –50 (लघुत्तरी परीक्षा–20, शोध परियोजना–20, प्रस्तुतिकरण–10)

सत्रांत परीक्षा – 50

सत्रांत परीक्षा – प्रश्नपत्र का प्रारूप :

Kopargaon Taluka Education Society's
K. J. Somaiya College of Arts, Commerce & Science, Kopargaon Dist. A. Nagar
Dept of Political Science

List of Courses addresses crosscutting issues as per new syllabus (CBCS- 2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	FYBA (Sem.I)	11161	Introduction to Constitution	Human Values
2	FYBA (Sem.II)	12161	Introduction to Constitution	Professional Ethics
3	SYBA (Sem.III)	CC1-1C	An Introduction to Political Ideology	Professional Ethics
4	SYBA (Sem.IV)	CC1-1D	An Introduction to Political Ideology	Human Values
5	SYBA (Sem.III)	DSE-1A	Western Political Thought	Professional Ethics
6	SYBA (Sem.IV)	DSE-1B	Western Political Thought	Human Values
7	SYBA (Sem.III)	DSE-2A	Political Journalism	Professional Ethics
8	SYBA (Sem.IV)	DSE-2B	Political Journalism	Professional Ethics
9	SYBA (Sem.III)	SEC-2A	Basic of Indian Constitution	Human Values
10	SYBA (Sem.IV	SEC-2B	Basic of Indian Constitution	Human Values
11	TYBA (Sem.V)	CC-1E	Local Self Government in Maharashtra	Professional Ethics
12	TYBA(Sem.VI)	CC-2E	Local Self Government in Maharashtra	Professional Ethics
13	TYBA (Sem.V)	DSE-1C	Public Administration	Professional Ethics
14	TYBA (Sem.VI)	DSE-1D	Public Administration	Professional Ethics
15	TYBA (Sem.V)	DSE-2C	International Relations	Professional Ethics
16	TYBA (Sem.VI)	DSE-2D	International Relations	Professional Ethics
17	TYBA (Sem.V)	SEC-2C	Samyukt Maharashtra Movement	Human Values
18	TYBA (Sem.VI)	SEC-2D	Samyukt Maharashtra	Human Values

			Movement	
19	MA –I (Sem.I)	PO-C1	Tradition of Political Thought	Human Values
20	MA –I (Sem.I)	PO-C2	Administrative Theory	Professional Ethics
21	MA –I (Sem.I)	PO-C3	Political Institution in India	Professional Ethics
22	MA –I (Sem.I)	PO-O4	Party System in India	Professional Ethics
23	MA –I (Sem.II)	PO-C4	Comparative Political Analysis	Professional Ethics
24	MA –I (Sem.II)	PO-C5	Theory of International Politics	Professional Ethics
25	MA –I (Sem.II)	PO-C6	Public Policy	Professional Ethics
26	MA –I (Sem.II)	PO-O5	Politics and the Media	Professional Ethics
27	MA – II (Sem.III)	PO-C7	Modern Political Thought	Human Values
28	MA – II (Sem.III)	PO-C8	Political Sociology	Human Values
29	MA – II (Sem.III)	PO-C9	World Politics New Developments	Professional Ethics
30	MA – II (Sem.III)	PO-O9	Indian Administration Structure and Organization	Professional Ethics
31	MA – II (Sem.IV)	PO-C10	Fundamentals of Political Theory	Human Values
32	MA – II (Sem.IV)	PO-C11	Political Process in India	Professional Ethics
33	MA – II (Sem.IV)	PO-C12	Politics and Society	Human Values
34	MA – II (Sem.IV)	PO-O15	Election Studies	Professional Ethics

PRINCIPAL
K. J. Somaiya College
Kopargaon

List of Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Political Science	Human Rights	CC.014	2017-18	Human Values

List of Add-on/Value Added Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	All PG (I Sem.)	Human Rights	10091	2019-20	Human Values
	All PG (II Sem.)	Human Rights	20091	2019-20	
2	All PG (Sem. III)	Introduction to Constitution	30095	2019-20	Human Values
3	All PG (Sem. III)	Skill Development	30094	2019-20	Professional Ethics
4	All PG (Sem. IV)	Skill Development	40094	2019-20	Professional Ethics
5	All PG (I Sem.)	Cyber Security	10092	2019-20	Professional Ethics
6	All PG (II Sem.)	Cyber Security	20092	2019-20	Professional Ethics
7	All PG (III Sem.)	Cyber Security	30092	2019-20	Professional Ethics
8	All PG (IV Sem.)	Cyber Security	40092	2019-20	Professional Ethics

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Kopargaon



SAVITRIBAI PHULE PUNE UNIVERSITY

(formerly University of Pune)

F. Y. B. A. Political Science

Syllabus

(Semester & Choice Based Credit System)

(To be implement ted from the Academic Year, 2019-20)

Savitribai Phule Pune University

F. Y. B. A. Political Science (CBCS pattern to be implemented from 2019-2020)

G-1 General Paper INTRODUCTION TO INDIAN CONSTITUTION

Total Credits : 03

Objectives

The contents of this course are designed with the following objectives: .

1. To acquaint students with the important features of the Constitution of India andwith The basic framework of Indian government.
2. To familiarize students with the working of the Constitutionof India.

Semester-I Period

Unit 1: Making of the Indian Constitution 12

- a) Historical Background
- b) Constituent Assembly
- c) Preamble
- d) Salient Features

Unit 2: Fundamental Rights, Duties and DirectivePrinciples 12

- a) Fundamental Rights
- b) Fundamental Duties
- c) Directive Principles of State Policy

Unit 3: Federalism 12

- a) Salient Features of Indian Federalism
- b) Centre –State Relations
- c) Issues of Conflict (Water and Border Issues)

Unit 4: Constitutional Amendments: Scope and Limitations 12

- a) Constitutional Provisions
- b) Major Constitutional Amendments (42, 44 & 86)
- c) Basic Structure of the Indian Constitution

Semester- II

Unit5: Legislature 12

- a) Union Legislature – Structure, Powers and Role
- b) State Legislature – Structure, Powers and Role

Unit6: Executive 12

- a) Union Executive – i) President and Vice President– Powers, Functions and Role
- ii) Prime Minister - Powers, Functions and Role
- iii) Council of Minister – Powers and Functions and Role
- b) State Executive- i) Governor - Powers, Functions and Role
- ii) Chief Minister – Powers, Functions and Role
- iii) Council of Minister – Powers and Functions and Role

Unit7: Judiciary 12

- a) Supreme Court : Powers and Functions
- b) High Court : Powers and Functions
- c) Judicial Review and Judicial Activism

Unit8: Electoral System 12

- a) Election Commission:Composition, Functions and Role
- b) Chief Election Commissioner
- c) Electoral reforms

References:

1) Austin Granville, 1999, The Indian Constitution: Cornerstone of a Nation, Oxford, Oxford University Press.

Savitribai Phule Pune University, Pune
S. Y. B. A. Political Science
(CBCS pattern to be implemented from 2020-2021)
Core Course (C.C.)
AN INTRODUCTION TO POLITICAL IDEOLOGIES

Objectives:

This course is designed to acquaint students with the –

1. Role of different political ideologies and their impact in politics
2. Close link between an idea and its actual realization in public policy
3. Legacy of all the major ideologies

SEMESTER III	**PERIOD**
CC-1 C (3)	
Unit 1: Ideology	**12**
a) Origin, Meaning, Definition	
b) Nature	
c) Scope	
Unit 2: Nationalism	**11**
a) Meaning, Definitions and Elements	
b) Progressive and Reactionary	
c) Internationalism	
Unit 3: Democratic Socialism	**11**
a) Meaning and Nature	
b) Features	
c) Achievements and Limitations	
Unit 4: Fascism	**11**
a) Principles	
b) Factors responsible for the rise of Fascism	
c) Evaluation	
SEMESTER IV	
CC-1 D (3)	
Unit 5: Marxism	**12**
a) Historical Materialism	
b) Marxian State	
c) Neo Marxism	
Unit 6: Phule-Ambekarism	**11**
a) Equality	
b) Cast & Religion	
c) Democracy	
Unit 7: Gandhism	**11**
a) Truth and Non-Violence	
b) Theory of Gram Swaraj	
c) Satyagraha	
Unit 8: Feminism	**11**
a) Meaning and Nature	
b) Liberal Feminism	
c) Feminism in India : Caste and Patriarchy	

Readings:

Savitribai Phule Pune University

F. Y. B. A. Political Science (CBCS pattern to be implemented from 2019-2020)

G-1 General Paper INTRODUCTION TO INDIAN CONSTITUTION

Total Credits : 03

Objectives

The contents of this course are designed with the following objectives:

1. To acquaint students with the important features of the Constitution of India andwith The basic framework of Indian government.
2. To familiarize students with the working of the Constitutionof India.

Semester-I Period

Unit 1: Making of the Indian Constitution
- a) Historical Background
- b) Constituent Assembly
- c) Preamble
- d) Salient Features

12

Unit 2: Fundamental Rights, Duties and DirectivePrinciples
- a) Fundamental Rights
- b) Fundamental Duties
- c) Directive Principles of State Policy

12

Unit 3: Federalism 12
- a) Salient Features of Indian Federalism
- b) Centre –State Relations
- c) Issues of Conflict (Water and Border Issues)

Unit 4: Constitutional Amendments: Scope and Limitations
- a) Constitutional Provisions
- b) Major Constitutional Amendments (42, 44 & 86)
- c) Basic Structure of the Indian Constitution

12

Scmester- II

Unit5: Legislature
- a) Union Legislature – Structure, Powers and Role
- b) State Legislature – Structure, Powers and Role

12

Unit6: Executive
- a) Union Executive – i) President and Vice President– Powers, Functions and Role
  ii) Prime Minister - Powers, Functions and Role
  iii) Council of Minister – Powers and Functions and Role
- b) State Executive- i) Governor - Powers, Functions and Role
  ii) Chief Minister – Powers, Functions and Role
  iii) Council of Minister – Powers and Functions and Role

12

Unit7: Judiciary
- a) Supreme Court : Powers and Functions
- b) High Court : Powers and Functions
- c) Judicial Review and Judicial Activism

12

Unit8: Electoral System
- a) Election Commission:Composition, Functions and Role
- b) Chief Election Commissioner
- c) Electoral reforms

12

References:

1) Austin Granville, 1999, The Indian Constitution: Cornerstone of a Nation, Oxford, Oxford University Press.

Savitribai Phule Pune University, Pune

S. Y. B. A. Political Science

(CBCS pattern to be implemented from 2020-2021)

DISCIPLINE SPECIFIC ELECTIVE COURSE

WESTERN POLITICAL THOUGHT

Objectives:

This course is designed to acquaint students with the –

1. Major traditions of thought that have shaped political discourse in different parts of the world.
2. The great diversity of social contexts and philosophical visions.
3. The history of political thought as a series of critical, interconnected and open-ended conversations about the ends and means of the good life.

SEMESTER III — **PERIOD**

DSE-1A (3)

Unit 1: Plato — **12**
- a) Ideal State
- b) View on Education
- c) Theory of Justice

Unit 2: Aristotle — **11**
- a) Classification of the State
- b) Views on Slavery
- c) Theory of Revolution

Unit 3: Machiavelli — **11**
- a) Human Nature
- b) Attitude towards Religion and Morality
- c) Views on State

Unit 4: Locke — **11**
- a) State of Nature
- b) Natural Rights
- c) Theory of Social Contract

SEMESTER IV

DSE-1B (3)

Unit 5: Rousseau — **12**
- a) State of Nature
- b) General Will
- c) Theory of Social Contract

Unit 6: Hegel — **11**
- a) Idealism
- b) Theory of State
- c) Views on Freedom

Unit 7: J. S. Mill — **11**
- a) Views on Liberty
- b) Representative Government
- c) Views on Utilitarianism

Unit 8: Karl Marx — **11**
- a) Historical Materialism
- b) Class Struggle
- c) Theory of State and Revolution

Savitribai Phule Pune University, Pune
S. Y. B. A. Political Science
(CBCS pattern to be implemented from 2020-2021)
DISCIPLINE SPECIFIC ELECTIVE COURSE
POLITICAL JOURNALISM

Objectives:

This course is designed to acquaint students with the –

1. Complex relationship between the communication, media and power politics.
2. Critical appraisal of practices of political image management, campaigns, propaganda and censorship.
3. Indian context of political Journalism

SEMESTER III	**PERIOD**
DSE-2A (3)	
Unit 1: An introduction to Political Journalism	**12**
a) Definition and Meaning	
b) Nature	
c) Scope	
Unit 2: Agencies of Political Journalism	**11**
a) Print	
b) Electronic	
c) Web	
Unit 3: History of Political Journalism	**11**
a) Pre-Independence	
b) Post-Independence	
c) World History	
Unit 4: Methods of Political Journalism	**11**
a) Reporting of Political Events	
b) Political Interview	
c) Commentary of Legislation	

SEMESTER IV	
DSE-2B (3)	
Unit 5: Indian Political Process & Journalism	**12**
a) Role of Social Media in Political Process	
b) Election and Media: Loksabha and Maharashtra Vidhansabha 2014 and 2019 General Elections	
c) Political Parties and Social Media	
Unit 6: Mediatisation of Politics	**11**
a) Definition and Meaning	
b) Practices	
c) Mediums	
Unit 7: Media & Public Opinion	**11**
a) Definition and Meaning	
b) Practices	
c) Mediums	
Unit 8: Challenges before Political Journalism	**11**
a) Increase of Paid News	
b) Party Spirited News Papers & Commercialization	
c) Media Saturation	

Savitribai Phule Pune University
Political Science
Syllabus for S. Y. B. A. (Extra Credit)
BASICS OF INDIAN CONSTITUTION

Objectives:

1. To acquaint students with the important features of the Constitution of India and with the basic framework of Indian government.
2. To familiarize students with the working of the Constitution of India.

SEMESTER III
SEC-2A (2)
UNIT – I
1. Making of the Indian Constitution
a) Historical Background
b) Constituent Assembly
c) Preamble
d) Salient Features
UNIT - II
2. Fundamental Rights
Major Fundamental Rightsa)
Right to Equality
b) Right to Liberty
c) Right to Freedom of Religion
d) Cultural and Educational Rights

Savitribai Phule Pune University
Political Science
Syllabus for S. Y. B. A. (Extra Credit)
BASICS OF INDIAN CONSTITUTION

Objectives: This paper focuses in detail on the political processes and the actual functioning of the political system. It emphasizes on local influences that derive from social stratification of castes and jatis, from language, religion, ethic and economic determinants and critically assesses its impact on the political processes.

SEMESTER – IV
SEC 2B (2)
UNIT – I
1. Fundamental Duties
a) Concept of Fundamental Duties
b) Nature of Fundamental Duties
c) Importance of Fundamental Duties
UNIT – II
2. Directive Principles of State Policy
a) Concept of Directive Principles of State Policy
b) Nature of Directive Principles of State Policy
c) Significance of Directive Principles of State Policy

Savitribai Phule Pune University, Pune
S. Y. B. A. Political Science
(CBCS pattern to be implemented from 2020-2021)
DISCIPLINE SPECIFIC ELECTIVE COURSE
POLITICAL JOURNALISM

Objectives:
This course is designed to acquaint students with the –
1. Complex relationship between the communication, media and power politics.
2. Critical appraisal of practices of political image management, campaigns, propaganda and censorship.
3. Indian context of political Journalism

SEMESTER III

DSE-2A (3)	**PERIOD**
Unit 1: An introduction to Political Journalism	
a) Definition and Meaning	**12**
b) Nature	
c) Scope	
Unit 2: Agencies of Political Journalism	
a) Print	**11**
b) Electronic	
c) Web	
Unit 3: History of Political Journalism	
a) Pre-Independence	**11**
b) Post-Independence	
c) World History	
Unit 4: Methods of Political Journalism	
a) Reporting of Political Events	**11**
b) Political Interview	
c) Commentary of Legislation	

SEMESTER IV

DSE-2B (3)	
Unit 5: Indian Political Process & Journalism	
a) Role of Social Media in Political Process	**12**
b) Election and Media: Loksabha and Maharashtra Vidhansabha 2014 and 2019 General Elections	
c) Political Parties and Social Media	
Unit 6: Mediatisation of Politics	
a) Definition and Meaning	**11**
b) Practices	
c) Mediums	
Unit 7: Media & Public Opinion	
a) Definition and Meaning	**11**
b) Practices	
c) Mediums	
Unit 8: Challenges before Political Journalism	
a) Increase of Paid News	
b) Party Spirited News Papers & Commercialization	**11**
c) Media Saturation	

Savitribai Phule Pune University
T.Y.B.A. Political Science
(CBCS pattern to be implemented from 2021-2022)
Core Courses (C.C.)
LOCAL SELF GOVERNMENT IN MAHARASHTRA

Objectives:
1. To introduce the evolution of Local Self Government in Maharashtra
2. To make students aware about 73rd and 74th Constitutional Amendments
3. To introduce the students the structure of Local Self Government
4. To make students aware about composition, power and functions of local bodies

SEMESTER-V

CC-1 E (3)	**PERIOD**
Unit 1: Evolution of Local Self Government	12
a. Background of Panchayati Raj in British Era	
b. Community Development Program – 1952	
c. Balavantrai Mehata Committee – 1957	
Unit 2: Varies committee of Local Self Government in Maharashtra	12
a. Vasantrao Naik Committee – 1960	
b. L. N. Bongirwar Committee – 1970	
c. P. B. Patil Committee – 1985	
Unit 3: 73rd Amendment and Rural Bodies	12
a. Background of 73rd Constitutional Amendment	
b. Constitutional change in Article 243	
c. Gram Sabha & Gram Panchayat	
Unit 4: 73rd Constitutional Amendment and Rural Bodies	12
a. Panchayat Samiti	
b. Zilha Parishad	
c. Schedule XI In Constitution	

SEMESTER-VI

CC-2 E (3)	
Unit 1: 74th Constitutional Amendment and Urban Bodies	12
a. Urban Bodies before 74th Constitutional Amendment	
b. Constitutional change in Article 243	
c. Nagar Panchayat	
Unit 2: 74th Constitutional Amendment and Urban Bodies	12
a. Municipal Council	
b. Municipal Corporation	
c. Schedule XII In Constitution	
Unit 3: Commissions about Local Self Government	12
a. State Election Commission	
b. State Finance Commission	
c. Challenges before Commission	
Unit 4: Future of Local Self Government	12
a. Control on Local Self Government	
b. Limitations of Local Self Government	
c. Challenges before Local Self Government	

Savitribai Phule Pune University

T.Y.B.A. Political Science

(CBCS pattern to be implemented from 2021-2022)

DISCIPLINE SPECIFIC ELECTIVE COURSE

PUBLIC ADMINISTRATION

Objectives:

This paper is an introductory course in Public Administration. The essence of Public Administration lies in its effectiveness in translating the governing philosophy into programmes, policies and activities and making it a part of community living. The paper covers personnel public administration in its historical context thereby proceeding to highlight several of its categories, which have developed administrative salience and capabilities to deal with the process of change. The recent developments and particularly the emergence of New Public Administrations are incorporated within the larger paradigm of democratic legitimacy. The importance of legislative and judicial control over administration is also highlighted

SEMESTER-V

DSE 1 C (3)+1	**PERIOD**
Unit 1: Public Administration	**12**
a) Meaning	
b) Nature	
c) Scope and Significance	
Unit 2: New Public Administration	**12**
a) Evolution	
b) Salient Features	
c) Goals	
Unit 3: Approaches to Public Administration	**12**
a) Traditional Approach	
b) Behavioral Approach	
c) System Approach	
Unit 4: Governance	**12**
a) Idea of Good Governance	
b) E-Governance	
c) Public Private Partnership	

SEMESTER-VI

DSE 1 D (3)+1	
Unit 1: Bureaucracy	**12**
a) Meaning and Definitions	
b) Administrative Reforms	
Unit 2: Personnel Administration	**12**
a) Recruitment	
b) Training	
c) Promotion	
Unit 3: Budgeting	**12**
a) Meaning and types and Principles of sound Budget	
b) Budgetary Process in India	
c) Gender Budgeting	
Unit 4: Accountability and Control	**12**
a) Administrative Accountability	
b) Legislative Control	
c) Judicial Control	

Savitribai Phule Pune University

T.Y.B.A. Political Science

(CBCS pattern to be implemented from 2021-2022)

DISCIPLINE SPECIFIC ELECTIVE COURSE

INTERNATIONAL RELATIONS

Objectives:

This paper deals with concepts and dimensions of International Relations and makes an analysis of different theories highlighting the major debates and differences within the different theoretical paradigms. The dominant theories of power and the question of equity and justice, the different aspects of balance of power leading to the present situation of a unipolar world are included. It's highlights various aspects of conflict and conflicts resolution, collective security and in the specificity of the long period of the post second world war phase of the cold war, of Detent and Deterrence leading to theories of rough parityin armaments.

SEMESTER-V

DSE 2 C (3)+1	**PERIOD**
Unit 1: Introduction to International Relations a) Development and Meaning b) Nature c) Scope	**12**
Unit 2: Approaches to International Relations a) Idealism b) Realism – Neo realism c) System approach d) Marxism	**12**
Unit 3: World War II and the Cold War a) Causes and Consequences of the world war II b) Emergence of the cold war and its phase c) End of cold war and the emerging world order	**12**
Unit 4: International Organizations a) The United Nations - its structure and peacekeeping Functions- Reforms of UN b) International Financial institutions : World Bank, IMF, WTO c) Regional Organizations : EU, SAARC, ASEAN, BRICS	**12**

SEMESTER-VI

DSE 2 D (3)+1	
Unit 1: The Theory of Non-Alignment a) Meaning and basic principles of Non-Alignment b) Emergence of Non-Alignment c) Non-Alignment as a Movement d) Relevance of NAM In Post cold war period	**12**
Unit 2: Globalization a) Meaning of Globalization b) Evolution and Impacts of Globalization c) Limits of Globalization d) Role of The state	**12**
Unit 3: International Political Economy a) Neo-Colonialism b) New International Economic Order c) North-South Divide d) South-South Co-operation	**12**
Unit 4: Contemporary Global Issues a) International Terrorism b) Environmental Issues c) Poverty, Development and Hunger d) Human Rights	**12**

SKILL ENHANCEMENT COURSE (SEC)

(Value/Skill Based Course)

Savitribai Phule Pune University

Political Science

Syllabus of T.Y.B.A. (Extra Credit)

Value/Skill Based Course

Samyukta Maharashtra Movement

Objectives:

1. This Course is an introduction to the political process in Maharashtra with special reference to regionalism sub-regionalism and Samyukta Maharashtra Movement.
2. The aim of the course is that students are expected to understand both the historical evolution of Maharashtra's politics and different analyses of politics of the state.
3. It tries to acquiant students with the main issues and concerns in the public life of a regional society as it shaped in the concept of colonialism, nationalism and modernity.

SEMESTER – V

SEC-2C(2)

UNIT - I

1. Regional Aspirations in India

a. Concept of Regionalaism: Its Nature
b. Genesis of Regionalaism in India
c. Indian National Congress and Regionalism

UNIT - II

2. Samyukta Maharashtra Movement - I

a. Emergence and Development of Regional Consciousness in Maharashtra
b. Preferntial Treatment for the 'Sons of Soil'
c. Difficulties in the Formation of Samyukta Maharashtra

Savitribai Phule Pune University

Political Science

Syllabus of T.Y.B.A. (Extra Credit)

Value/Skill Based Course

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SEMESTER – VI

SEC-2D(2)

UNIT - I

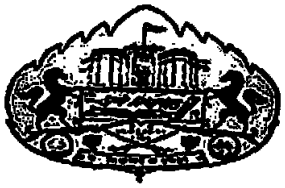
1. Samyukta Maharashtra Movement - II

a. Rethinking on the Bilingual Bombay state
b. Formation of the Samyukta Maharashtra
c. The aftermath of the formation of Samyukta Maharashtra

UNIT - II

2. Emergence of Sub-Regionalism in Maharashtra

a. Regional Imbalance and Regional Development Boards
b. Seperate Vidarbha State
c. Marathwada Vikas Andolan



SAVITRIBAI PHULE PUNE UNIVERSITY

(formerly University of Pune)

M. A. Political Science Syllabus

(CREDIT & SEMESTER SYSTEM)

Revised syllabus will be implemented with effect from the academic year 2019-2020 at College Centers

Savitribai Phule Pune University
Political Science
Syllabus for M.A. - I

Semester I

List of Compulsory Courses **(C= compulsory)**

PO-C1: Traditions of Political Thought
PO-C2: Administrative Theory
PO-C3: Political Institutions in India

List of Optional Courses **(O = optional)**

PO-O1-Modern Political Ideologies
PO-O2- Political Process in Maharashtra
PO-O3- India's Foreign Policy
PO-O4- Party System in India

Semester II

List of Compulsory Courses **(C= compulsory)**

PO-C4: Comparative Political Analysis
PO-C5: Theory of International Politics
PO-C6: Public Policy

List of Optional Courses **(O = optional)**

PO-O5- Politics and the Media
PO-O6- Human Rights
PO-O7- Social Movements in India
PO-O8- Political Thought in Modern Maharashtra

SAVITRIBAI PHULE PUNE UNIVERSITY
(formerly University of Pune)
M. A. Political Science Syllabus
(CREDIT & SEMESTER SYSTEM)
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M.A. - I
Political Science
Semester I

PO-C1: Traditions of Political Thought

Objectives:
This course is meant to serve as a window on the major traditions of thought that have shaped political discourse in different parts of the world over the last three millennia. It stresses the great diversity of social contexts and philosophical visions that have informed the ideas of key political thinkers across epochs. The chief objective is to project the history of political thought as a series of critical, interconnected and open-ended conversations about the ends and means of the good life.

1. ANCIENT ERA
1. Confucius
a. Life and Works b. Ruling through Virtue c. Rituals and Filial Piety

2. Plato
a. Life and Works b. Plato's concept of Ideal State c. Platonic Theory of Justice
2. MODERN ERA
1. Niccolo Machiavelli
a. Life and Works b. Suggestions to the "Prince" c. Relationship between Ethics and Politics
2. Jean-Jacques Rousseau
a. Life and Works b. Social Contract Theory c. General Will

3. INDUSTRIAL ERA
1. John Stuart Mill
a. Life and Works
b. Liberty
c. Representative Government
2. Karl Marx
a. Life and Works
b. State and Class
c. Historical Materialism

4. COLONIAL ERA
1. M. K. Gandhi
a. Life and Career
b. Views on the State
c. Critique of Western Civilization
2. Frantz Fanon
a. Life and Career
b. Africana Phenomenology
c. Theory of Decolonization

PO-C2: Administrative Theory

Objectives:
Public Administration is an essential part of a society. In last few years the profession of Public Administration is going through changes. Present paper aims to make aware the students about Evolution & Importance of the Public Administration. Paper introduces changing trends in the field of Public Administration.

1. Public Administration
a. Evolution of the Discipline
b. Changing Nature of Public Administration
c. Changing Role of Public Administration in Developing Societies

2. Major Approaches to Public Administration
a. Bureaucratic Approach
b. Decision Making Approach
c. Ecological Approach

3. Theories of Public Administration
a. Rational Choice Theory
b. Comparative Public Administration
c. Development Administration

4. Principles of Organization
a. Hierarchy, Unity of Command,
b. Span of Control – Centralization and Decentralization
c. Line- Staff Agencies

5. New Trends in Public Administration
a. New Public Management
b. Challenges of Liberalization, Privatization

6. Governance
a. Problems of Administrative Corruption
b. Ombudsman
c. Lok Pal, Lok Ayukta

PO-C3: Political Institutions in India

Objectives:
The course introduces the student to the leading institutions of India's political system and to the changing nature of these institutions. Apart from explaining the structure and functions of the main institutions the course will try to acquaint students with the idea of institutional balance of power as discussed in the Indian constitution and as developed during the functioning of Indian democracy over the past seven decades.

1. Nationalist legacies
a. Unity and Integrity
b. Democracy
c. Development and Social Transformation

2. Federal institutions
a. Strong Centre' framework
b. Autonomy and devolution
c. Multilevel federalism

3. Executive
a. President and prime minister
b. Principle of collective responsibility and accountability to the legislature
c. Role of governor

4. Legislature
a. Composition and powers
b. Norms of representation
c. Legislative supremacy

5. Judiciary
a. Composition
b. Judicial review and judicial activism
c. Judicial interpretations of Fundamental Rights and Directive Principles, basic structure doctrine

6. Welfare, Regulation and Security
a. UIDAI
b. TRAI
c. AFSPA

PO-O4- Party System in India

Objectives:
This course provides a much fuller treatment, otherwise not available, on political parties and on the electoral process and on the factors that shape and influence both in the specifically Indian context. As parties constitute an important part of the political process, this course would expect students to understand the evolution of different parties and the different configurations of competition both at all-India level and in different states of India. Students will also study the ideological variations across parties, their relationship with social movements and the social bases of parties.

1. Party System in India
a. One Party Dominance
b. Multi Party System and Coalition Politics
c. Reemergence of one party Dominance

2. Indian National Congress
a. Ideology and Leadership
b. Social Base and Support Structure
c. Electoral Performance

3. Bhartiya Janata Party
a. Ideology and Leadership
b. Social Base and Support Structure
c. Electoral Performance

4. Communist Party of India and Marxist Communist Party
a. Origin and Development
b. Social Base and Leadership Patterns
c. Electoral Performance

5. Bahujan Samaj Party
a. Origin and Development
b. Social Base and Leadership Patterns
c. Electoral Performance

6. People's Movement and Political Parties
a. Peasant Movements
b. Dalits and Tribal's Movement
c. Women and Environment Movements

M.A. - I
Political Science
Semester II

PO-C4: Comparative Political Analysis

Objectives:

The purpose of this course is to acquaint the student with the sub-discipline of comparative politics. It expects the students to understand the comparative methodology and dynamics of domestic politics across countries.

1. Nature of Comparative Analysis

a. Old and New Comparative Politics

b. Nature and Scope

2. Approaches to the study of Comparative Politics

a. New Institutional

b. Structure-Functional

3. Theories of Development

a. Modernization b. World System Theory

4. Security Apparatus and Concerns

a. Military b. Violence

5. Parties and Pressure Groups

a. Parties and Party System

b. Pressure Groups in Politics

6. Non State Political Actors

a. Social Movements

b. Non-Governmental Organizations

PO-C5: Theory of International Politics

Objectives:

Students need a brief history of international politics to understand why we study the subject and how current scholarship is informed by what preceded it. Theories provide interpretative frameworks for understanding what is happening in the world and the levels of analysis. Competing theories are presented.

1. Introduction to International Politics

a. Meaning b. Nature c. Scope

2. Changing International Political Order since World War II

a. Rise of super powers; cold war & Détente

b. Non-aligned movement: aims and achievements, relevance

c. Collapse of the Soviet Union; Rise of American hegemony

3. Approaches to International Politics

a. Idealism b. Realism c. Liberalism d. Marxism

4. Geopolitical Issues

a. Theories of Geopolitics, Alfred Mahan, Harry Mackinder and Robert Kohen

b. Contemporary Geopolitics

5. Positivist and Post Positivist Framework

a. Positivism b. Critical Theory c. Constructivism

6. Contemporary concerns

a. Terrorism b. Environment c. Gender d. Human Rights

PO-C6: Public Policy

Objectives:
The purpose of this course is to provide students an understanding of the basic concepts, theories and process of public policy. The course also seeks to help students understand public policy processes and actors involved in it by studying specific policies. It attempts to help students understand and analyze policy making in practical context.

1. Public Policy
a. Nature and Scope b. Evolution of Discipline
2. **Major Approaches**
a. Group b. Incremental c. Policy Network
3. **Public Policy in Action**
a. Implementation b. Evolution c. Bureaucracy
4. **Shaping of Public Policy**
a. Agenda b. Public formulation and adoption c. Role of legislature
5. Public Policy Development
a. Health b. Agriculture c. Environment
6. **Globalization and Public Policy**
a. Global Policy Process b. Role of Transnational Actors
c. Impact of Globalization on Public Policy making.

Optional Papers

PO-O5- Politics and the Media

Objectives:
The news media are sometimes called the fourth branch of government-and for good reason. Much of our exposure to politics comes not from direct experience but from mediated stories. This course is designed to help you think about this relationship between the news media and politics. We will explore how news organizations decide what is news, how they report it, how those reports have an impact on viewers or readers, and ultimately, the political system.

1. Media, Politics and Democracy
a. Nature of Media- Folk Media, Print Media, Broadcast Media and New Media
b. Media as fourth Pillar of Democracy c. Role of Media in Power Politics
2. Media and Political Socialization
a. Role of Media in Socializing the Public towards Politics and Political Processes
b. Role of Media in creating Political Attitudes of Public
c. Influence of Media in deciding levels of Political Participation of the Public
3. Effects of Media on Public Opinion and Political Processes
a. Role of Media in the Formation of Public Opinion about Political Issues
b. Role of Media in Setting Political Agendas
c. The Level of Media influence on Public Opinion
4. Election Campaigns, Awareness and Propaganda
a. Campaign and Propaganda b. The Techniques of Media Election Campaigns
c. Political Coverage and Paid News
5. Governing through the Media
a. Assessing Partisan Bias in Political News b. Media Favoritism and Political Nominations
c. Role of Media in Policy Making Process
6. New Media, Social Movements and Collective Action
a. Role of New Media in Collective Action, Social Movements and Popular Mobilization
b. Media Impact on Voters and Political Outcome c. Media and Image Building

SAVITRIBAI PHULE PUNE UNIVERSITY

(Formerly University of Pune)

M. A. Political Science Syllabus

(CREDIT & SEMESTER SYSTEM)

Revised syllabus will be implemented with effect from the academic year 2020-2021 at College Centers

PO-C7 Modern Political Thought

Objectives: The purpose of this course is to introduce to the student political ideas, views and concerns of leading Indian thinkers. The course encourages students to understand and decipher the diverse and often contesting ways in which the ideas of nationalism, democracy and social transformation were discussed in pre and post-independence India.

1. Mahadeo Govind Rande
a) Views on Social Reforms
b) Economic Ideas
c) Political Liberalism

2. Mahatma Gandhi
a) Truth and Non-violence
b) Satyagraha
c) Concepts of Trusteeship

3. Jawaharlal Nehru
a) Secularism
b) Democratic Socialism
c) Nationalism and Internationalism

4. Bhimrao Ramji Ambedkar
a) Critique of Caste System.
b) Democracy
c) State Socialism.

5. Ram Manohar Lohia
a) Caste and Indian Politics
b) Linguistic Politics
c) Synthesis of Socialism

PO-C8: Political Sociology

Objectives: This Course will introduce the overall scope of the sub-discipline of political sociology. The focus of the course will be on the political sociology of power. The emphasis is on the nature of power in modern societies-more in the form of organizations and social formations than as individual power. Students are also expected to understand different forms of justifications of power and the role of ideology in this regard. State will be studied as a repository of power in society while class and patriarchy are two instances of how the nature of power is shaped by social factors.

1. Nature and Scope

2. Intellectual Foundations

a) Karl Marx

b) Max Weber

c) Behavioral Approach

3. Political culture and Socialization

a) Culture- Nature, Elements and Types

b) Socialization- Nature, Importance and Agencies

4. Political Participation and Public Opinion

a) Meaning and Nature

b) Levels and Factors affecting Political Participation

c) Role of Public Opinion

5. Political Development and Change

a) Meaning and Nature

b) Theories of Political Development

c) Types of Political Change

PO-C9 World Politics-New Developments

Objectives:

1. The objectives of this course are to introduce the students to the contemporary issues and debates in the world politics.
2. The students would also be made aware of the dimensions of the making of the foreign policy as well as the role of Non- State Actors in World Politics.
3. They would also learn about the emerging New World Order and the challenges to it.

1. Foreign Policy
a) Definition and making of foreign policy
b) Factor influencing the foreign policy (Internal and external)
c) Role of state in making of foreign policy

2. Intervention and coercive
a) Methods of Intervention
b) Impact of Intervention
c) Cross- border relationship

3. Impact of world Trade on Politics
a) World trade and behavioral of nation
b) Role of MNCS and TNCS on national politics

4. Challenges before the nation
a) Use of Military
b) Terrorism
c) Ethnic Problems
d) Refugees

5. Environmental Issues and the nation
a) Environmental depletion
b) Effort mode by the nation for environmental awareness
c) Feminism

Optional Papers

PO-O9 Indian Administration – Structure and Organization

Objectives:

1. To introduce the students to the evolution of Indian Administration.
2. To acquaint them with the Principles and structure of Indian Administration.
3. To provide comprehensive understanding of administrative development.

1. Evolution and Constitutional Framework

a) Evolution: Ancient, Medieval and British periods
b) Constitutional Framework: Parliamentary and Federal Features
c) Salient Features Indian Administration

2. Central Administration

a) Prime Minister and Council of Ministers
b) Central and Cabinet Secretariat
c) Prime Minister Office

3. Civil Services in India

a) Classification- All India Central and State Services
b) Recruitment Agencies- Union Public Service Commission and State Union Public Service
c) Capacity Building of Civil Servants and Civil Service Reforms

4. State Administration

a) Chief Minister and Council of Ministers
b) Chief Secretary, State Secretariat and Directorates
c) Chief Minister Office

5. Issues in Indian Administration

a) Citizen Grievance Redressal Mechanism- Lok Pal, Lokayuta and Central Vigilance Commission
b) Politician and Civil Servants Relations
c) Combating Corruption / Generalists and Specialists Debate

M.A. – II
Political Science
Semester – IV

PO-C10 Fundamentals of Political Theory

Objectives: This course introduces the students to the evolution, importance to the study of Political Theory. It introduces Political Theory as a distinctive area of inquiry. It is the integral area to the study of politics. It highlights debates in the field and places them in a historical perspective.

1. Political Theory: Meaning, Nature and Scope

2. Liberty, Equality and Fraternity

3. Justice, Rights, Citizenship

4. Power, Authority and Legitimacy

5. State, Democracy, Civil Society

PO-C11 Political Process in India

Objectives: The course will introduce to the student the key issues and details of the political process in post independence India. It will also try to develop among students a perspective to understand and analyse Indian politics. The aim is to help students understand the expansive meaning of political process as it shapes in the arena of electoral and party politics, in the form of mass mobilizations and as politics of interests.

1. Nature Of party and electoral politics
a) One party dominance
b) Competitive multi party system
c) Collation Politics

2. Centre –State Financial Relations
a) Distribution of Financial Sources between Centre and State
b) Role of Finance Commission
c) NITI Ayog

3. Centre-State Political Relations
a) Role of Governor
b) Emergency Provisions.
c) State Autonomy.

4. Social Determinants of State Politics
a) Religion
b) Caste
c) Language

5. Politics of mass mobilization
a) Naxalite movements
b) Farmers movements
c) Civil society organizations

PO-C12 Politics and Society

Objectives: This Course expects students to understand the interface of politics with social structures and processes and how the nature of power is shaped by social factors.

1. Introduction
a) Community b) Culture c) Religion

2. Inter-relationship between Politics and Society
a) Role of State b) Nationalism c) Leadership

3. Politics, Society and Economy
a) Inequality b) Class c) Caste

4. Social Movements and Development
a) Anti Corruption Movement
b) Nirbhaya Movement
c) Environmental Movement

5. Issues in Society and Politics
a) The Politics of National Identity
b) Ethnicity and Gender c) Human Right

PO-O15 Election Studies

Objectives: - This course has a dual purpose. It seeks to introduce to the students the methods of studying elections. It also seeks to acquaint the student with the practice of studying elections in India and issues involved in it. The course expects students to understand the different methods of election study. Taking off from the history and evolution of election studies, the course further dwells on key issues in India's electoral politics.

1. History of Election Studies
a) Meaning and Importance
b) Demand and Development of Representation
c) Election Studies in India

2. Overview of Elections in India
a) Election Commission
b) i. People's Representation Act ii. Model Code of conduct
c) Landmark Elections: 1952, 1967, 1977, 1996, 2004 and 2014

3. Research Methods
a) Serve
b) Field study and Ethnographic Studies
c) Data Analysis

4. Major Determinants of Election
a) Social Identities b) Media c) Funding

5. Practices of Election Commission of India
a) Electoral Awareness Program
b) Prevention from Malpractices in Election
c) Electoral Reforms

Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce and Science

Kopargaon, Ahmednagar, (M. S.)



DEPARTMENT OF ECONOMICS

Crosscutting Issues

List of Courses addresses crosscutting issues as per Syllabus (2013 Pattern)

Sr. No.	Program Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	B.A. Economics	1157	Indian Economy: Problems & Prospects	Environment and Sustainability
2	B.A. Economics	2158	Micro Economics	Professional Ethics
3	B.A. Economics	2159	Macro Economics	Professional Ethics
4	B.A. Economics	2157	Modern Banking	Professional Ethics
5	B.A. Economics	3158	International Economics	Professional Ethics
6	B.A. Economics	3159	Public Finance	Professional Ethics
7	B.A. Economics	3157	Economic Development & Planning	Professional Ethics
8	B.Com Economics	101	Business Economics (Micro)	Professional Ethics
9	M.A. Part-I SEM-I	EC-1001	Micro Eco Analysis-I	Professional Ethics
10	M.A. Part-I SEM-I	EC-1002	Public Economics-I	Professional Ethics
11	M.A. Part-I SEM-I	EC-1003	International Trade	Professional Ethics
12	M.A. Part-I SEM-I	EC-1005	Labour Economics	Professional Ethics
13	M.A. Part-I SEM-II	EC-2001	Micro Eco Analysis-II	Professional Ethics
14	M.A. Part-I SEM-II	EC-2002	Public Economics-II	Professional Ethics
15	M.A. Part-I SEM-II	EC-2003	International Finance	Professional Ethics
16	M.A. Part-I SEM-II	EC-2004	Agricultural Economics	Professional Ethics
17	M.A. Part-II SEM-III	EC-3001	Macro Eco Analysis-I	Professional Ethics
18	M.A. Part-II SEM-III	EC-3002	Growth & Development-I	Professional Ethics
19	M.A. Part-II SEM-III	EC-3003	Modern Banking	Professional Ethics
20	M.A. Part-II SEM-III	EC-3004	Economics Of Finance	Professional Ethics
21	M.A. Part-II SEM-IV	EC-4001	Macro Eco Analysis-II	Professional Ethics
22	M.A. Part-II SEM-IV	EC-4002	Growth & Development-II	Professional Ethics
23	M.A. Part-II SEM-IV	EC-4003	Research Methodology	Professional Ethics
24	M.A. Part-II SEM-IV	EC-4004	Rural Development	Professional Ethics

List of Courses addresses crosscutting issues as per new syllabus (CBCS-2019 Pattern)

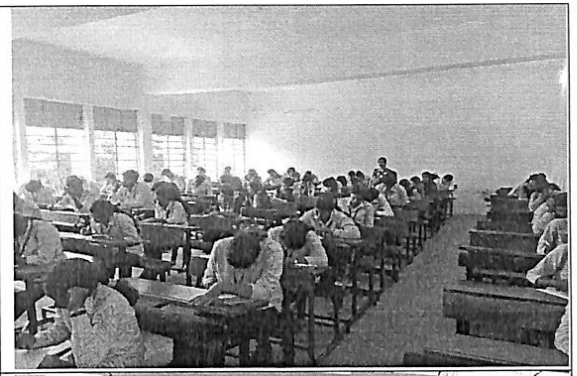
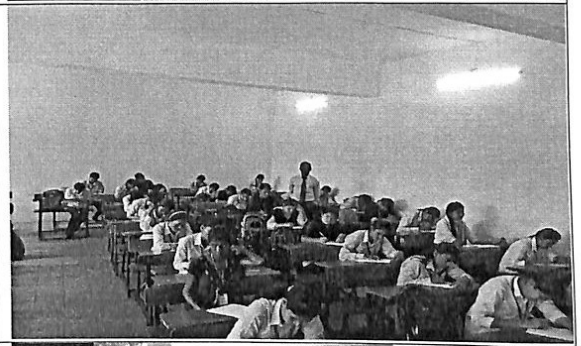
Sr. No.	Program Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	B.A. Economics	11151	Indian Economics Environment-I	Environment and Sustainability
2	B.A. Economics	12151	Indian Economics Environment-II	Environment and Sustainability

3	B.Com Economics	113	Business Economics-I (Micro)	Professional Ethics
4	B.Com Economics	123	Business Economics-II (Micro)	Professional Ethics
5	First Years All Class SEM-II	----	Democracy	Professional Ethics, Human Values, Environment and Sustainability
6	B.A. Economics	CC-1C-23153	Financial System-I	Professional Ethics
7	B.A. Economics	CC-1D-24153	Financial System-II	Professional Ethics
8	B.A. Economics	DSE-1A-23151	Micro Economics-I	Professional Ethics
9	B.A. Economics	DSE-1B-24151	Micro Economics-II	Professional Ethics
10	B.A. Economics	DSE-2A 23152	Macro Economics-I	Professional Ethics
11	B.A. Economics	DSE-2B 24152	Macro Economics-II	Professional Ethics
12	B.A. Economics	SEC-I SEC-2A	Basic Concept Of Research Methodology-I	Professional Ethics
13	B.A. Economics	SEC-II SEC 2B	Basic Concept Of Research Methodology-II	Professional Ethics
14	B.A. Economics	35151	International Economics-I	Professional Ethics
15	B.A. Economics	36151	International Economics-II	Professional Ethics
16	B.A. Economics	35152	Public Finance-I	Professional Ethics
17	B.A. Economics	36152	Public Finance-II	Professional Ethics
18	B.A. Economics	35153	Indian Economic Development-I	Environment and Sustainability
19	B.A. Economics	36153	Indian Economic Development-II	Environment and Sustainability
20	B.A. Economics	SEC-III SEC-3A	Business Management-I	Professional Ethics
21	B.A. Economics	SEC-IV SEC-3A	Business Management-II (Project)	Professional Ethics
22	M.A. Part-I SEM-I	EC-1001	Micro Eco Analysis-I	Professional Ethics
23	M.A. Part-I SEM-I	EC-1002	Public Economics-I	Professional Ethics
24	M.A. Part-I SEM-I	EC-1003	International Trade	Professional Ethics
25	M.A. Part-I SEM-I	EC-1004	Agricultural Economics	Professional Ethics
26	M.A. Part-I SEM-II	EC-2001	Micro Eco Analysis-II	Professional Ethics
27	M.A. Part-I SEM-II	EC-2002	Public Economics-II	Professional Ethics
28	M.A. Part-I SEM-II	EC-2003	International Finance	Professional Ethics
29	M.A. Part-I SEM-II	EC-2004	Labour Economics	Professional Ethics
30	M.A. Part-II SEM-III	EC-3001	Macro Eco Analysis-I	Professional Ethics
31	M.A. Part-II SEM-III	EC-3002	Growth & Development-I	Professional Ethics
32	M.A. Part-II SEM-III	EC-3003	Research Methodology-I	Professional Ethics
33	M.A. Part-II SEM-III	EC-3004	Demography	Professional Ethics
34	M.A. Part-II SEM-IV	EC-4001	Macro Eco Analysis-II	Professional Ethics
35	M.A. Part-II SEM-IV	EC-4002	Growth & Development-I	Professional Ethics
36	M.A. Part-II SEM-IV	EC-4003	Research Project	Professional Ethics
37	M.A. Part-II SEM-IV	EC-4004	Economics of Environment	Environment and Sustainability

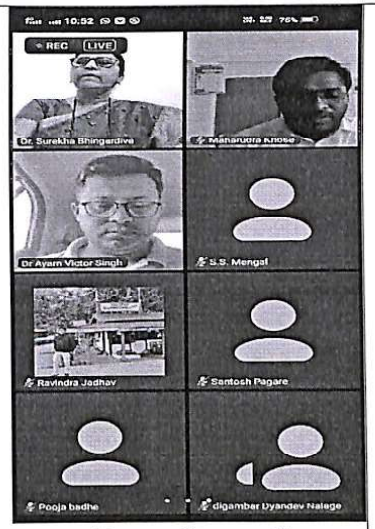
List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Economics	Financial Literacy	CC.002	2018-19	Professional Ethics

List Showing Curricular and Extra Curricular activities to address Crosscutting Issues (Similar/repeated activities are not listed)

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1	**Bank Visit – State Bank of India, Kopargaon Branch** 18/09/2018 Time: 10:00 am	Professional Ethics	
2	Field Visit at Dahegaon Bolka, Tel. Kopargaon, 24/12/2018 Time: 10:00 am	Professional Ethics	
3	Subject **Based Competitive Exam** 30/08/2018 Time: 10:00 am	Professional Ethics,	
4	**Bank Visit – Bank of Baroda, Kopargaon Branch** 17/01/2020 Time: 10:30 am	Professional Ethics	
5	**Based Competitive Exam** 22/08/2019 Time: 10:00 am	Professional Ethics	
6	**Bank Visit – IDFC, Kopargaon Branch** 25/11/2022 Time: 10:00 am	Professional Ethics	

7	**Subject Based Competitive Exam** 27/09/2022	Professional Ethics	

Sr.No.	Title of the Activity	Period		Representative Photograph	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
		From	To		
1	One Day National Webinar on New Farm Act 2020 :	29 Oct 2021			Professional Ethics
2	One Day webinar on Indian Budget	2022-23			Professional Ethics
3	One Day National Virtual Conference	27 Sep 2022			Professional Ethics
4	Guest lecture of Hon. Abasaheb Kalyankar, Chief Editor,Arthak altan on on the topic " Arthakalyan	17Jan 2019			Professional Ethics
5	Guest lecture of Hon. Prof Dr. Sambhaji Kale Economics BOS Member (SPPU, Pune) on the topic "Indian Economy & Agricultural"	2018-19			Professional Ethics

HOD
Dept. Of Economics
K. J. Somaiya College,
Kopargaon

F.Y.B.A. Economics

G-1 Indian Economic Environment

Annexure –II

1) Title of the course:

Class: F.Y.B.A.

Subject: Economics.

Title: Year of Implementation: From June - 2019

2) Preamble of the syllabus:

The proposed curriculum is with an objective to enhance the existing syllabus, make it contextual as well as applicable and to incorporate all the latest changes in the national economy. The board examined the short comings of the existing syllabus and expressed the need to change it. While doing so the board analyzed other curricula of existing universities in respective subjects in terms of content, relevance, quality and pattern of teaching that has been synthesized in the present proposal. While framing the draft of syllabus, guidance from industrial experts and professionals was seeked.

The present era is that of structural transformation especially within the country. Moreover fast changing international scenario and approach of other countries towards our human resource makes it mandatory for the educational system to impart latest knowledge to our students, so that they are prepared to merge themselves in the challenging economic and corporate environment.

Hence, a change in the paper and restructuring of syllabus becomes imperative. The syllabus needs to be holistic in nature. It should be contextual and clear the basics of economics but at the same time it should teach application of the theories in day to day life.

In the modern world, competition is an inseparable part of our lives. To inculcate a competitive spirit among the students, the syllabus should include all the recent advancement with in and out of the country with its pros and cons.

3) Objectives of the paper

- To familiarize the students with the recent developments in the Indian Economy
- To provide the students with the background of the Indian Economy with focus on contemporary issues like economic environment.
- To help the students to prepare for varied competitive examinations
- To enable students to understand and comprehend the current business scenario, agricultural scenario and other sectorial growth in the Indian context. To make the student aware of the developments such as MSMEs, Digital Economy, E-Banking, BPO & KPO, etc.

Programme Outcome:

- Ability to develop an understanding of the economic environment and the factors affecting economic environment.
- Ability to develop awareness on the various new developments in the different sectors of an economy – agriculture, industry, services, banking, etc.
- Ability to compare and contrast Indian Economy with other world economies.
- At the end of the course, the student should be able discuss and debate on the various issues and challenges facing the Indian Economic Environment.

4) Introduction:

Semester system with the pattern of 70:30

5) Eligibility:

Students who have passed 12th standard from any stream with minimum 35% of marks in all the subjects. (as per the rule of affiliating SPPU)

6) Examination:

A) Pattern of examination: 70:30

i) Internal university examination of 70 marks with internals of 30 marks

ii) Pattern of question paper: pattern for 70 marks

- Question Number 1: 8 questions to be answered out of 10 with total marks 16
- Question Number 2: 4 questions to be answered out of 6 with total marks of 16
- Question Number 3: 3 questions to be answered out of 4 with total marks of 18
- Question Number 4: 2 questions to be answered out of 3 with total marks of 20

iii) Duration for 70 marks: 3 Hrs

iv) Pattern for 30 marks:

- Internal exam (20 marks)
- PPT (oral or poster)/ Project work/Assignments/visits (10 marks)

v) Unit wise classification of marks

Unit	Name of the Chapter	Distribution of marks
Semester 1		
Unit 1	Introduction	23
Unit 2	Agricultural Environment	23
Unit 3	Industrial Environment	24
	Total	**70**
Semester 2		
Unit 1	Service Sector Environment	20
Unit 2	Banking Environment	25
Unit 3	Overview of Indian economy	25
	Total	**70**

B) Standard of Passing:

To pass, the candidate must obtain at least 40% in individual subjects, in internal assessment and in university examination each in all the papers.

C) ATKT rules

As per the rules of SPPU, a student can have maximum two papers as backlog and go to second year.

D) Award of Class:

i. Those successful candidates who obtained 40 % and above of the total aggregate marks in all subjects for internal assessment and university examination taken together at one and same sitting, shall be placed in Pass Class.

ii. Those successful candidates who obtained 50 % and above of the total aggregate marks in all subjects for internal assessment and university examination taken together at one and same sitting, shall be placed in Second Class.

iii. Those successful candidates who obtained 55 % and above of the total aggregate marks in all subjects for internal assessment and university examination taken together at one and same sitting, shall be placed in Higher Second Class.

iv. Those successful candidates who obtained 60 % and above of the total aggregate marks in all subjects for internal assessment and university examination taken together at one and same sitting, shall be placed in First Class.

v. Those successful candidates who obtained 70 % and above of the total aggregate marks in all subjects for internal assessment and university examination taken together at one and same sitting, shall be placed in First Class with

E) External students:

The students who appear for the examinations without attending any college and take admission in the university as external students will be considered as external students.

F) Setting of question paper/pattern of question paper

Question papers will be set by the panel of paper setters appointed by Savitribai Phule Pune University.

G) Verification/ revaluation

Verification and or revaluation will be done by panel appointed by Savitribai Phule Pune University.

7) Structure of the course

a) Compulsory paper:

Only one paper will be given without and optional subject

b) Optional paper

No subjects are optional.

c) Medium of instructions:

Medium of instruction for the paper will be both Marathi and English.

Structure of the entire course

		BA Economics	
FY		Indian Economic Environment	2019-20
SY	G1	Financial System	2020-21
SY	G2	Micro Economics	2020-21
SY	S1	Macro Economics	2020-21
TY	S2	Public Finance	2021-22
TY	G3	International Economics	2021-22
TY	S3	Economics of Development	2021-22
	S4		

8) Equivalence of previous syllabus with the proposed syllabus

The revised syllabus has changes in the name of the paper, topics and sub topics offered as compared to the old syllabus. The paper will make the syllabus more comprehensive and modified to suitably align with the changing Indian scenario. The paper will set an apt background for students to comprehend knowledge of economics in their academic career and apply the knowledge in their life.

9) University terms

Academic calendar of the affiliating university will be followed.

10) Subject wise detail syllabus

Semester 1		
Units	**Name and sub titles of the Chapter**	**No of lectures**
Unit 1	**Introduction**	**16**
	1.1 Meaning, Factors affecting Economic Environment- Economic, Political, Technological, Social & Cultural	08
	1.2 Challenges to Indian Economy: Natural Resources, Energy Resources, Education, Health, Environment	04
	1.3 Comparison of Indian Economy with the World Economy- Population, Agriculture, Industry and Service Sector	04
Unit 2	**Agricultural Environment**	**16**
	2.1 Role of Agriculture in Indian Economy	04
	2.2 Challenges to Indian Agriculture-Productivity, Rural Credit, Marketing, Rural Entrepreneurship	08
	Recent Trends in Indian Agriculture: Cropping pattern, Technology, Crop Insurance, Water Management, Agri-Business	04
Unit 3	**Industrial Environment**	**16**
	3.1 Role of Industry in Indian Economic Development	04
	3.2 Industrial Policy Resolution, 1991- Liberalization, Privatization and Globalization (LPG)	03
	3.3 Challenges to Indian Industry-Labour & Employment, Regional Imbalance, Finance, Technology	03
	3.4 Micro, Small and Medium Enterprises (MSME)- Definition & Role	03
	3.5 Recent trends in Indian Industry- Indian Multinationals & New Policies	03
Semester 2		
Unit 1	**Service Sector Environment**	**12**
	1.1 Role and Growth of Service Sector in Indian Economy	02

	1.2 Challenges to Indian Service sector- Business-based & Knowledge-based Sector, Education sector, Health sector, Insurance, Tourism, Banking	06
	1.3 Recent Trends in Indian Service Sector- Digital Economy, E-Commerce, E- Finance	04
Unit 2	**Banking Environment**	**18**
	2.1 Banking- Definition, Functions, Changing Structure of Banking in India- New Private Banks, Small Banks, Payment Banks	08
	2.2 Bank Accounts- Types, Procedure and Operation of Accounts	05
	2.3 Recent Trends in Indian Banking Environment- E-Banking, E- Wallets, Bank Mergers and Amalgamations	05
Unit 3	**Overview of Indian economy**	**18**
	3.1 Challenges of Indian Economy- Poverty, Employment, Inequality, Informal Sector	09
	3.2 Policy Measures (Two-Three recent Programmes)- Poverty Alleviation Programmes; Employment Generation Programmes; Agriculture Development Programmes, Skill Development Programmes	09

11) Recommended books

Semester I: Basic Reading List

- Agrawal A.N., Problems of Development & Planning, (Latest Edition)
- Ashwani Mahajan, 'Indian Economy' S. Chand & Company Ltd., New Delhi.
- Cherunilam Francis, 'Business Environment-Text and Cases' Himalaya Publishing House(Latest Edition)
- Faisal Ahmed 'Business Environment: Indian and Global Perspective' PHL Learning Pvt. Ltd. (Latest Edition)
- Fernando A.C. (2014) 'Business Environment' Pearson Education,
- Misra & Puri, 'Business Environment', Himalaya Publication House, Mumbai. (Latest Edition)
- Misra & Puri, 'Indian Economy', Himalaya Publication House, Mumbai. (Latest Edition)

Recommended Reading

- Asian Development Bank (2009) 'Urban Poverty in India' BS Books

Revised syllabi (2019Pattern) for three years F.Y. B. Com. Degree course (CBCS)

Semester-I

Business Economics (Micro) - I

No. of Credits :- 03

Course Code - 113

Objectives of the course:-

1. To impart knowledge of business economics
2. To clarify micro economic concepts
3. To analyze and interpret charts and graphs
4. To understand basic theories, concepts of micro economics and their application

Unit No.	Unit Title	Contents	Purpose & skills to be developed
1	**Introduction and Basic Concepts**	1.1 Meaning, Nature, Scope and Importance of Business Economics 1.2 Concept of Micro and Macro Economics 1.3 Tools for Economic Analysis- Functional Relationship, Schedules, Graphs and Equations 1.4 Basic Concepts: Household, Consumer, Firm, Plant and Industry 1.5 Goals of Firms- Economic and Non-Economic	• To make the students aware of concepts in micro economics • To help the students understand the difference between micro and macro economics • To make the students understand economic and non-economic goals of firms. **Skills :** Analyze and think critically, develop writing skills
2	**Consumer Behavior**	Utility: Concept and Types 2.2 Cardinal Approach: Law of Diminishing Marginal Utility and Law of Equi Marginal Utility 2.3 Consumer Surplus: Concept and Measurement 2.4 Ordinal Approach: Indifference curve	• To help the students understand the concept of utility • To impart knowledge of cardinal and ordinal approach • To make them understand the concept of consumer surplus **Skills:** Understanding complex theories and concepts Geometrical skills, mathematical aptitude, writing skills

	1.2 Challenges to Indian Service sector- Business-based & Knowledge-based Sector, Education sector, Health sector, Insurance, Tourism, Banking	06
	1.3 Recent Trends in Indian Service Sector- Digital Economy, E-Commerce, E- Finance	04
Unit 2	**Banking Environment**	**18**
	2.1 Banking- Definition, Functions, Changing Structure of Banking in India- New Private Banks, Small Banks, Payment Banks	08
	2.2 Bank Accounts- Types, Procedure and Operation of Accounts	05
	2.3 Recent Trends in Indian Banking Environment- E-Banking, E- Wallets, Bank Mergers and Amalgamations	05
Unit 3	**Overview of Indian economy**	**18**
	3.1 Challenges of Indian Economy- Poverty, Employment, Inequality, Informal Sector	09
	3.2 Policy Measures (Two-Three recent Programmes)- Poverty Alleviation Programmes; Employment Generation Programmes; Agriculture Development Programmes, Skill Development Programmes	09

11) Recommended books

Semester I: Basic Reading List

- Agrawal A.N., Problems of Development & Planning, (Latest Edition)
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- Cherunilam Francis, 'Business Environment-Text and Cases' Himalaya Publishing House(Latest Edition)
- Faisal Ahmed 'Business Environment: Indian and Global Perspective' PHL Learning Pvt. Ltd. (Latest Edition)
- Fernando A.C. (2014) 'Business Environment' Pearson Education,
- Misra & Puri, 'Business Environment', Himalaya Publication House, Mumbai. (Latest Edition)
- Misra & Puri, 'Indian Economy', Himalaya Publication House, Mumbai. (Latest Edition)

Recommended Reading

- Asian Development Bank (2009) 'Urban Poverty in India' BS Books

Revised syllabi (2019Pattern) for three years F.Y. B. Com. Degree course (CBCS)

Semester-I

Business Economics (Micro) - I

No. of Credits :- 03

Course Code - 113

Objectives of the course:-

1. To impart knowledge of business economics
2. To clarify micro economic concepts
3. To analyze and interpret charts and graphs
4. To understand basic theories, concepts of micro economics and their application

Unit No.	Unit Title	Contents	Purpose & skills to be developed
1	**Introduction and Basic Concepts**	1.1 Meaning, Nature, Scope and Importance of Business Economics 1.2 Concept of Micro and Macro Economics 1.3 Tools for Economic Analysis- Functional Relationship, Schedules, Graphs and Equations 1.4 Basic Concepts: Household, Consumer, Firm, Plant and Industry 1.5 Goals of Firms- Economic and Non-Economic	• To make the students aware of concepts in micro economics • To help the students understand the difference between micro and macro economics • To make the students understand economic and non-economic goals of firms. **Skills :** Analyze and think critically, develop writing skills
2	**Consumer Behavior**	Utility: Concept and Types 2.2 Cardinal Approach: Law of Diminishing Marginal Utility and Law of Equi Marginal Utility 2.3 Consumer Surplus: Concept and Measurement 2.4 Ordinal Approach: Indifference curve	• To help the students understand the concept of utility • To impart knowledge of cardinal and ordinal approach • To make them understand the concept of consumer surplus **Skills:** Understanding complex theories and concepts Geometrical skills, mathematical aptitude, writing skills

Revised syllabi (2019 Pattern) for Three Years B. Com. Degree course (CBCS)

First Year B. Com
Semester-II Course Code - 123

Business Economics (Micro) - II

Objectives:

1. To understand the basic concepts of micro economics.
2. To understand the tools and theories of economics for solving the problem of decision making by consumers and producers.
3. To understand the problem of scarcity and choices.

Depth of the program – Fundamental Knowledge

Objectives of the Program

1. To impart knowledge of business economics
2. To clarify micro economic concepts
3. To analyze and interpret charts and graphs
4. To understand basic theories, concepts of micro economics and their application

Unit No.	Unit Title	Contents	Purpose skills to be developed
1	**Cost and Revenue**	1.1 Concepts and Types of Cost- Economic Cost and Accounting Cost, Private Cost and Social Cost, Actual Cost and Opportunity Cost, Explicit Cost and Implicit Cost, Incremental Cost and Sunk Cost, Fixed Cost and Variable Cost 1.2 Relation between Total Cost, Average Cost and Marginal Cost 1.3 Cost Curves in Short run and Long run 1.4 Concept of Total Revenue, Average Revenue and Marginal Revenue	• To understand the concept and types of cost • To make the students know about short run and long run cost concepts • To impart knowledge about types of revenue Skills: Interpretation of cost curves, integrate cost and revenue concepts, draw inferences

Savitribai Phule Pune University, Pune
For All faculties

2 credit Compulsory course for all the First Year students in All Faculties

Democracy, Election and Governance

Objectives:

1. To introduce the students meaning of democracy and the role of the governance
2. To help them understand the various approaches to the study of democracy and governance

Module 1 Democracy- Foundation and Dimensions

a. Constitution of India
b. Evolution of Democracy- Different Models
c. Dimensions of Democracy- Social, Economic, and Political

Module 2 Decentralization

a. Indian tradition of decentralization
b. History of panchayat Raj institution in the lost independence period
c. 73rd and 74th amendments
d. Challenges of caste, gender, class, democracy and ethnicity

Module 3 Governance

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

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२. व्होरा राजेंद्र., पळशीकर, सुहास.(२०१४). *भारतीय लोकशाही अर्थ आणि व्यवहार.* पुणे : डायमंड प्रकाशन.
३. सुमंत, यशवंत.(२०१८). *प्रा. यशवंत सुमंत यांची तीन भाषणे.* पुणे : युनिक अॅकॅडमी पब्लिकेशन्स प्रा.लि
४. भोळे. भा.ल. (२०१५). *भारतीय गणराज्याचे शासन आणि राजकारण.* नागपूर: पिंपळापुरे बुक प्रकाशन
५. कसबे. रावसाहेब. (२०१०)*डॉ. आंबेडकर आणि भारतीय राज्यघटना.* पुणे: सुगावा प्रकाशन

S.Y.B.A. Economics (Revised Syllabus)

Choice Based Credit System (CBCS)

G -2. Financial System

Preamble:

A financial system is a network of financial institutions, financial markets, financial instruments and financial services to facilitate the transfer of funds. It serves as a backbone of any economy. This paper aims to provide knowledge about the financial system in the country. It also aims to introduce international financial institutions operating in the global economy. The present era is the one with huge changes, development and challenges in every sector. This paper on financial system will also highlight some of the important changes taking place in the Indian financial sector.

Objectives (Course Outcomes) of the Paper:

- To understand fundamentals of modern financial system.
- To understand the recent trends and developments in banking system.
- To understand the role of the Reserve Bank of India in Indian financial system.
- To provide the knowledge of various financial and non-financial institutions.
- To provide the students the intricacies of Indian financial system for better financial decision making.

Method of Teaching:

Classroom lectures, Use of ICT, YouTube lectures, Online PPTs, Group Discussions, Teacher driven Power Point Presentations

Semester III

CC-1C - Financial System I

Unit	Name and Contents	Number of Lectures
1	**Indian Financial System**	12
1.1	Introduction: Meaning, Nature, Role and Importance of Indian Financial System.	
1.2	Structure of Indian Financial System.	
1.3	Characteristics and Functions of Components of Indian Financial System.	
2	**Banking in India**	10
2.1	Commercial Banks (Public Sector Banks, Private Sector Banks, Foreign Banks): Management, Organization and Functions.	
2.2	Regional Rural Banks and Co-operative Banks: Evolution, Management and Organization, Loan Management, Functions, Problems and Measures to solve the problem.	
3	**Financial Markets in India**	12
3.1	Classification of Financial Market.	
3.2	Indian Money Market: Features, Functions and Instruments.	
3.3	Indian Capital Market: Features, Functions and Instruments.	
3.4	Foreign Exchange Market: Role and Importance.	
4	**Important Financial Institutions**	14
4.1	Meaning and Importance of Financial Institutions.	
4.2	Stock Markets: NSE and BSE: Meaning & Functions.	
4.3	Non-Banking Financial Intermediaries: Meaning and Functions.	
4.4	Role and Functions of Financial Institutions in India with reference to UTI, LIC, GIC	

Semester IV

CC -1D - Financial System II

Unit	Name and Contents	Number of Lectures
1	**Reserve Bank of India**	12
1.1	Structure and Role of RBI in Indian Economy	
1.2	Major Functions of RBI.	
1.3	Monetary Policy: Tools and their Limitations.	
2	**Other Financial Regulators in India**	10
2.1	SEBI: Role and Functions.	
2.2	IRDA: Role and Functions.	
3	**International Financial Institution**	14
3.1	Role, Structure, Objectives and Functions of IMF.	
3.2	Role, Structure, Objectives and Functions of World Bank.	
3.3	Role, Structure, Objectives and Functions of Asian Development Bank.	
3.4	Role, Structure, Objectives and Functions of BRICS Bank.	
4	**Recent Developments in Indian Financial Sector**	12
4.1	Objectives and Outcomes of Changing Landscape of Banking Sector in India.	
4.2	Insolvency and Bankruptcy Code.	
4.3	Alternate Source of Finance.	
4.4	Risk Management in Banking Sector.	

Basic Reading List:

1. The Indian Financial System, Markets, Institutions and Services, Bharati V.Pathak, Kindle Edition.
2. Indian Financial System, Jaydeb Sarkhel, Seikh Salim, McGraw-Hill India Pvt. Ltd. Chennai, 2018.
3. Indian Banking, R. Parmehwaram & S. Natrajan , S. Chand Publishing, Delhi.

S.Y.B.A. Economics (Revised Syllabus)
Choice Based Credit System (CBCS)

S -1. Micro Economics

Preamble

As a foundation course, in this Paper, student is expected to understand the definition, nature and scope of economics, method and approaches to the study of Economics. The chapters incorporated in this Paper deal with the theory of consumer's behavior, theory of demand and supply, analysis of production function, cost and revenue analysis, market structures and the equilibrium of a firm and industry. In addition, the principles of factor pricing and commodity pricing and welfare economics have been included.

Objectives of the Paper:

- To develop an understanding about subject matter of Economics.
- To impart knowledge of microeconomics.
- To clarify micro economic concepts
- To analyze and interpret charts, graphs and figures
- To develop an understanding of basic theories of micro economics and their application.
- To demonstrate that the theories discussed in class will usually be applied to real-life situations.
- To help the students to prepare for varied competitive examinations

Method of Teaching:

Classroom lectures, Use of ICT, YouTube lectures, Online PPTs, Group Discussions, Teacher driven Power Point Presentations

Semester III
DSE – 1A - Micro Economics I

Unit	Name and Contents	Number of Lectures
Unit 1	**Introduction**	10
1.1	Meaning, Nature, Scope, Importance of Micro economics	
1.2	Basic Economic Problems	
1.3	Tools of economic analysis- Functional Relationship, Schedules, Graphs and Equations.	
1.4	Variables- Dependent and Independent Variable, Endogenous and Exogenous	
Unit 2	**Theory of Consumer Behavior**	14
2.1	Utility – Meaning and Types Cardinal Approach: Law of Diminishing Marginal Utility, Law of Equi-Marginal Utility, Consumer's Equilibrium	
2.2	Ordinal Approach: Indifference Curve Analysis- Meaning and Definition, Characteristics of Indifference Curve, Consumer's Equilibrium	
Unit 3	**Theory of Demand**	12
3.1	Meaning of Demand, Determinants of Demand	
3.2	The Law of Demand & Its Exceptions, Market Demand	
3.3	Elasticity of Demand –Meaning and Types 3.3.1 Price Elasticity of Demand: Meaning, Types, Methods of Measurement 3.3.2 Income Elasticity of Demand: Meaning and Types 3.3.3 Cross Elasticity of Demand: Meaning and Types	
Unit 4	**Supply and Production Analysis**	12
4.1	Meaning, Definition and Determinants of Supply	
4.2	The Law of Supply	
4.3	Elasticity of Supply: Meaning and Types	
4.4	The Production Function: Meaning and Definition	
4.5	Total, Average and Marginal Production	
4.6	The Law of Variable Proportions	
4.7	The Law of Returns to Scale	

Semester IV
DSE – 1B - Micro Economics II

Unit 1	**Cost and Revenue Analysis**	8
1.1	Cost Concepts : Fixed Costs, Variable Costs, Total Cost, Average Cost, Marginal Cost, Economic Cost and Accounting Cost, Opportunity Cost	
1.2	Short-Run and Long Run Costs curves	
1.3	Revenue Concept: Total Revenue, Average Revenue & Marginal Revenue	16
Unit 2	**Market Structure**	
2.1	Meaning & Classifications of Market Structure	
2.2	Perfect Competition: Meaning, Characteristics, Equilibrium of Firm and Industry in Short Run and Long Run	
2.3	Monopoly: Meaning, Characteristics, Short and Long Run Equilibrium. Price Discrimination	
2.4	Monopolistic Competition: Meaning, Characteristics, Short & Long Run Equilibrium of firm and Industry, Selling cost- Meaning	
2.5	Oligopoly: Meaning and Characteristics	16
2.6	Duopoly: Meaning and Characteristics	
Unit 3	**Factor Pricing**	
3.1	Marginal Productivity Theory Of Distribution	
3.2	Rent: Ricardian Theory of Rent, Modern Theory of Rent, Quasi Rent	
3.3	Wages: Modern Theory of Wages, Supply Curve of Labour	
3.4	Interest: Keynesian Liquidity Preference Theory, Loanable Fund Theory	
3.5	Profit: Risk and Uncertainty Theory, Innovation Theory	08
Unit 4	**Introduction to Welfare Economics**	
4.1	Welfare Economics: Definition and Meaning	
4.2	Pigovian Welfare Economics	
4.3	Thought of Amartya Sen on Welfare Economics	

S.Y.B.A. Economics (Revised Syllabus)
Choice Based Credit System (CBCS)
S -2. Macro Economics

Preamble -

Macroeconomics is the branch of economics that deals with the functioning of an economy as a whole. Macroeconomic analysis involves theoretical, empirical as well as policy-related aspects. The theoretical aspect of macroeconomics involves the conceptual as well as theoretical framework of macroeconomics. It deals with various macroeconomic concepts as well as various macroeconomic theories. The theoretical framework of macroeconomics focuses on functioning of an economy in its totality, determination of the level of national income and employment in an economy, role of aggregate demand as well as aggregate supply, role of money, determination of value of money, determination of general price level as well as rate of inflation and business cycles. The empirical aspect of macroeconomics applies macroeconomic theories to the study of real economies and tests the validity of macroeconomic theories. The policy-related aspect focuses on the role of fiscal and monetary policy in achieving macroeconomic objectives with the help of various policy instruments.

This curriculum integrates conceptual, theoretical, empirical and policy-related aspects of macroeconomics. This curriculum introduces the undergraduate students to the field of macroeconomics and enables them to learn the functioning of the economy in a systematic manner.

Objectives –

- To introduce students to the historical background of the emergence of macroeconomics
- To familiarize students with the differences between microeconomics and macroeconomics
- To familiarize students with various concepts of national income
- To familiarize students with keynesian macroeconomic theoretical framework of consumption and investment functions
- To introduce students to the role of money in an economy.
- To introduce students to the conceptual and theoretical frameworks of inflation, deflation and stagflation, Business Cycle .

- To familiarize students with the conceptual and theoretical framework of business cycles
- To introduce students to the role of monetary and fiscal policies in fulfilling the macroeconomic objectives of stability, full employment and growth.
- To introduce students to the various instruments of monetary and fiscal policies

Method of Teaching:

- Classroom lectures, Use of ICT, You Tube lectures, Online PPTs, Group Discussions, Teacher driven Power Point Presentations

Semester III

DSE – 2A - Macro Economics I

Unit	Name and Contents of the Chapter	Number of Lectures
Unit 1	**Introduction**	12
1.1	Meaning, Nature and Scope of Macro Economics	
1.2	Importance and Limitations of Macro Economics	
1.3	The difference between Micro Economics and Macro Economics	
Unit 2	**National Income**	12
2.1	Meaning and Importance of National Income	
2.2	Various Concepts of National Income – GDP, GNP, NNP, PCI, Personal Income, Disposable Income	
2.3	Methods of National Income Measurement Difficulties in the Measurement of National Income	
2.4	Circular Flow of National Income	
Unit 3	**Theory of Employment and Output**	12
3.1	Classical Theory of Employment , Say's Law of Market.	
3.2	Keynes' Criticism on Classical Theory	
3.3	Keynesian Theory of Employment – Aggregate Supply Price and Aggregate Demand Price, Employment Determination	
Unit 4	**Consumption and Investment**	12
4.1	Consumption Function – Meaning, Various Concepts - APC, MPC, Psychological Law of Consumption, Factors Influencing Consumption Function	
4.2	Saving - APS, MPS. Investment – Meaning, Types, Marginal Efficiency of Capital	
4.3	The Concept of Multiplier; The Principle of Accelcration	

Semester IV

DSE – 2B - Macro Economics II

Unit 1	**Money**	12
1.1	Money – Meaning and Functions	
1.2	Value of Money – Meaning, Quantity Theory of Money, Cash Balance Approach	
1.3	Supply of Money – Various Measures of RBI	
Unit 2	**Inflation**	12
2.1	Inflation – Meaning, Types, Causes – Demand Pull and Cost Push Inflation, Effects	
2.2	Measures to Control Inflation	
2.3	Deflation – Meaning, Causes and Effects	
2.4	Philips Curve, Stagflation – Meaning	
Unit 3	**Business Cycles**	12
3.1	Meaning, Features and Phases of Business Cycle	
3.2	Causes and Effects of Business Cycle	
3.3	Keynes' Theory of Business Cycle	
3.4	Control of Business Cycles – Monetary and Fiscal Controls	

Unit 4	Macroeconomic Policies	12
4.1	Objectives of Macroeconomic Policies	
4.2	Monetary Policy - Meaning, Instruments, Advantages and Limitations	
4.3	Fiscal Policy - Meaning, Instruments, Advantages and Limitations	

Basic Reading List –

1 David Colander, Macro Economics, McGraw Hill Education Private Limited (Latest Edition)

2. D. N. Dwivedi, Macro Economics: Theory and Policy, McGraw Hill Education Private Limited (Latest Edition)

3. H. L. Ahuja, Macro Economics: Theory and Policy, S. Chand & Company Limited. (Latest Edition)

4. M. L. Jhingan, Macro Economic Theory, Vrinda Publications Private Limited (Latest Edition)

5. Wavare Anil Kumar & V.Kumbhar ,(2019)Macro Economics,Ruby Publisher, Kolhapur, MS, India.

6. N. Gregory Mankiw, Principles of Macroeconomics, Cengage Learning (Latest Edition)

7. Olivier Blanchard & David Johnson, Macroeconomics, Pearson (Latest Edition)

8. Rudiger Dornbusch, Stanley Fischer & Richard Startz, Macroeconomics, Tata McGraw Hill Education Private Limited (Latest Edition)

9. Sampat Mukherjee, Macroeconomics: A Global Text, New Central Book Agency Private Limited (Latest Edition)

10. Stephen Williamson, Macroeconomics, Pearson (Latest Edition)

11. Kute Santosh & Rithe M. , Macro Economics, Prashant Publication,Jalgaon,MS,India

12. श्रीधर देशपांडे आणि विनायक देशपांडे, समष्टी अर्थशास्त्रीय विश्लेषण, हिमालय पब्लिशिंग हाउस(Latest Edition)

Advanced Reading List

1. Ben Fine & Ourania Dimakou, Macroeconomics: A Critical Companion, Pluto Press (Latest Edition)

2. Brian Snowdon & Howard Vane (2003), The Development of Modern Macroeconomics: A Rough Guide, in Macroeconomics: A Reader, (Ed.) Brian Snowdon and Howard Vane, Routledge

Savitribai Phule Pune University
Skill Enhancement Course (SEC):

SYBA (Economics)

Basic Concept of Research Methodology

Credits: 02 Periods: 45 Marks: 50

Course outline:

The course will be given in the form of lectures and practical work .Lectures will focus on research, especially with regard to sampling methods, data collection and data preparation. The course will focus on the practical implementation of diverse sample techniques. Students are expected to collect and classify the data.

Aims and objectives of course:

- To develop the understanding of the basic concept of research.
- To develop the understanding of the basic framework of sampling and data collection..
- To develop the understanding of various sampling methods and techniques.
- To identify various sources of information for data collection.
- To develop the understanding of the conducting survey on various issues.

Learning outcomes of course :

On completion of the course, the student shall be able to

- Demonstrate his/her understanding of sampling methods and the ability to use collection of data
- Identify the appropriate sample techniques for different kinds of research questions
- Identify the appropriate source of data in relation to the collection of research data.
- Able to classify and present the collected data in the form of graph, bar diagram, chart etc

T.Y.B.A. Economics
General Paper-III: Indian Economic Development-I
(Course Code:)
Semester V

Preamble:

The course will be useful for learners aiming towards careers in the government sector, policy analysis and the social sector. This course would take an overview of aspects of economic development with special reference to India.

The course aims to introduce the learner to the main concepts in economic and human development, equip them compare and contrast different economies: recognize various indicators of economic and human development. The course will also provide a broad outline of the Sustainable Development Goals.

Course Learning Outcomes

At the end of the course the learner will have ability -

- To relate and recognize the concept and indicators of Economic Development.
- To describe and analyze the concept and indicators of Human Development.
- To explain the characteristics of Developing and Developed Countries.
- To describe the constraints to the process of Economic Development.

Unit No.	Name and Sub Titles of the Topic	No. of Lectures
1	**Economic Development and Growth**	10
	1.1 Economic Development: Meaning, Definition and Indicators	
	1.2 Economic Growth: Meaning, Definition and Indicators	
	1.3 Need and Importance of Economic Development	
2	**Developed and Developing Countries**	14
	2.1 Concepts of Developed and Developing Countries	
	2.2 Characteristics of Developed Countries	
	2.3 Characteristics of Developing Countries : Economic, Demographic, Technological, Social and Political	
	2.4 India as an Emerging Economy	
3	**Constraints to Development Process**	12
	3.1 Vicious Circle of Poverty	
	3.2 Capital Constraints	
	3.3 Technology Constraints	
	3.4 Socio- Cultural Constraints	
	3.5 Political and Administrative Constraints	
	3.6 External Bottlenecks	
4	**Human Resources and Economic Development**	12
	4.1 Role of Human Resources in Economic Development	
	4.2 Human Development Index and India	
	4.3 Concepts of Physical Quality of Life Index:	
	4.3.1 Gender Development Index	
	4.3.2 Gender Inequality Index	
	4.3.3 Multidimensional Poverty Index	

T.Y.B.A. Economics
General Paper- III: Indian Economic Development-II
(Course Code:)

Semester VI

Preamble:

This course would take an overview of the process of Economic Planning and the Development Goals. The course aims to introduce the learner to the main concepts in Economic Planning, equip them with understanding of the planning process in India and changing in recent times and familiarize them to the Sustainable Development Goals. The Course also reviews the relation between Economic Development and Environment.

Course Learning Outcomes

At the end of the course the learner will have ability-

- To describe and explain the process of Economic Planning.
- To describe and examine the changing structure of planning process in India.
- To describe and explain the relation between Economic Development and Environment.

Unit No.	Name and Sub Titles of the Topic	No. of Lectures
1	**Economic Planning** **1.1** Economic Planning – Meaning, Definition and Features **1.2** Need of Economic Planning **1.3** Objectives of Economic Planning in India	12
2	**National Institution for Transforming India Aayog (NITI Aayog)** **2.1** NITI Aayog- Objectives and Structure **2.2** Role of NITI Aayog **2.3** Difference between Planning Commission and NITI Aayog	12
3	**Sustainable Development** **3.1** Sustainable Development : Meaning and Importance **3.2** 17 SDGs (Sustainable Development Goals) **3.3** Measures for Sustainable Development **3.4** Current Scenario of SDG in India	12
4	**Environment and Economic Development** **4.1** Relation between Environment and Economic Development **4.2** Environment and Sustainable Development **4.3** Environmental Policies in India: **4.3.1** National Conservation Strategy (1992) - Highlights **4.3.2** National Environmental Policy (2006) - Highlights **4.4** Global Warming	12

T.Y.B.A. Economics
Special Paper - III: International Economics-I
(Course Code:)

Semester - V

Preamble:

This course provides the students a thorough understanding and deep knowledge about the concept of international economics and international trade. The contents of the paper spread over various modules, lay stress both on theory and applied nature of the subject. Besides this, the contents prepare the students to know the important theories of international trade. The paper also covers the meaning, types, importance of terms of trade and causes of unfavorable terms of trade to developing countries like India.

Course Learning Outcomes

At the end of the course the learner will have Ability

- To relate and recall the concepts of International Economics and International Trade.
- To describe and apply the theories of international trade.
- To explain and comprehend the issues relating to Terms of trade and Balance of Payment.

Unit No.	Name and Sub Titles of the Topic	No. of Lectures
1	**Introduction** **1.1** International Economics- Meaning, Scope and Importance **1.2** Inter-regional and International Trade **1.3** Importance of International Trade	12
2	**Theories of International Trade** **2.1** Theory of Absolute Cost Advantage and Theory of Comparative Cost Advantage **2.2** Heckscher-Ohlin Theory **2.3** Leontief's Paradox **2.4** Intra-Industry Trade	12
3	**Terms of Trade** **3.1** Meaning, Types and Importance of Terms of trade **3.2** Determinants of Terms of trade **3.3** Causes of Unfavorable Terms of trade to Developing Countries	12
4	**Balance of Payments** **4.1** Balance of trade and Balance of payments- Concepts **4.2** Balance of payments - Components **4.3** Disequilibrium of Balance of Payments, Causes and Consequences **4.4** Measures to correct Disequilibrium in the Balance of Payments	12

T.Y.B.A. Economics
Special Paper – IV: Public Finance -II
(Course Code:)
Semester – VI

Objectives:

1. To make students able to analyze Budget process of India.
2. To make the students aware about Role and working of Finance Commission.
3. To make students competent to become success in competitive examination.

Course Learning Outcomes

At the end of the course the learner will have ability

- To explain and assess the components and instruments of Fiscal Policy.
- To relate to the concepts of Budget and its components.
- To describe and analyze the concept of Deficit Financing and its effects.
- To describe and explain the Centre and State Financial Relationship.

Unit No.	Name and Sub Titles of the Topic	No. of Lectures
1	**Fiscal Policy** 1.1 Fiscal Policy- Meaning, Instruments and Objectives 1.2 Fiscal Policy in Developing Countries 1.3 Limitations of Fiscal Policy 1.4 Review of Fiscal Policy in India Since 2011	12
2	**Budget** 2.1 Budget- Meaning, Nature and Objectives 2.2 Classification of Budget 2.3 Preparation of Indian Central Budget 2.4 Gender Budget- Meaning and Importance.	12
3	**Deficit Financing** 3.1 Deficit Financing- Meaning and Objectives 3.2 Role of Deficit Financing in Developing Countries 3.3 Trends in India's Deficit Financing Since 2011 3.4 Effects of Deficit Financing	12
4	**Centre-State Financial Relationship** 4.1 Centre-State Financial Relationship: Constitutional Provisions 4.2 Conflict in the Centre-State Financial Relationship 4.3 Role of the Finance Commission 4.4 Recommendations of 15th Finance Commission	12

Recommended Books

1. Andley and Sundaram- Theory and Practice of Public Finance.
2. Bhatia H.L "Public Finance " Vikas Publishing House, 18th edition
3. Jayaram Hiregange, Deepak Rao (2017), India GST for Beginners, White Falcon Pub.

T.Y.B.A. Economics
Skill Enhancement Course
Business Management

Semester	CC Paper	Paper No.	Name of Paper	Lectures / Week	Total Lect.	CA Marks	ESE Marks	Total	No. of Credits
V	SEC -III SEC-3A		Business Management- I	03	30	15	35	50	2
VI	SEC -IV SEC-3A		Business Management - II Project	03	30	15	35	50	2

SEC -Skill Enhancement Course; CC -Core Course; CA - Continuous Assessment;
ESE -End of Semester Examination

T.Y.B.A. Economics
Skill Enhancement Course
SEC 3A: Business Management-I
(Course Code:)
Semester – V

Course Learning Outcomes:

At the end of the Course, the Learner will have the following skills:

- Management of Business.
- Business planning and decision making
- Leadership Skills- Ability to work in teams at the same time, ability to show leadership qualities

Unit No.	Name and Sub Titles of the Topic	No. of Lectures	Skill Enhancement Exercises
1	**Business Management** **1.1** Nature and Scope of Management **1.2** Characteristics of Management **1.3** Need & Importance of Study of Management **1.4** Process of Management	6	• Discussion/ Practical/ Field Study
2	**Business Planning and Decision Making** **2.1** Nature of Planning **2.2** Steps in Planning Process **2.3** Types of Business Planning **2.4** Study of Planning Process **2.5** Steps in Decisions Making Process **2.6** Factors affecting decision Making	6	• Case Studies / Mini Projects / Individual /Team Presentations. • Practical Exercises in Decision Making Process/ Problem Solving

T.Y.B.A. Economics
Special Paper – IV: Public Finance -II
(Course Code:)
Semester – VI

Objectives:

1. To make students able to analyze Budget process of India.
2. To make the students aware about Role and working of Finance Commission.
3. To make students competent to become success in competitive examination.

Course Learning Outcomes

At the end of the course the learner will have ability

- To explain and assess the components and instruments of Fiscal Policy.
- To relate to the concepts of Budget and its components.
- To describe and analyze the concept of Deficit Financing and its effects.
- To describe and explain the Centre and State Financial Relationship.

Unit No.	Name and Sub Titles of the Topic	No. of Lectures
1	**Fiscal Policy** 1.1 Fiscal Policy- Meaning, Instruments and Objectives 1.2 Fiscal Policy in Developing Countries 1.3 Limitations of Fiscal Policy 1.4 Review of Fiscal Policy in India Since 2011	12
2	**Budget** 2.1 Budget- Meaning, Nature and Objectives 2.2 Classification of Budget 2.3 Preparation of Indian Central Budget 2.4 Gender Budget- Meaning and Importance.	12
3	**Deficit Financing** 3.1 Deficit Financing- Meaning and Objectives 3.2 Role of Deficit Financing in Developing Countries 3.3 Trends in India's Deficit Financing Since 2011 3.4 Effects of Deficit Financing	12
4	**Centre-State Financial Relationship** 4.1 Centre-State Financial Relationship: Constitutional Provisions 4.2 Conflict in the Centre-State Financial Relationship 4.3 Role of the Finance Commission 4.4 Recommendations of 15th Finance Commission	12

Recommended Books

1. Andley and Sundaram- Theory and Practice of Public Finance.
2. Bhatia H.L "Public Finance " Vikas Publishing House, 18th edition
3. Jayaram Hiregange, Deepak Rao (2017), India GST for Beginners, White Falcon Pub.

T.Y.B.A. Economics
Skill Enhancement Course
Business Management

Semester	CC Paper	Paper No.	Name of Paper	Lectures / Week	Total Lect.	CA Marks	ESE Marks	Total	No. of Credits
V	SEC -III SEC-3A		Business Management- I	03	30	15	35	50	2
VI	SEC -IV SEC-3A		Business Management - II Project	03	30	15	35	50	2

SEC -Skill Enhancement Course; CC -Core Course; CA - Continuous Assessment;
ESE -End of Semester Examination

T.Y.B.A. Economics
Skill Enhancement Course
SEC 3A: Business Management-I
(Course Code:)
Semester – V

Course Learning Outcomes:

At the end of the Course, the Learner will have the following skills:

- Management of Business.
- Business planning and decision making
- Leadership Skills- Ability to work in teams at the same time, ability to show leadership qualities

Unit No.	Name and Sub Titles of the Topic	No. of Lectures	Skill Enhancement Exercises
1	**Business Management** **1.1** Nature and Scope of Management **1.2** Characteristics of Management **1.3** Need & Importance of Study of Management **1.4** Process of Management	6	• Discussion/ Practical/ Field Study
2	**Business Planning and Decision Making** **2.1** Nature of Planning **2.2** Steps in Planning Process **2.3** Types of Business Planning **2.4** Study of Planning Process **2.5** Steps in Decisions Making Process **2.6** Factors affecting decision Making	6	• Case Studies / Mini Projects / Individual /Team Presentations. • Practical Exercises in Decision Making Process/ Problem Solving

CORE COURSE-SEMESTER II
EC-1001 MICRO-ECONOMIC ANALYSIS–II
(This course will have *FOUR* credits)

PREAMBLE

The course makes an attempt to provide an introduction to the advanced theories in Microeconomics and at the same time provide an understanding of the analytical rigour of the subject. Micro Economics is a core course that covers Market Structure, Equilibrium, Competition, Price Determination, Price Discrimination, Price Leadership as well as Game Theory. Microeconomics brings to the fore the practical significance of microeconomic theories

Course Objectives:

- To provide a thorough understanding of the principles of economics
- To enable students to apply micro economic concepts in various contexts.
- To enable understanding the basic theories in microeconomics such as demand theory, production theory, market structures.
- To discuss the modern developments in micro economics such as Game Theory.

Programme Outcome:

- Ability to apply the concepts of micro economics such as demand, supply, revenue, cost, elasticity, etc.
- Ability to compare and contrast various market structures and understand concept of equilibrium, price determination
- At the end of the course, the student should be able to evaluate microeconomic concepts, models and its use in real life situations.

1. Market Structures

1.1 Perfect Competition - Short Run and Long Run Equilibrium **(6 Lectures)**
1.2 Equilibrium of a Firm and Industry

2. Monopoly

2.1 Short Run & Long Run Equilibrium of a Firm under Monopoly **(12 Lectures)**
2.2 Price Discrimination under Monopoly, Degrees of Price Discrimination.
2.3 Comparison of Monopoly and Perfectly Competitive Market outcomes.
2.4 Regulation of Monopoly Power.

3. Monopolistic Competition

3.1 Monopolistic Competition, Price and Non-price competition, Equilibrium. **(10 Lectures)**
3.2 Product Differentiation, Selling Costs and Excess Capacity.

4. Oligopoly

4.1 Oligopoly, Basic market structure, Kinky Demand Curve, Price and Output **(10 Lectures)**

CORE COURSE-SEMESTER I
EC-1002 PUBLIC ECONOMICS I
(This course will have *FOUR* credits)

PREAMBLE

There has been a considerable change in the role of the government in modern times. Traditionally, Public Finance was applied to the policies and operation of revenue, expenditure and debt, while the applications have extended to resource utilization, distribution, equality, stabilization, etc. An understanding is provided on how political processes are instrumental in the fiscal policy processes and decision-making, supported by theoretical concepts and practical applications.

Course Objectives:

- To develop an understanding of the changing role of the government and the fiscal functions of the modern governments.
- To discuss and deliberate on the concepts and theories in public economies like public policy, principles of taxation, theories of public expenditure, etc.
- To develop an understanding of various policies in public economics like fiscal policy, taxation policy, public debt policy, public expenditure policy etc.

Programme Outcome:

- Ability to recognize, apply and analyze concepts and theories in public economics.
- Ability to appraise and assess the theory of public economics in real life situations.

1. Introduction **(10 Lectures)**

1.1 Changing Role of Government – Fiscal Functions of Modern Governments - The Allocation Function, The Distribution Function, The Stabilization Function, (Case Study: The Great Depression- From Police to Welfare State)
1.2 Private Goods, Public Goods, Social Goods, Merit Goods, Club Goods

2. Rationale for Public Policy **(14 Lectures)**

2.1 Allocation of Resources- Provision of Public Goods.
2.2 Voluntary Exchange Models- Lindahl, Johansen and Samuelson
2.3 Impossibility of Decentralized Provision of Public Goods
2.4 Contributions of Paul Samuelson, Robert Musgrave, Hugh Dalton- Demand Revealing Schemes for Public goods
2.5 The Clarke Tax, The Tiebout Hypothesis **(12 Lectures)**

3. Taxation

3.1 Principles of Taxation- Benefit and Ability to Pay Approaches
3.2 Theory of Incidence; Alternative concepts of Incidence
3.3 Allocative and equity aspects of Individual Taxes;
3.4 Theory of Optimal Taxation; Excess Burden of Taxes;

CORE COURSE SEMESTER II
EC-2002 PUBLIC ECONOMICS II
(This course will have *FOUR* credits)

PREAMBLE

There is considerable change in the public economics in modern economies. Public Finance was applied to the policies and operation of public debt, budgets, deficits as well as fiscal federalism, with understanding of the fiscal policy in the management and responsibility context. An understanding is provided on the reforms and change in government finances, supported by theoretical concepts and practical applications.

Course Objectives:

- To develop an understanding of various policies in public economics like fiscal policy, public debt policy, fiscal finances, etc.
- To help the students to understand the normative policies and compare it with the policies framed and followed by Indian economy.
- To impart information to the students about the reforms like taxation reforms in India.

Programme Outcome:

- Ability to understand, apply and analyze concepts-public debt, budget, fiscal policy in public economics.
- Ability to interpret the theories relating to public economics in real life situations.
- Ability to discuss and debate on the public finance and policies w.r.t. India

1. Public Finance in India **(12 Lectures)**

1.1 Indian Tax System- Tax and Non-tax Revenue
1.2 Taxes in India - Direct and Indirect Taxes
1.3 Reforms in Direct and Indirect Taxes, Introduction of GST
1.4 Budget- Meaning and Components, Economic Classification of Budget, Balanced Budget Multiplier, Gender Budget- Concept, Objectives & Purpose
1.5 Budget Deficits and Their Implications.

2. Public Debt **(12 Lectures)**

2.1 Sources of Public Debt w.r.t India;
2.2 Burden of Public Debt on Indian Economy
2.3 Deficit financing, Public Borrowings and Level of Prices
2.4 Principles of Debt Management and Repayment

3. Fiscal Policy **(10 Lectures)**

3.1 Objectives of Fiscal Policy in Countries like India, Interdependence between Fiscal and Monetary Policies

CORE COURSE-SEMESTER I
EC 1003- INTERNATIONAL TRADE
(This course will have *FOUR* credits)

PREAMBLE

International Economics is subject that is ever dynamic and relevant in the current context. International Economics provides a framework on international trade and finance in the theoretical context, along with economic analysis as well as practical applications. The subject discusses Free Trade, Barriers to Trade, Trade Agreements and Trade Organizations. Various issues are discussed and analyzed arising out of international trade and finance.

Course Objectives:

- To develop an understanding of the theoretical concept in international trade.
- To analyze international economics with reference to terms of trade, trade policy, trade agreements etc.
- To provide knowledge to students regarding recent developments and changes in international banking, international banking agreements etc.
- To make the students understand role of international economic organization and global crisis development.

Programme Outcome:

- Ability to understand the concepts of international economics such as comparative cost, terms of trade, trade policies and trade agreements
- Ability to interpret and apply theory relating to understand international trade
- Ability to discuss and debate the effects of trade policy, trade agreements, exchange rate policies on the world economy/trade

1. Overview of Classical and Modern Trade Theories **(20 lectures)**

1.1 The Theory of Comparative Cost- David Ricardo
1.2 The Heckscher-Ohlin Theorem- The Opportunity Cost Approach
1.3 Verification of Physical Criterion and Price Criterion,
1.4 Leontief Paradox – Factor Price Equalization [Edgeworth Box Diagram]
1.5 New Theories of Trade, Product Life Cycle and Technology Gap Models,
1.6 Preference Similarity and Intra-Industry Trade,
1.7 Economies of Scale and Monopolistic Competition
1.8 Krugman- Theory of Economic Geography
1.9 Neo-Heckscher Ohlin Theorem

2. Terms of Trade **(4 lectures)**

2.1 Concepts of Terms of Trade, Factors affecting Terms of Trade
2.2 Gross & Net Barter Terms of Trade
2.3 Terms of Trade and Economic Development

CORE COURSE SEMESTER II
EC - 2003- INTERNATIONAL FINANCE
(This course will have *FOUR* credits)

PREAMBLE

International Economics is subject that is relevant in the current context. International Finance provides an understanding of the various aspects of International Finance in the analytical context along with a theoretical background. The subject discusses Balance of Payments, Foreign Exchange, Risk, Currency Management as well as International capital flows. Various topics are discussed and analyzed that relate to international finance, banking and markets.

Course Objectives:

- To develop an understanding of the theoretical concept in international finance- Balance of Payments, exchange rate policies, capital flows, etc.
- To compare and contrast the scenarios on international trade in India vis-à-vis the world economy.
- To provide knowledge to students regarding recent developments and changes in international banking, international banking agreements etc.
- To make the students understand role of international economic organization and global crisis development.

Programme Outcome:

- Ability to understand and interpret the concepts such as Balance of Payments, Exchange Rates, Foreign Exchange transactions, International capital flows, etc.
- Ability to critically analyze the effects of deficits, exchange risk, role of foreign capital on the world economy/trade
- Ability to discuss and debate on subjects related to international trade and finance w.r.t the Indian Economy

1. Balance of Payment

1.1 Balance of Trade- Concept, Structure & Components **(10 Lectures)**
1.2 Balance of Payments- Concept, Disequilibrium, Causes of Disequilibrium;
1.3 Correction of Disequilibrium-Automatic Correction, Deliberate Correction,
1.4 Foreign Trade Multiplier- Meaning, Working, Implications & Limitations
1.5 Policies for Internal and External Balance-Fiscal and Monetary Policy Under Fixed and Floating Exchange Rates
1.6 Devaluation of Indian Rupee- Effect on Balance of Payment in 1991.

2. Foreign Exchange

2.1 Components of Foreign Exchange Market- Transfer of Purchasing Power, Provision of Credit, Provision of Hedging Facilities **(12 lectures)**

ELECTIVE COURSE-SEMESTER I
EC.1004-AGRICULTURAL ECONOMICS
(This course will have *FOUR* credits)

PREAMBLE

Agricultural Economics is an applied field in economics; the subject provides an understanding of the production and distribution of food. Agricultural Economics provides an understanding of the various aspects of agriculture- productivity, labour, credit, markets for farm products, with appropriate economic analysis. The subject discusses agrarian structures w.r.t. growth, employment, efficiency and prices as well as incomes. It is important to analyze the challenges to agriculture in the context of emerging economies.

Course Objectives:

- To develop an understanding of agricultural economics in the theoretical as well as practical context.
- To discuss and debate the various issues and challenges faced by agrarian economies w.r.t. production, productivity, efficiency, employment, etc.

Programme Outcome:

- Ability to analyze and evaluate the subject with reference to various aspects of agrarian economies.
- Ability to develop an understanding of agriculture with its intricacies and imperfections and to be able to construct intellectual dialogue on the challenges of agriculture.

(8 Lectures)

1. Introduction

1.1 Role of Agriculture in Indian Economy
1.2 Agrarian Structure in India in a Liberalizing and Globalizing Economy,
1.3 Barriers to Agricultural Growth in India
1.4 Need for Policy Intervention – Productivity, Equity and Sustainability **(10 Lectures)**

2. Agriculture Productivity and Agricultural Labour

2.1 Trends in Agricultural Productivity in India since 1991
2.2 Challenges to Agricultural Productivity– Crop Insurance, Irrigation, Exports
2.3 Agricultural Labour- Trends in Agricultural Employment and Efficiency
2.3 Technology Inputs in Agriculture and Impact on Agriculture Labour
2.4 Review of the National Employment Guarantee Scheme **(10 Lectures)**

3. Agriculture and Credit

3.1 Financial Sector Reforms and Rural Credit
3.2 Role of NABARD, Commercial Banks and Cooperative Institutions
3.4 Micro Finance in Rural Finance – Emergence, Role and Challenges
3.5 Challenges to Rural and Agricultural Credit in India

ELECTIVE COURSE-SEMESTER II
EC- 2004 LABOUR ECONOMICS
(This course will have *FOUR* credits)

PREAMBLE

Labour Economics is a specialized area in economics; the subject covers the study of labour, the industrial structure and industrial relations. Labour Economics provides an understanding of the various aspects of labour markets on structure, division of labour, employment and wage determination with a relevant theoretical background. The subject discusses labour markets, wages and wage determination, labour dynamics and industrial relations. Various contemporary topics are discussed and analyzed such as migration, absenteeism, wage differentials and social security under labour economies.

Course Objectives:

- To develop an understanding of labour economics in the theoretical as well as practical context.
- To discuss and debate the various issues and challenges faced by labour with reference to division of labour, employment, wage determination, etc.
- To demonstrate on the various aspects of labour dynamics and labour relations w.r.t. India

Programme Outcome:

- Ability to analyze and evaluate the subject with reference to various aspects of Labour economics.
- Ability to develop an understanding of the labour with its intricacies and imperfections and to be able to construct intellectual dialogue on the challenges of labour w.r.t. the Indian Economy.

1 Introduction **(8 Lectures)**

1.1 Concept of Labour Force, Determinants of Labour Force Participation
1.2 Historical Emergence and Relevance of Labour Economics
1.3 Indian Labour Market- Changing Structure and Impact of Globalization
1.4 Unemployment in India and Policies for Employment Generation

2 Labour Markets and Wage Determination **(12 Lectures)**

2.1 Labour Markets- Rural & Urban, Formal and Informal, Organized and Unorganized, Contract Labour
2.2 Growth and Trends in Labour Market,- New Legislation, Unionization, Labour Dynamics, Labour Market Flexibility
2.3 Theories of Wages- Marginal Productivity Theory, Theory of Collective Bargaining, Modern Theory of Wages- Demand and Supply Theory
2.4 Wage Structure, Minimum Wage, Fair Wage, Wage Differentials- Inequality, Inter-sectoral Differences, Gender Differences

CORE COURSE
SEMESTER III
EC-3001
MACRO ECONOMICS ANALYSIS - I
(This course will have *FOUR* credits)

PREAMBLE

Macroeconomics or aggregative economics analysis establishes the functional relationship between various aggregates of the economy. Aggregative analysis assumed such a great significance in recent times that a prior understanding of macroeconomic theoretical structure is considered essential for proper comprehension of different issues and policies. Macroeconomics now is not only a scientific method of analysis but also a body of empirical economic knowledge. The course equips the students at the postgraduate level to understand systematic facts and theoretical developments for empirical analysis,

Course Objectives:

- To provide a thorough understanding of the principles of macroeconomics and the application of macroeconomic concepts in real-life situations.
- To discuss the modern developments in macroeconomics.

Programme Outcome:

- Ability to analyze and demonstrate knowledge of the basic theories/laws in macroeconomics.
- At the end of the course, the student should be able to evaluate macroeconomic concepts, models and its use in real life situations.

1. Traditional Approaches to Macroeconomics **12**

1.1 Classical Approach-Introduction and main features
1.2 Keynesian Approach-Introduction and main features
1.3 Neoclassical Approach-Introduction and main features

2. National Income and Social Accounting **12**

2.1 Circular Flow Income in two-three and four sector economy
2.2 Different forms of national income accounting-
2.2.1 Social accounting
2.2.2 Input-output accounting
2.2.3 Flow of funds Accounting
2.2.4 Balance of payments Accounting
2.2.5 Matrix presentation of Social Accounting

3. Demand and Supply of Money **12**

3.1 Definition of Money, Debates relating to definition of Money
3.2 The Liquidity Theory, Gurley and Shaw Hypothesis, Demand for Money-Classical and Keynesian
3.4 Cash Balance Approach- Post Keynesian Theories of Demand for Money, Tobins Approach, Baumol's Inventory Theoretic Approach, Friedman's Theory of Demand for Money.

CORE COURSE
SEMESTER IV
EC- 4001
MACRO ECONOMIC ANALYSIS II
(This course will have *FOUR* credits)

PREAMBLE

Macroeconomics or aggregative economics analysis establishes the functional relationship between various aggregates of the economy. Aggregative analysis assumed such a great significance in recent times that a prior understanding of macroeconomic theoretical structure is considered essential for proper comprehension of different issues and policies. Macroeconomics now is not only a scientific method of analysis but also a body of empirical economic knowledge. The course equips the students at the postgraduate level to understand systematic facts and theoretical developments for empirical analysis,

Course Objectives:

- To provide a thorough understanding of the principles of macroeconomics and the application of macroeconomic concepts in various contexts.
- To discuss the modern developments in macroeconomics.

Programme Outcome:

- Ability to analyze and demonstrate knowledge of the basic theories/laws in economics- general equilibrium psychological law of consumption, etc.
- At the end of the course, the student should be able to evaluate macroeconomic concepts, models and its use in real life situations.

1. Aggregate Demand and Aggregate Supply Analysis **12**

1.1 Aggregate Demand Curve (with price flexibility)-Derivation of aggregate demand curve-shift in aggregate demand curve and multiplier effect
1.2 Aggregate Supply curve (with variable prices)-shift in aggregate supply curve-long-run aggregate supply curve –Derivation of Aggregate supply curve-
1.3 Macroeconomic equilibrium: AS-AD Model-Friedman's Natural Rate Hypothesis-Economic Fluctuations
1.4 Three Models of the Upward Sloping SRAS (short-run aggregate supply curve) –The Sticky Wage Theory, The Sticky Price Theory and The Misperceptions (Fooling) Theory

2. The IS-LM Curves Model **12**

2.1 Introduction-The Structure of the Model
2.2 Derivation of IS Curve and LM Curve –Shifts in IS Curve and LM curve, causes in shifts in IS and LM Curve.
2.3 Simultaneous Equilibrium in Goods Market and Money Market-Extension IS-LM model with government sector Fiscal policies.
2.4 Extension of IS-LM model with Labor Market and flexible prices.

3. Inflation-Unemployment Trade-Off: Phillips Curve and Rational Expectations Theory **12**

3.1 Inflation and Unemployment-Phillips curve-Explanation of Phillips curve.
3.2 Causes of shifts in Phillips Curve- Long-run Phillips curve and adaptive expectations – Long-run Phillips curve: Rational expectations.
3.3 Relation between short-run Phillips curve and long-run Phillips curve.

CORE COURSE
SEMESTER III
EC- 3002
GROWTH AND DEVELOPMENT- I
(This course will have *FOUR* credits)

PREAMBLE

The course makes an attempt to provide an introduction to the economics of Growth and Development and at the same time provide an understanding of the analytical rigour of the subject. Growth and Development-I is a core course that covers meaning and concept of Economic Growth and Development, measuring the economic growth and development, theories of economic growth and development, poverty, inequality and unemployment and role human capital in economic development . Growth and development-I will try to clear the concepts regarding the economic growth and development and provides basic knowledge to the students to get engaged in the activities.

Course Objectives:

- To enable learning and understanding of the basic concepts and process to measure the growth and economic development etc.
- To analyze and evaluate the obstacles in the process of economic growth and development

Programme Outcome:

- Ability to apply the concepts of economic growth and compare international comparison of economic development, etc.
- Ability to analyze and demonstrate knowledge of the economic growth and development theories of economic growth and development

1 Principles and Concepts of Growth and Development **12**

1.1 Concepts of growth and Development
1.2 Measuring Economic Development: Income and Alternative Measures
1.3 International Comparison of Incomes: PPP and Exchange Rate Approaches
1.4 Developing / Emerging Economies – Concept
1.5 Barriers to Economic Development

2 Theories of Economic Development and Growth **12**

2.1 Classical Theory of Economic Development: Adam Smith
2.2 The Harrod-Domar Model
2.3 Solow model of economic growth
2.4 The Cobb-Douglas Production Function
2.5 The Big push theory
2.6 The New (Endogenous) Growth Theory

3 Poverty, Inequality and Unemployment **12**

3.1 Measurement of Poverty- Uni-dimensional & Multi-dimensional, Amartya Sen's Approach to Poverty measurement, Rural and Urban Poverty, Participatory Approach to Poverty, Women and Poverty
3.2 Measuring Inequality, Lorenz Curve, Gini Coefficient, Functional Distribution,
3.3 Challenge of Unemployment, Disguised Unemployment and Economic Development, Concept of Jobless Growth
3.4 Employment and Migration

CORE COURSE
SEMESTER IV
EC- 4002
GROWTH & DEVELOPMENT II
(This course will have *FOUR* credits)

PREAMBLE

The course makes an attempt to provide an introduction to the economics of Growth and Development and at the same time provide an understanding of the analytical rigour of the subject. Growth and Development-I is a core course that covers meaning and concept of Economic Growth and Development, measuring the economic growth and development, theories of economic growth and development, poverty, inequality and unemployment and role human capital in economic development . Growth and development-I will try to clear the concepts regarding the economic growth and development and provides basic knowledge to the students to get engaged in the activities.

Course Objectives:

- To enable learning and understanding of the basic concepts and process to measure the growth and economic development etc.
- To analyze and evaluate the obstacles in the process of economic growth and development

Programme Outcome:

- Ability to analyze and demonstrate knowledge of the economic growth and development theories of economic growth and development
- Ability analyze, evaluate and apply the growth and development concepts, role of human capital, etc. in real life situations

1. Sectoral Development: An Overview

1.1 International agreements and Agriculture in India **12**
1.2 Agriculture Productivity, Agriculture Price Policy, Land Holding and Cropping Pattern
1.3 Industrial Production Trends at National and International Level, Role Of MSMEs, Government Policies for Industrial Development
1.4 Growth of Services Sector in India, ICT and Services sector, International Comparison.

2. Technology and Development

2.1 Role of Technology and Development **12**
2.2 Capital Formation and Technical Progress as Sources of Growth
2.3 Technological Strategy of Development
2.5 Economics of R&D, Invention and Innovation, Relation to Development
2.6 Technology Centered Development

3. Environment and Development

3.1 Sustainable Development, Sustainability Performance and Reporting **12**
3.3 Environment and Rural-Urban Development
3.4 Industrialization and Environment Protection
3.5 Climate change and Agriculture

CORE COURSE
SEMESTER III
EC- 3003
RESEARCH METHODOLOGY I
(This course will have *FOUR* credits)

PREAMBLE

The main objective of this paper is to make the students aware of the importance of Research Methodology. Today research is of importance in every field of life. Hence students need sound initiation in the world of research. Thus this syllabus is prepared to equip students with basics of research methodology and also provide them acquaintance with the main ingredients of major sources secondary data on Economics, some hands-on experience in conduct so survey including designing questionnaire and interview schedules, collection of data, analysis of data and preparation of report.

Course Objectives:

- To enable an understanding of Research and its methods under various areas of economics.
- To demonstrate the practical and the applied aspects of research in relation to Economics.

Programme Outcome:

- Ability to develop, demonstrate and examine topics under Economics to pursue research.
- Ability to evaluate and examine subject areas in economics and explore possibilities of research.

1 Introduction **08**

1.1 Research : Meaning ,Nature , Scoup. And Importance
1.2 Scientific Research : Methods - Stages /Steps
1.3 Social Science Research - Meaning ,Nature , Scoup. And Importance
1.4 Review of Literature- Need, Scope, Use and Precautions

2 Research Problem And Design **10**

2.1 Research Problem- Meaning, Identification and Selection of Research Problems
2.2 Research design ; Meaning , Objective ,
2.3 Need , Characteristics of Research design
2.4 Types of research Design – Descriptive, Diagnostic ,Exploratory, Experimental

3 Data Collection And Data Analysis **12**

3.1 Collection of Data – Meaning ,Importance
3.2 Sources of data – Primary Data And secondary data
3.3 Methods of Primary Data Collection- Questionnaire and Interview method, Schedule , Observation Method; ,
3.4 Secondary Data Sources
3.5 Sampling Method –Meaning and Types—(Probability and Non-probability)
3.6 Analysis of Data- Classification and Tabulation of Data
3.7 Computer Use Of Data Analysis

4 Testing of Hypothesis **12**

4.1 Hypothesis: Definitions, Characteristics and Importance
4.2 Types Of Hypothesis
4.3 Procedure of Hypothesis Testing

CORE COURSE
SEMESTER IV
EC-4003
RESEARCH PROJECT
(This course will have *FOUR* credits)
(Only for Internal Students)

PREAMBLE:

Students who complete their post-graduation in Economics are mentally equipped to pursue research in the same discipline. It is generally accepted that research is nothing but extension and application of knowledge in a certain specialized field. Therefore regular students who do their post-graduation, as internal students will be given an opportunity to get exposed to a few elements of social research and also they are expected to complete a small research project under the expert guidance and supervision, Elementary knowledge of research methodology shall consolidate and deepen their understanding of various branches of Economics. Preparing a small dissertation is intended to train them in scientific thinking and art of systematic presentation. It is essentially a job-oriented exercise to enable them to take up the exciting field of social and economic research.

Part I: Internal IV Semester students shall submit a dissertation of minimum 8000 words & maximum 10,000 words in three copies to the Head of the Department on or before 30th April. The dissertation shall be prepared under the guidance of an internal postgraduate recognized teacher.

Part II: An internal supervisor shall assess each dissertation for out of 50 marks, based on the methodology, analysis, contents and quality of the dissertation.

Part III: A viva voce examination of each candidate shall be held where he/she will have to make a presentation of the dissertation and defend the research. A panel of two referees shall be formed out of whom one shall be an internal examiner.

The viva voce shall carry 50 marks. Internal & external examiners shall give out of 25 marks each. The copies of dissertation and the record of the viva voce examination shall be maintained by the centre for two more academic years for inspection. The Marks obtained for project work shall be included in the statement of marks of all the regular internal students.

Scale of Remuneration will be as per the University Guidelines.
External examiner will be appointed by the University.

ELECTIVE COURSE
SEMESTER III
EC-3004
DEMOGRAPHY
(This course will have *FOUR* credits)

PREAMBLE

The main objective of this paper is to make the students aware of the importance of population in economic development and the various theories that explain the growth of population in a country. The paper also enlightens the students on the quantitative and the qualitative aspects and characteristics of the population through various demographic techniques. In recent times, the gender aspect of the population has acquired importance and these have also been included in the framework of study. Fertility and Aging are also vital characteristics of the undergoing structural change. Their study is essential to understand the dynamics of this change. The paper exposes the students to sources of population and related characteristics and also to the rationale, need and evolution of population policy.

Course Objectives:

- To provide an understanding of Demography and its application under various topics under economics.
- To demonstrate the practical and the applied aspects of Demography and the study of Population and its relation to Economics.

Programme Outcome:

- Ability to develop, demonstrate and examine various topics under Demography.
- Ability to evaluate and examine subject areas in economics bringing out the relation to population studies and demography.

10

1. **Demography**
1.1 Demography: Evolution, Nature and Scope
1.2 Development of Population Studies - relationship with other disciplines
1.3 History of Population Growth – Primitive, Pre-Industrial, Developed and Developing
1.4 Population Growth- Components, Interdependence, World Population Growth and Distribution, Growth in Developed and Developing Countries
1.5 Measures of Population Growth- Sources of Demographic Data

14

2. **Population theories**
2.1 The Malthusian theory
2.2 Post-Malthusian Theories
2.3 The Optimum Population Theory
2.4 The Theory of Demographic Transition
2.5 Population and Development (Meadows, Enke and Simon)

10

3. Population structure and characteristics
3.1 Structure of Population, Growth Rate and
3.2 Mortality- Meaning, Measurement of Mortality, Measures - causes of death.
3.3 Fertility- Meaning, Measurement of Fertility, Extent and Trends of Fertility, Factors affecting Fertility, Fertility Differentials in India
3.4 Pattern of Age and Sex Structure- Determinants, Impact and Implications; Age and Population

ELECTIVE COURSE
SEMESTER IV
EC-4004
ECONOMICS OF ENVIRONMENT
(This course will have *FOUR* credits)

PREAMBLE

Environmental economics has emerged as an important sub-discipline of economics in recent times as humanity struggles to respond to the environmental crisis that challenges the very existence of human beings. Environmental economics focuses on the relationship between human behavior, economic systems as well as mechanisms and environmental quality. It attempts to explore fundamental questions of how the economic system shapes economic incentives in ways that lead to environmental degradation as well as improvement. It focuses on the nature of environment as a social good and the relationship between environment and economic development. Environmental economics explores economic principles, economic theories and various analytical tools of economics for environmental protection, regulation and policy making. This curriculum introduces post graduate students of economics to the field of environmental economics and equips them with analytical tools to comprehend various environmental issues.

Course Objectives:

- To develop an understanding of the economics of environment in the theoretical as well as practical context.
- To discuss various analytical tools to comprehend various environmental issues.

Programme Outcome:

- Ability to analyze and evaluate the subject with reference to various aspects of the economics of environment.
- Ability to develop an understanding of the economics of environment and various analytical tools to comprehend environmental issues

1 Introduction **12**

1.1 Economics of Environment – Meaning, Nature, Scope and Significance
1.2 Environment as an Economic and a Social Good – Exhaustive and Renewable Common Property Resources
1.3 Economic Development and Environment – Trade-off, Environmental Kuznets Curve & Limits to Growth
1.4 Sustainable Development

2 Environmental Challenges **12**

2.1 Environment and Agricultural Development – Technological Change –Use of Water, Fertilizers, Pesticides – Groundwater and Forest Depletion
2.2 Environment and Industrial Development – Pollution, Urbanization
2.3 Global Environmental Issues – Depletion of Ozone Layer, Green House Effect, Global Warming, Climate Change, Loss of Bio-diversity

3 Environmental Regulation – Theories and Analytical Tools **12**

3.1 The Economic Theory of Efficient Pollution Control – Marginal Abatement Cost (MAC) & Marginal Environmental Damage (MED)
3.2 Externalities and Market Failures – Coase Theorem

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Crosscutting Issues in Syllabus of Geography

Crosscutting Issues in 2019 Pattern:

Sr. No.	Class	Course Code	Course Name	Addressed issues
1.	B. A. Geography	SEC-2B	(Value/skill based course) IV SEC 2 B Introduction to Remote Sensing	Professional Ethics
2.	B. A. Geography	SEC- 2C	(Value/skill based Course) SEC 2C Research Methodology – I	Professional Ethics
3.	B. A. Geography	SEC- 2D	Value/skill based course) SEC 2 D Research Methodology – II	Professional Ethics
4.	M.A./M.Sc. Geography	GGDT130	Geography of Tourism	Professional Ethics
5.	M.A./M.Sc. Geography	GGUT 251	Research Methodology	Professional Ethics
6.	B. A. Geography	Gg: 220(A)	Geography of Maharashtra – I	Gender, Environment & Sustainability
7.	B. A. Geography	Gg: 220(B)	Geography of Maharashtra – II	Gender, Environment & Sustainability
8.	M.A. /M.Sc. Geography	GGDT-114	Principles of Population and Settlement Geography	Gender
9	M.A /M.Sc. Geography	GGUT239	Urban Geography	Human Values & Professional Ethics
10.	B.A. Geography	Gg: 210(A)	Economic Geography I	Professional Ethics
11.	B.A. Geography	Gg: 210(B)	Economic Geography II	Professional Ethics
12.	B.A. Geography	SEC 2 A	(Value/skill based course) III Introduction to Geographical Information System	Professional Ethics
13.	B.A. Geography	Gg: 310(A)	Geography of Tourism-I	Environment and Sustainability Gender, Professional Ethics

14.	B.A. Geography	Gg: 310(B)	Geography of Tourism-I	Environment and Sustainability Gender, Professional Ethics
15.	M.A. /M.Sc. Geography	GGUT112	Principles of Climatology	Environment and Sustainability
16.	M.A. /M.Sc. Geography	GGUT 243	Watershed Management	Environment and Sustainability

Dr. G. K. Chavhan
Head, Dept. of Geography

Dr. V. C. Thange
IQAC, Coordinator

Dr. B. S. Yadav
Principal

S.Y.B.A. Geography Syllabus

Name of Subject: Introduction to Remote Sensing

Subject Code: SEC-B Semester – IV

Total Credit:02, Total Periods: 30

Objectives:

1. To introduce the students about the basic concepts of Remote Sensing.
2. To acquaint the students with the utility of RS and its applications.
3. To inculcate the skill of satellite image interpretation among the students.

urse Outcome:

1. The basic concepts and fundamentals in remote sensing.
2. The applicability of remote sensing techniques.
3. The skills of satellite image interpretation and map-making.

Sr. No.	Topic	Sub Topics	Teaching Hours	Total Credits
1	Introduction to Remote Sensing	1. Concept, Definition and Types of RS 2. Development of RS in India 3. Stages in RS 4. Electromagnetic Spectrum 5. Applications of RS	07	2
2	Image Interpretation	1. Elements of Visual Image Interpretation 2. Visual Image Interpretation of Satellite Images i.e. IRS or LANDSAT	07	
3	Software based Practical	1. Image Downloading through Bhuvan/USGS 2. Layer Stacking 3. Image Enhancement 4. Image Classification - Unsupervised	16	

Reference Books:

- Anji Reddy, M. (2008): Textbook of Remote Sensing and Geographic Information System, B.S. Publication, Hyderabad.
- Bhatta B., (2011): Remote Sensing and GIS, Oxford University Press, India.
- Campbell, J. (2002): Introduction to Remote Sensing, Taylor & Francis, London.
- Gupta, R.P. (1990): Remote Sensing Geology. Springer Verlag.
- Heywood, I., Steve, C. and Cornelius, S. (2003): An Introduction to Geographical Information Systems, Pearson Education.
- Jensen, J. R. (2000): Remote Sensing of the Environment: An Earth resource Perspective, Prentice Hall.
- Jensen, J. R. (2005): Introductory Digital Image Processing, Prentice Hall, New Jersey.
- Karlekar, S. (2006): Doorsamvedan - Remote Sensing (Marathi), Diamond Publications, Pune.
- Karlekar, S. (2017): Dursamvedan Aani Bhougolik Mahiti Pranali (Marathi), Diamond Publications, Pune.
- Lillesand, T. M., Kiefer, R. W. and Chipman, J. W. (2016): Remote Sensing and Image Interpretation, 6th Edition, Wiley India.
- Rao R. M. (2002): Geographical Information Systems, Rawat Publication.
- Sabins, F. F. (1996): Remote Sensing: Principles and Interpretation, W.H. Freeman and Company, San Francisco.

Semester V
SEC 2 C
Value/Skill based Course
Research Methodology - I
CREDIT - 2

Objectives:

1. To develop the understanding of the basic concept of research
2. To develop the understanding of the basic framework of sampling and data collection
3. To develop the understanding of various sampling methods and techniques

Course Outcome:

1. To develop the understanding of the basic concept of research
2. To develop the understanding of the basic framework of sampling and data collection
3. To develop the understanding of various sampling methods and techniques
4. To identify various sources of information about data collection.
5. Understanding of the conducting survey on various issues and develop the Report writing skill

Topic No.	Topic	Sub-Topic	No. of Lectures
1	Introduction to Research Methodology	i. Meaning and Objectives of Research ii. Characteristics of Research iii. Types of Research iv. Various Steps in Research Process	10
2	Research Design	i. Introduction of Research Design ii. Purpose of Research Design iii. Characteristics of Good Research Design	10
3	Research Problem	i. Definitions of Research Problem ii. Identification of a Research Problem iii. Technique Involved in Defining a Research Problem	10

References

1. Montello Daniel R. and Sutton Paul C. (2006) – Introduction to scientific research Methods if Geography. By Saga Publication
2. Kothari , C. R. (2004) – Research Methodology -Methods and techniques, New Age.
3. Mishra, H.N. and Sing, V.P. (1998)- research Methodology in Geography, Rawat Publication
4. Clifford, N. Fresh S, Valentine, G. (2010) - Key Methods in Geography , Saga Publication
5. Gregory , K. J. (2000) – The changing Nature of Physical Geography, Arnold,London
6. Gomez basil and Jones, III John Paul (editor) (2010) – Research Methods ingeography : A Critical, Wiley – Blackwell
7. Harvey, David (1971) – Explanation in Geography, Edward Arnold , London
8. Chorley, R. J. and P. Hagg-tt(ed) (1967) – Models in Geography , Methuen

Semester VI

SEC 2 D

Value/ Skill based Course

Research Methodology – II

CREDIT - 2

Objectives:

1. To identify various sources of information for data collection.
2. Understanding of the conducting survey on various issues and develop the Report writing skill of students

Course Outcome:

1. To develop the understanding of the basic concept of research
2. To develop the understanding of the basic framework of sampling and data collection
3. To develop the understanding of various sampling methods and techniques
4. To identify various sources of information about data collection.
5. Understanding of the conducting survey on various issues and develop the Report writing skill

Sr. No.	Topic	Sub-Topic	No. of Lectures
		A) Primary Data Questionnaire Method and Field Visit i.) Questionnaire – definition	
1	Methods of Data	ii.) Characteristics of a good questionnaire	
	Collection	iii.) Merits and demerits Questionnaire method	
		B) Secondary Data i) Government Sources	10
		ii) Syndicated Sources iii) Other types of Sources	
2	Types of Research Report	i. Dissertation and Thesis ii) Research paper, review article iii) Characteristics of good Research Report Writing	10
3	Techniques of Research Report Writing	i) Structure and organization of research reports: Title, abstract, key words ii) Introduction, Methodology, results, discussion,conclusion, references, footnotes iii) Concepts of Case Study	10

Semester II

Course: GGDT-130: Geography of Tourism

Course Outcome:

1. Students will get introduced with the basic and recent concepts related to tourism.
2. The course will help the students to understand various factors which affect tourism.
3. Students will comprehend various roles of accommodation in tourism.
4. Students will be aware of Indian tourism through various case studies.
   Students will get overall knowledge about tourism section in India.

No. of Credits: 02No. of Periods: 30

Topic No.	Topic	Sub topics	No. of Periods
1	Introduction to Geography of tourism	i. Definition: tourist and tourism ii. Concept of recreation and leisure iii. Importance of tourism iv. Impact of tourism on economy of nation	02
2	Classification and Recent Concepts of Tourism	i. Classification on the basis of: nationalitytime of travel, number of tourist and purpose ii. Recent concepts: agro-tourism, eco-tourism, heritage tourism and adventure tourism	10
3	Factors of Tourism	i. Physical factors:relief, climate, vegetation, wild life and water bodies ii. Socio-cultural factors:religious, historical and cultural, economic, transportation and accommodation	08
4	Role of Accommodation in Tourism	i. Hotels, motels, inn, saraies, dharmashalas ii. Governmentaccommodation, tourist homes iii. Youth hostels, cottages, tents, caravans iv. Rail yatribhavan, house boats v. Private accommodations and unrecognizedaccommodations	06
5	Indian Tourism	Case studies i. Hill stations: Manali, Mahabaleshwar ii. Beaches: Kalangut (Goa), Ganpatipule iii. Historical centres: Agra, Pratapgad iv. Caves : Badami, Ajanta v. Religious Centres: Prayagraj (Allahabad), Shirdi vi. National Parks: Kaziranga, Tadoba vii. Dams: SardarSarovar, Koyna viii. Waterfalls: Nohkalikai Fall, Thoseghar	04

SAVITRIBAI PHULE PUNE UNIVERSITY

Geography MA/MSc-II (Credit System)

Revised Syllabus (From June-2020)

Course: GGUT – 251 Research Methodology

Course Outcome:

Students should be able to understand meaning, types and process of research.
Students should be able to distinguish a purpose statement, a research problem.
They understand purpose of good research design.
Students should be able to define the advantages, disadvantages, characteristics and types of sampling.
Students should be able to understand methods of data collection methods.
Students should be able to define the meaning of a variable, hypothesis, and various data analysis methods.
Make use of proper tools and surveying methods for measurement in context of collection and processing of data.
Students should understand the technical writing and reporting of research.
They understand research ethics, plagiarism and funding agencies for the development of research.

No. of Credits: 04 **Total Periods: 60**

Topic No.	Topic	Sub-Topic	Periods
1	Introduction to Research Methodology	i. Meaning and objectives of research ii. Characteristics of Research iii. Types of Research iv. Various steps in Research Process v. Research Methods versus Methodology	10
2	Research Design	i. Research Design - definition ii. Purpose of a Research Design iii. Characteristics of Good Research Design	06
3	Research Problem	i. Definitions of the Research Problem ii. Identification of a Research Problem iii. Technique involved in defining a problem	06
4	Sampling Design	i. Sampling Design – Definition of Population, Sample and Sampling Design ii. Advantages and disadvantages of Sampling iii. Characteristics of a good sample iv. Types or method of sampling	08
5	Methods of Data Collection	A) Primary Data Questionnaire Method i. Questionnaire – definition ii. Characteristics of a good questionnaire iii. Merits and demerits Questionnaire Method Interview Method i. Interview – definition ii. Characteristics of an interview iii. Merits and demerits of Interview iv. Difference between Interview and Questionnaire Observation Method/Field Work Method B) Secondary Data	06

6	Data Analysis	i. Variables and their types ii. Hypothesis- definition and types iii. Measure for Central Tendency and Dispersion iv. Correlation and Regression Analysis v. Time series analysis vi. T test, Z test, Chi-square test	12
7	Technical writing and reporting of research	Types of research report i. Dissertation and thesis, research paper, review article, short communication, conference presentation, meeting report, etc. ii. Structure and organization of research reports- Title, abstract, key words, introduction, methodology, results, discussion, conclusion, acknowledgements, references, footnotes, tables and illustration iii. Literature Review	06
8	Research ethics, plagiarism and funding agencies	i. Research ethics ii. Plagiarism iii. Use of plagiarism detection softwares iv. Research opportunities and funding agencies	06

Reference Books:

1. Gaum, Carl G., Graves, Harod F., and Hoffman, Lyne, S.S., (1950): Report Writing, 3rd ed., New York: Prentice-Hall.
2. Kothari, C.R. (2004): Research Methodology: Methods and Techniques, New Age International (P) Ltd.,New Delhi – 110002.
3. Kothari, C.R., (1984): Quantitative Techniques, 2nd ed., New Delhi: Vikas Publishing House Pvt. Ltd.
4. Mishra Shanti Bhushan and Shashi A. (2011): Handbook of Research Methodology,Educreation Publishing, New Delhi – 110075.
5. Pandey, P. and Pandey, M.M. (2015): Research Methodology: Tools and Techniques,Bridge Center, Romania, European Union.
6. Tandon, B.C., (1979): Research Methodology in Social Sciences. Allahabad, Chaitanya Publishing House.
7. Ullman, Neil R. (1978): Elementary Statistics, New York: John Wiley & Sons, Inc.
8. Yamane, T., Statistics (1973): An Introductory Analysis, 3rd ed., New York: Harper and Row.

S.Y.B.A. Geography (S1), Syllabus for Semester III

Name of Subject: Geography of Maharashtra, Subject Code: Gg.220 (A)

Objectives:

1. To acquaint students with Geography of our State.
2. To make students aware of the magnitude of problems and prospects in Maharashtra.
3. To help students understand the inter relationship between the subject and the society.
4. To help students understand the recent trends in regional studies

Course Outcome:

1. Learn the geography of Maharashtra state.
2. Aware about problems and prospects of Maharashtra.
3. Understand the relationship between geographic variations and society in Maharashtra.
4. Learn the recent trends in regional studies.

Sr. No.	Topic	Sub Topics	Teaching Hours	Total Credits
1	Administrative Set up of Maharashtra	1. Historical and Political Background of the state 2. Geographical location of State 3. Adjoining States 4. Administrative Divisions	12	03
2	Physical settings	1. Geological Structure of Maharashtra. 2. Physical Structure (Mountain, plateau, Plains) 3. Drainage Pattern (East and West flowing rivers) 4. Major Soil types and Distribution.	12	
3	Climate	1. Climatic Regions of Maharashtra 2. Distribution of Rainfall 3. Draught prone areas- Problems and Management 4. Flood areas - Problems and Management	12	
4	Resources	1. Water :Problems in Utilization and conservation 2. Forest : Types and Conservation 3. Mineral; Iron ore, Manganese and Bauxite 4. Power : Hydro, Thermal, Atomic	12	

Reference Book:

1. Dikshit K.R ., Maharashtra in Maps,
2. Deshpande C. D. , Maharashtra
3. Sadhu Arun, Maharashtra, National Book Trust
4. Savadi A. B., Geography of Maharashtra: Nirali Prakashan, Pune.
5. Dastane S., Maharashtra, Ramchandra and company, Pune
6. Sawadi A. B., The Mega State Series : Nirali Publication, Pune.

S.Y.B.A. Geography (S1), Syllabus for Semester IV

Name of Subject: Geography of Maharashtra, Subject Code: Gg.220

(B) Objective :

1. To make students aware about the Agriculture problems and prospects of Maharashtra.
2. To understand the population distribution and settlement pattern in Maharashtra.
3. To understand the concept of rural development.
4. To understand the prospectus in Tourism activity in Maharashtra and the role of MTDC and Role of MIDC in industrial development in rural area of Maharashtra

Course Outcome:

1. Aware about the problems and prospects of agriculture in Maharashtra.
2. Learn the distribution of population and patterns of settlements in Maharashtra.
3. Learn the concepts in rural development.
4. Understand the prospectus of tourism activities in Maharashtra with role of MTDC in development.
5. Understand the role of MIDC in industrial development in rural Maharashtra.

Sr. No.	Topic	Sub Topic & Learning Point	Hours	Credits
1	Agriculture	1. Importance of Agriculture in Economy of Maharashtra 2. Major Crops - Wheat, Rice, Jawar, Bajra. 3. Cash Crops and Horticulture - Cotton, Sugarcane, Pomegranate, Grapes. 4. Problems of agriculture in Maharashtra.	12	03
2	Population and Settlement	1. Population distribution of Maharashtra 2. Population composition - Sex Ratio, Literacy, Occupational structure, Migration 3. Rural and Urban Settlements 4. Potential of Major Cities in Maharashtra – Mumbai, Pune, Nagpur	12	
3	Rural Development of Maharashtra	1. Concept of Rural Development 2. Parameters of Rural Development 3. Schemes For Rural Development 4. Case Studies – Hivare Bazar and Ralegan Siddhi (Ahmednagar), Patoda (Aurangabad)	12	
4	Tourism	1. Growth and development of tourism in Maharashtra 2. Tourism Potential of Maharashtra 3. Agro-Tourism 4. Role of MTDC	12	

- **Saptarshi, P.G., More, J.C. Ugale, V.R. and Musmade, A.H. (2009):** India A Geographical Analysis Diamond, Pune.
- **Saxena, H.M. (2013):** Economic Geography, Rawat publication, Jaipur.
- **Siddhartha, K. (2000):** Economic Geography: Theories, Process and Patterns, Kisalaya Publications, New Delhi
- **Smith, D.M. (1971):** Industrial Location: An Economic Geographical Analysis, John Wiley and Sons, New York
- **Pagar, Thorat& More (2015):** Agriculture Geography, (Marathi), Atharv Publication, Pune
- **More J. (2014):** Geography & Agriculture For MPSC Examination, (Marathi), Atharv Publication, Pune

Semester I

Course: GGDT-114 :Principles of Population and Settlements Geography

Course Outcome:

1 Student gets acquainted with the basic concepts in Population and settlement Geography.
2 The students will acquire knowledge about the population distribution in the world, factors affecting population distribution and about the concept of migration.
3 Understand patterns and processes of population growth and its implications.
4 Students understand the theories along with the fundamental concepts in Population and settlement Geography.

No. of Credits: 04 No. of Periods: 60

Topic No.	Topic	Sub topics	No. of Periods
1	Introduction to Population and Settlement Geography	i. Definition, Nature and scope of Population Geography ii. Development of Population Geography as discipline iii. Approaches to the study of population Geography iv. Definition, subject matter and scope ofSettlement Geography v. Development of Settlement Geography vi. vi. Approaches: genetic, spatial and ecological	08
2	Population Distribution	i. Population distribution and factors affecting distribution of population ii. Density : definition and types iii. Factors affecting density of population iv. Population density in India v. Urbanization: definition and stages vi. Trend and level of urbanization in India	08

3	Population Growth and trend	i. Concept of population growth ii. Component of population growth (Fertility, Mortality, and Migration) iii. Theory of Demographic Transition iv. Malthus Theory v. Population growth and trend in India vi. Migration: concept of migrant and migration, immigration and emigration	08
4	Population Structure and Characteristics	i. Age and sex structure ii. Concept of aging of populations, iii. Dependency ratio iv. Sex Ratio: definition and affecting factors ofsex ratio v. Sex ration in India vi. Population Composition: religious, linguistics, ethnic, marital and educational vii. Literacy: definition and measures of literacy viii. Literacy in India	06
5	Fertility and Mortality	i. Concepts: fertility, fecundity, sterility, cohort ii. Crude birth rate, Total fertility rate iii. Concept of baby boom iv. Concepts: mortality and morbidity v. Death rate and its measures vi. Level and trends of mortality in India	06
6	Human Settlement	i. Classification: urban and rural ii. Rural-urban dichotomy iii. Site and situation aspect in settlement iv. Types: compact, semi-compact, hamleted anddispersed v. Patterns of settlement	08
7	Rural Settlements	i. Definition, classification of villages ii. Size and spacing of villages iii. Nearest neighbor analysis iv. Concepts of dispersion and nucleation v. Factors affecting dispersion and nucleation	08
8	Urban Settlements	i. Concept: urban place, urban agglomeration,urban sprawl ii. Urban settlement hierarchy iii. Urban-rural fringe iv. Rank-size rule v. Central Business District (CBD)	08

Reference Books:

- **Bhende, A. and Kanitkar, T. (2011):** Principles of Population Studies, Himalaya Publishing House, Bombay.
- **Beaujeu, G. J. (1966):** Geography of Population, Longman Group Ltd.
- **Chandna, R.C. (Rep.2010):** Geography of Population, Concepts, Determinants and Patterns, Kalyani Publishers, New Delhi.

Savitribai Phule Pune University, Pune

MA/MSc - II Syllabus in Geography (Credit System)
Revised Syllabus (from June, 2020)

Course: GGUT-240 Urban Geography

Course Outcome:

Students will be understood urban structure & Morphology.
Students will be able to map out the problems in the urban settlements.
Students will be do project or draw structure to learn the urban planning and development.

No. of Credits: 04 **No. of Periods: 60**

Topic No.	Topic	Subtopics	No. of Periods
1	Introduction to Urban Geography	i. Nature of Urban Geography ii. Scope of Urban Geography iii. Significance of Urban Geography iv. Relation to other disciplines	07
2	Urbanization	i. Meaning of Urban settlement and urbanization. ii. Brief review of spatial- temporal variations in urbanization in the world iii. Urbanization curve iv. Contemporary factors of urbanization	07
3	Urban Morphology	Models of urban structure: i. Park and Burgess Model ii. Homer Hoyet Model iii. Harris and Ullman Model iv. Characteristics and demarcation of CBD	07
4	Urban Classification	i. Criteria used for classification ii. Functional classification of towns and cities	04
5	Urban Demography	Characteristics of urban population: i. Growth of Urban population ii. Density of population in cities iii. Age, sex and occupational structure	08
6	City and its Region	i. Concepts of city region and various synonymous terms used ii. Criteria used to demarcate the city region	04
7	Central Place	i. Christaller's Central Place Theory ii. Rank-size relationship and rank- size rule iii. Hierarchy of urban settlements	08
8	Contemporary Urban issues	i. Price of land and vertical and horizontal growth of cities ii. Scarcity of housing and growth of slums iii. Problems of civic amenities iv. Urban transport problem v. Urban Environmental pollution vi. Urban floods, health and hygiene	08

3	Population Growth and trend	i. Concept of population growth ii. Component of population growth (Fertility, Mortality, and Migration) iii. Theory of Demographic Transition iv. Malthus Theory v. Population growth and trend in India vi. Migration: concept of migrant and migration, immigration and emigration	08
4	Population Structure and Characteristics	i. Age and sex structure ii. Concept of aging of populations, iii. Dependency ratio iv. Sex Ratio: definition and affecting factors ofsex ratio v. Sex ration in India vi. Population Composition: religious, linguistics, ethnic, marital and educational vii. Literacy: definition and measures of literacy viii. Literacy in India	06
5	Fertility and Mortality	i. Concepts: fertility, fecundity, sterility, cohort ii. Crude birth rate, Total fertility rate iii. Concept of baby boom iv. Concepts: mortality and morbidity v. Death rate and its measures vi. Level and trends of mortality in India	06
6	Human Settlement	i. Classification: urban and rural ii. Rural-urban dichotomy iii. Site and situation aspect in settlement iv. Types: compact, semi-compact, hamleted anddispersed	08
7	Rural Settlements	i. Patterns of settlement ii. Definition, classification of villages iii. Size and spacing of villages iv. Nearest neighbor analysis v. Concepts of dispersion and nucleation	08
8	Urban Settlements	i. Factors affecting dispersion and nucleation ii. Concept: urban place, urban agglomeration,urban sprawl iii. Urban settlement hierarchy iv. Urban-rural fringe v. Rank-size rule Central Business District (CBD)	08

Reference Books:

- **Bhende, A. and Kanitkar, T. (2011):** Principles of Population Studies, Himalaya Publishing House, Bombay.
- **Beaujeu, G. J. (1966):** Geography of Population, Longman Group Ltd.
- **Chandna, R.C. (Rep.2010):** Geography of Population, Concepts, Determinants and Patterns, Kalyani Publishers, New Delhi.

Savitribai Phule Pune University, Pune

MA/MSc - II Syllabus in Geography (Credit System)
Revised Syllabus (from June, 2020)

Course: GGUT-240 Urban Geography
Course Outcome:
Students will be understood urban structure & Morphology.
Students will be able to map out the problems in the urban settlements.
Students will be do project or draw structure to learn the urban planning and development.

No. of Credits: 04 **No. of Periods: 60**

Topic No.	Topic	Subtopics	No. of Periods
1	Introduction to Urban Geography	i. Nature of Urban Geography ii. Scope of Urban Geography iii. Significance of Urban Geography iv. Relation to other disciplines	07
2	Urbanization	i. Meaning of Urban settlement and urbanization. ii. Brief review of spatial- temporal variations in urbanization in the world iii. Urbanization curve iv. Contemporary factors of urbanization	07
3	Urban Morphology	Models of urban structure: i. Park and Burgess Model ii. Homer Hoyet Model iii. Harris and Ullman Model iv. Characteristics and demarcation of CBD	07
4	Urban Classification	i. Criteria used for classification ii. Functional classification of towns and cities	04
5	Urban Demography	Characteristics of urban population: i. Growth of Urban population ii. Density of population in cities iii. Age, sex and occupational structure	08
6	City and its Region	i. Concepts of city region and various synonymous terms used ii. Criteria used to demarcate the city region	04
7	Central Place	i. Christaller's Central Place Theory ii. Rank-size relationship and rank- size rule iii. Hierarchy of urban settlements	08
8	Contemporary Urban issues	i. Price of land and vertical and horizontal growth of cities ii. Scarcity of housing and growth of slums iii. Problems of civic amenities iv. Urban transport problem v. Urban Environmental pollution vi. Urban floods, health and hygiene	08

9	Urban policy and planning	i. Urban development policy in India ii. Need &Element of city plan iii. Use of GIS in Urban Planning	07

Reference Books:

1. Bhattacharya: Urban Development in India, Shree publication
2. Brian, R.K. (1996): Landscape of Settlement Prehistory to present, Routledge, London
3. Careter (1972): Fourth edition: The study of Urban Geography, Arnold, London
4. Gadakh B.L. and Jaybhaye R. G. (2017): Urban Sprawal Analysis of Nashik City. Scholar press
5. Hall P. (1992): Urban and Regional Planning, Routedge, London
6. K. Siddharth and S. Mukherji : Cities, Urbanization and Urban Systems
7. Kundu, A. (1992): Urban Development and Urban Research in India, Khanna Publication
8. Mayer and Kohan: Readings in Geography
9. Northam: Urban Geography
10. Roy Turner: Indian's Urban Future
11. R.B Mandal-V.G A Textbook (Concept publishing Company
12. Shah Manzooor Alam: Urbanization in Developing Countries
13. Singh.K.and Steinberg.F. (eds)(1998): Urban India in Crisis. New Age Interns
14. Urban Geography: Tim Hall
15. Verma: Urban Geography, Rawat, Jaipur

S.Y.B.A. Geography (G2) Syllabus for Semester III

Name of Subject: Economic Geography- I, Subject Code: Gg.210 (A)

Objectives:

1. To introduce students to the basic principles and concepts of economic geography
2. To acquaint students with the applications to economic geography for development in different areas
3. The students should be able to integrate various factors of economic development and dynamic aspect of economic geography.

urse Outcome:

e principles and fundamental concepts in economic geography.
e application of concepts in economic geography for development in different areas.
integrate the various concepts in economic geography with factors of economic development.

Sr. No.	Topic	Sub Topics	Teaching Hours	Total Credits
1	Introduction to Economic Geography	1. Definition, nature and scope of economic geography. 2. Need and significance of economic geography 3. Economic geography and its relation with social sciences 4. Approaches of the study of economic geography	12	03
2	Economic Activity	1. Introduction and concept of economic activity with problems and prospect 2. Primary activity 3. Secondary activity 4. Tertiary activity	12	
3	Concept and classification of resources	1. Concept of resources 2. Renewable energy Resources i. Hydro electricity ii. Solar energy iii. Wind energy 3. Non-renewable Resources i. Coal, ii. Iron ore iii. Mineral oil 4. Conservation of resources	12	
4	Agriculture	1. Role of Agriculture in Indian economy 2. Factors influencing agriculture in India a) Physical b) Socio-economic c) Political and cultural 3. Agro-based industries in India a) Dairy industry b Cotton industry 4. Agro –Tourism	12	

S.Y.B.A. Geography (G2) Syllabus for Semester IV

Name of Subject: Economic Geography- II, Subject Code: Gg.210 (B)

Objectives:

1. To acquaint students with the basic principles and concepts of economic geography
2. To acquaint the students with the applications to economic geography for development in different areas.
3. The main aims are to integrate the various factors of economic development and to acquaint the students with this dynamic aspect of economic geography.

)urse Outcome:

Create awareness about dynamic environment among the students.
To acquaint students with the fundamental concepts of Environmental Geography.
To acquaint students about the past, presents and future utility and potentials of natural resources.
To make aware students about the problems of environment, its utilization and conservation in the view of sustainable development.

Sr.No.	Topic	Sub Topics	Teaching Hours	Total Credits
1	Trade and Transport	1.Modes of Transportation and their cost effectiveness Significance of a) Road b) Rail c) Air 2.Treansportation cost of Major types 3,Types of Trade a) National b) International 4.International trade of India	12	03
2	Industries	1. Factors influencing on location of industries. 2. Weber's theory of industrial location 3. Major industrial regions in India 4. a) Iron and steel industry in India b) Sugar Industry in Maharashtra	12	
3	Regional Planning Development	1. Concept of regional planning and development. Their importance 2. Objectives of regional planning 3. Regional and sectoral imbalance in India	12	
4	Rural Development in India	1. Concept of rural development 2. Index of rural development 3. Various schemes of government for rural development a) IRD Programme b) DPAD Programme	12	

S.Y.B.A. Geography Syllabus

Name of Subject: Introduction to Geographic Information System

Subject Code: SEC – A, Semester – III

Total Credit:02, **Total Periods: 30**

Objectives:

1. To introduce the students about the basic concepts of GIS.
2. To acquaint the students with the utility and applications of GIS Technique.
3. To create the awareness about Geospatial technology among the students.
4. To inculcate skill of map making among the students by using GIS Technique.

Course Outcome:

1. The basic concepts in GIS.
2. The applicability of GIS techniques.
3. The new techniques and skills of map-making with accuracy.

Sr. No.	Topic	Sub Topics	Teaching Hours	Total Credits
1	Introduction to GIS	1. Definition of GIS 2. Stages of GIS Development 3. Objectives of GIS 4. Components GIS 5. GIS Applications	06	2
2	Data Types & Models	1. Spatial Data – Concept, Sources; Data Models – Raster & Vector 2. Non-spatial Data – Concept, Sources; Data Models – Relational, Network, Hierarchical & Object-orientated	06	
3	Software based Practical	1. Geo-referencing of Toposheet/Map 2. Digitization of Point, Line & Polygon (at least one layer of each) 3. Data Attachment 4. Creation of Layout and Map	18	

Course Outcomes:

On successfully completion of this course, the students will able to -

- Comprehend knowledge about the concepts in GIS.
- Acquire skills of map making using GIS.

Reference Books:

- Burrough, P. A. and McDonnell, R. A. (2000): Principles of Geographical Information Systems, Oxford University Press, New York.
- Chang, K. T. (2008): Introduction to Geographic Information Systems, Avenue of the Americas, McGraw-Hill, New York.
- Debashis, C. and Sahoo, R. N. (2015): Fundamentals of Geographic Information System, Viva Books Private Limited.
- DeMers, M. N. (2008): Fundamentals of Geographic Information Systems, John Wiley and Sons, New Delhi.
- Heywood, I., Cornelius, S. and Carver, S. (2011): An Introduction to Geographical Information Systems, Pearson Education, New Delhi.
- Karlekar, S. (2007): Bhaugolik Mahiti Pranali (GIS), Diamond Publications, Pune.

Semester V

Geography of Tourism- I CC1E (No. of Credits: 03)

Objectives:

1) To understand the importance of Tourism
2) To introduce the students to the basic concepts in Tourism Geography.
3) To understand the types of Tourism
4) To gain knowledge different aspects of Tourism Geography.

Course Outcome:

1. Understand the history of Tourism.
2. Introduce the students to the basic concepts in Tourism Geography
3. Understand the types of Tourism.
4. To gain knowledge different aspects of Tourism Geography.

Sr. No.	Topic	Sub Topic & Learning Point	No. of Lectures
1	Introduction	a) Definition and Nature i. Definition of Tourists and Tourism ii. Nature of Tourism iii. Importance of Tourism b) Scope and Extent i. Tourism and Travel as basic needs of mankind. ii. Tourism and Development. iii. Tourism as product c) Role of Geography in Tourism	12
2	Determinants of Tourism Development	a) Physical i. Relief ii. Climate iii. Forest b) Socio-Cultural i. Religious ii. Historical iii. Sports c) Political i) Policies, ii) Safety of Tourists, iii) Accessibility	12
3	Concept and Classification of Tourism	a) Classification of tourism based on: i. Nationality ii. Travel Time iii. Purpose b) Concept of Tourism - I i. Agro-Tourism ii. Eco- Tourism iii. Wildlife Tourism iv. Geo-Tourism c) Concept of Tourism - II i. Health/medical Tourism ii Sports Tourism	12

4	Role of Infrastructure in Tourism Development	a) Mode of Transportation: i) Road, ii) Rail, iii) Water, iv)Air b) Communication: i. Role of Guide in tourism development ii. Internet/Telephone/Mobile/TV iii. Electronic and Printing Media c) Travel and Tourism Agencies:	12

Reference Books

1. Geography of Tourism: Robinson H. (1996)
2. Tourism Development, Principles and Practices: Bhatia A.K., Sterling Publisher Ltd., New Delhi
3. Geography of Tourism and Recreation: S. N. Singh (1985)
4. Tourism Today: A Geographical Analysis: Douglas Pearce (1987)
5. Tourism: Economic Physical and Social Impact: Mathiseson A. and Wall C, Logman, U.K.
6. India: A Tourist Paradise: Manoj Das.
7. Tourism Today: An Indian Perspectives: Maneet Kumar
8. Geography of Travel and Tourism: Hudman L.E.
9. Successful Tourism Management: Seth P.N. (1985) Sterling Publisher Ltd., New Delhi.
10. Tourism Analysis: Smith S.L.J.
11. Tourism in India: Gupta V.K.
12. Dynamics of Tourism: Kaul R. N., Sterline Publisher Ltd.
13. Geography of Tourism: S.B. Shinde, Phadke Prakashan, Kolhapur
14. Muluk, Musmade, Doke, More, (2021), Geography of Tourism-I, Nirali Publication, Pune.

Geography of Tourism- II CC1F(No. of Credits: 03)

Objectives:

1. To understand the activities of Tourism
2. To introduce the students to the basic concepts in Tourism Geography.
3. To understand the types of Tourism
4. To gain knowledge different aspects of Tourism Geography.

Course Outcome:

1. Understand the accommodation types.
2. The students should be able to integrate various factors of economic development and dynan aspect of tourism geography.
3. Understand the planning and policy of tourism word wide.
4. To make aware the students about some Hill Station, Historical and National Parks

Sr. No.	Topic	Sub Topic & Learning Point	No. of Lectures
1.	Role of Accommodation in Tourism	a) Accommodation Types i. Hotels, Motels, Inn, Dharmashalas, Youth Hostel ii. Govt. Accommodation, Tourist Homes iii. Private accommodations and unrecognized accommodations b) Factors affecting choice of Accommodation c) Role of Accommodation in Tourism Development	12
2.	Impact of Tourism	a) Economic impacts i. Effect on foreign exchange ii. Employment generation iii. Infrastructure development b) Physical and Environmental impacts i. Land Degradation ii. Impacts on Bio-diversity iii. Air and water pollution c) Social cultural impacts i. Crime and Gambling activities ii. Languages iii. Traditional arts	12
3.	Planning and Polices of tourism development	a) World Tourism Organization (WTO) b) India Tourism Development Corporation (ITDC) c) Maharashtra Tourism Development Corporation (MTDC)	12
4.	Case studies of Major Tourist Centers in India	a) Hill Station- Manali and Mahabaleshwar b) Historical- Tajmahal and Raigadh Fort c) National Parks- Kaziranga, Melghat d) Preparation of Tourist Plan on any of above tourist destination	12

Semester I

Course: GGUT- 112:Principles of Climatology

Course Outcome:

1. Student gets acquainted with the basic concepts in Climatology
2. Understand the elements of weather and climate, different atmospheric phenomena and climate change
3. Gain the knowledge to associate climate with other environmental and human issues.
4. Understands the concepts of Insolation and temperature

Realize the way atmospheric moisture works.

No. of Credits: 04 **No. of Periods: 60**

Topic No.	Topic	Sub topics	No. of Periods
1	Introduction toClimatology	i. Meteorology and Climatology ii. Nature and Scope of Climatology iii. Development of Climatology iv. Tropical Climatology	06
2	Earth's Atmosphere	i. Evolution ii. Structure and composition of atmosphere iii. The ozone layer depletion iv. Aurora - types	08
3	Insolation	i. Solar and terrestrial radiation ii. Electromagnetic spectrum iii. Factors affecting insolation iv. Latitudinal and seasonal variation v. Effect of atmosphere vi. Greenhouse effect vii. Heat budget viii. Mechanisms of heat transfer	10
4	Temperature	i. Heat and temperature ii. Temperature measurements and controls iii. Lapse rate iv. Temperature inversion v. Types of inversion	06

5	Atmospheric Pressure and Winds	i. Pressure measurement and distribution ii. Factors affecting distribution of pressure iii. Wind observation and measurement iv. Factors affecting wind v. Geostrophic wind and Gradient wind vi. Models of general circulation of the atmosphere vii. Eddy theory viii. Local winds ix. Jet stream x. Cyclones and Anticyclones	12
6	Atmospheri cMoisture	i. Atmospheric moisture ii. Hydrologic cycle iii. Evaporation and condensation iv. Forms of condensation v. Precipitation vi. Types of precipitation vii. Measurement of humidity	06
7	Atmospheri cStability	i. Lapse Rate: normal, environmental, dry adiabatic lapse rate and wet adiabatic lapse rate ii. Stable and unstable air iii. Absolute stability iv. Absolute instability v. Conditional instability	06
8	Air Masses andFronts	i. Introduction to air masses and fronts ii. Types of air masses iii. Types of fronts	06

Reference Books:

- **Critchfield, H.J. (Rep. 2010):** General Climatology. Prentice Hall, New Delhi.
- **Lal, D.S. (1998):** 'Climatology', Chaitanya Publishing House, Allahabad.
- **Lutgens, Frederic K. &Tarbuck, Edward J. (2010):** 'The Atmosphere: An Introduction to Meteorology', Pearson Prentice Hall, New Jersey.
- **Oliver, John E. &Hidore, John J. (2003):** Climatology: An Atmospheric Science, Pearson Education, Delhi
- **Savindra Singh (2005):** Climatology, PrayagPustakBhawan, Allahabad.
- **More, Pagar, Thorat (2014):** (Marathi), Elements of Climatology & Oceanography, Atharv Trewartha: Introduction to Weather and Climate. Publication, Pune

Savitribai Phule Pune University, Pune

MA/MSc - II Syllabus in Geography (Credit System)
Revised Syllabus (from June, 2020)

Course: GGUT-243 Watershed Management

Course Outcome:

Students will be identified and delineate watershed using DEM & toposheets.
Student will be analyzing and evaluate the linear, aerial & relief properties of watershed.
Students will be design maps using satellite images & aerial photographs.

No. of Credits: 02 **No. of Periods: 30**

Topic No.	Topic	Sub topics	Periods
1	Concept of watershed management	i. Definition, concepts of watershed; watershed management, Principle of watershed management ii. Necessity of watershed management iii. Problems in watershed management	06
2	Characteristics of watershed	i. Delineation of Watershed ii. Characteristics: Size , Shape , Physiography , Climate, Drainage, Land use, Vegetation, Geology and Soils, Hydrology, Socioeconomics	06
3	Hydrological process in watershed	i. Precipitation, interception, infiltration, evaporation, evapo-transpiration, surface runoff, ground water-flow, water budget ii. Hydrological cycle	06
4	Water and soil conservation in watershed	i. Water conservation: Nala Bunding, Check dams, Farm ponds, Percolation tanks, Artificial recharge ii. Soil conservation- Contour Bunding, Gully plugging, Trench cum mound, Levelling	06
5	Watershed development	i. Application of Remote Sensing and GIS in watershed management ii. Integrated watershed development plans iii. Importance of watershed management in national development.	

Reference Books

1. Dhruvanarayana, V.V., Sastry, G., Patnaik, U.S.: Watershed Management
2. Kakde, B.K.: Watershed Manual – A Guide for Watershed Development Practitioners and Trainers, BAIF Development Research Foundation, Pune.
3. Murthy, JVS: Watershed Management, New age International Publishers.
4. Rajesh Rajora: Integrated Watershed Management- A Field Manual for Equitable, Productive and Sustainable Development, Rawat Publication, Jaipur.
5. Singh Rajvir: Watershed Planning and Management, 2nd Edition, Yash Publishing House, Bikaner, India.
6. Suresh,R.: Soil and Watershed Conversation Engineering, 2nd Edition, Standard Publication Distributors, Delhi.
7. Schwab,G.O. et al: Soil and Water Conservation Engineering, 4th Edition, John Wiley Sons.

K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

F.Y.B.Com 2019 Pattern (CBCS) (Sem. –I)



Sr. No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	F.Y.B.Com 2019 Pattern	Financial Accounting-I	Accounting Concepts, Conventions Of Emerging Trends In Accounting	Professional Ethics
			Piecemeal Distribution Of Cash	Professional Ethics
			Accounts From Incomplete Records	Professional Ethics
			Introduction To Goods And Services Tax Laws And Accounting	Professional Ethics
2	F.Y.B.Com 2019 Pattern	Business Economics - I	Introduction And Basic Concepts	Professional Ethics
			Consumer Behaviour	Human Values
			Demand And Supply Analysis	Professional Ethics
			Production Analysis	Professional Ethics
3	F.Y.B.Com 2019 Pattern	Business Mathematics & Statistics- I	Interest And Annuity	Professional Ethics
			Shares And Mutual Funds	Professional Ethics
			Population And Sample	Professional Ethics
			Measures Of Central Tendency And Measures Of Dispersion	Professional Ethics
4	F.Y.B.Com 2019 Pattern	Computer Concepts And Application - I	Introduction To Computer And Operating System	Professional Ethics Professional Ethics
			Office Automation Tools	Professional Ethics
			Introduction To Computer Network	Professional Ethics Professional Ethics
			Computer Applications In Commerce	Professional Ethics Professional Ethics
5	F.Y.B.Com 2019 Pattern	Organizational Skills Development- I	Concept Of Modern Office	Professional Ethics
			Office Organisation And Management	Professional Ethics Professional Ethics
			Office Records Management	Professional Ethics Professional Ethics
			Office Work	Professional Ethics
6	F.Y.B.Com	Marketing And	Introduction To Market And Marketing	Professional Ethics

	2019 Pattern	Salesmanship- I	Market Segmentation And Marketing Mix	Professional Ethics
			Product Mix And Price Mix	Professional Ethics Professional Ethics
			Place Mix And Promotion Mix	Professional Ethics Human Values
7.	F.Y.B.Com 2019 Pattern	Computerised Accounting	Computerised Accounting	Professional Ethics Sustainability
			Tally Software	Professional Ethics Sustainability
			Voucher Entry in Tally Software	Professional Ethics Sustainability
			Ledger and financial statements in Tally Software	Professional Ethics Sustainability
8.	F.Y.B.Com 2019 Pattern	Value Education	Concepts of Value Education	Human Values
			Ethics and Moral Values	Human Values
			Gender Equity	Gender
			Ethics, Moral Values and Culture	Human Values
			Human Rights	Human Values & Gender Sensitization
			Awareness of values and ethics in economic progress	Sustainability
			Concept of Morality and Moral Education	Human Values

Head
Department of Commerce
K. J. Somaiya College, Kopargaon

Coordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

Financial Accounting- I

K. SOMAIYA COLLEGE Commerce KOPARGAON

Course Code - 112 **No. of Credits :- 03 and for practical - 01**

Objective of the Course:-

1. To impart knowledge of basic accounting concepts
2. To create awareness about application of these concepts in business world
3. To impart skills regarding Computerised Accounting
4. To impart knowledge regarding finalization of accounts of various establishments.

Unit No.	Unit Title	Contents	Purposed Skills to be developed
1	Accounting Concepts, Conventions and Principles and an overview of Emerging Trends in Accounting	**(A) Accounting Concepts, Conventions and Principles** 1. Money Measurement 2. Business Entity 3. Dual Aspect 4. Periodicity Concept 5. Realization Concept 6. Matching Concept 7. Accrual / Cash Concept 8. Consistency Concept 9. Conservatism Principle 10. Materiality Concept 11. Going Concern Concept 12. Historical Cost Concept **(B) Emerging Trends in Accounting** 1. Inflation Accounting 2. Creative Accounting	• Knowledge about various accounting Concepts, Conventions and Principles. • Understanding emerging trends in accounting and its effect on accounting Practices.

2	Fleeman Dissolution of Cash	1. Surplus Capital Method only, Asset taken over by a partner, 2. Treatment of past profits or past losses in the Balance sheet, 3. Contingent liabilities 4. Realization expenses/amount kept aside for expenses 5. adjustment of actual, Treatment of secured liabilities, 6. Treatment of preferential liabilities like Govt. dues/labour dues etc., Excluding: Insolvency of partner and Maximum Loss Method.	• Knowledge about process of dissolution of partnership firm.
3	Accounts from Incomplete Records (Single Entry System)	1. Meaning of single entry system 2. Features of Single Entry System 3. Conversion of Single Entry into Double Entry	• *Knowledge about single entry systems.* • *Purpose and advantages of double entry system* • *Process of conversion of single entry into double entry system.*
4	Introduction to Goods and Services Tax laws and Accounting	1. Constitutional Background of GST, Concepts and definition of GST. 2. IGST, CGST and SGST 3. Input and Output Tax credit 4. Procedure for registration under GST	• *Knowledge about conceptual framework of the GST* • *Knowledge about various components of GST.* • *Types of taxes under GST* • *Registration process under GST for business establishments.*

Business Economics (Micro) - I

Course Code - 113 **No. of Credits : 03**

Objectives of the course:-

1. To impart knowledge of business economics
2. To clarify micro economic concepts
3. To analyze and interpret charts and graphs
4. To understand basic theories, concepts of micro economics and their application

Unit No.	Unit Title	Contents	Purpose & skills to be developed
1	**Introduction and Basic Concepts**	1.1 Meaning, Nature, Scope and Importance of Business Economics 1.2 Concept of Micro and Macro Economics 1.3 Tools for Economic Analysis- Functional Relationship, Schedules, Graphs and Equations 1.4 Basic Concepts: Household, Consumer, Firm, Plant and Industry 1.5 Goals of Firms- Economic and Non-Economic	• To make the students aware of concepts in micro economics • To help the students understand the difference between micro and macro economics • To make the students understand economic and non-economic goals of firms. **Skills :** Analyze and think critically, develop writing skills
2	**Consumer Behavior**	Utility: Concept and Types 2.2 Cardinal Approach: Law of Diminishing Marginal Utility and Law of Equi Marginal Utility 2.3 Consumer Surplus: Concept and Measurement 2.4 Ordinal Approach: Indifference curve Analysis- Concept, Characteristics, Consumer Equilibrium	• To help the students understand the concept of utility • To impart knowledge of cardinal and ordinal approach • To make them understand the concept of consumer surplus **Skills:** Understanding complex theories and concepts Geometrical skills, mathematical aptitude, writing skills

			3.4 Elasticity of Demand 3.4.1 Price Elasticity of Demand - Meaning, Types, Measurement, Uses and Significance 3.4.2 Income Elasticity of Demand-Meaning and Types 3.4.3 Cross Elasticity of Demand-Meaning and Types 3.5 Supply : Concept, Determinants and Law of Supply 3.6 Equilibrium of Demand and Supply for Price Determination	of law of supply • To help the students understand price determination in varie demand and supply condition **Skills imparted:** *Applying mathematical and statistical analysis methods extracting information, drawing conclusions*
		4.	**Production Analysis**	4.1 Concept of Production Function 4.2 Total, Average and Marginal Production 4.3 Law of Variable Proportions 4.4 Law of Returns to Scale 4.5 Economies and Diseconomies of Scale-Internal and External	• *To help the students understand the relation between revenue concepts* • *To understand theories of production function* • *To make students know about economies and diseconomies of scale* **Skills:** *Interpret economic theories, writing skills, understand charts and graphs.*

K. J. SOMAIYA COLLEGE OF ARTS & COMMERCE KOPARGAON

Course Code – 114 (A) **Semester: I** **Business Mathematics & Statistics- I**

Objective of the Program

1. To introduce the basic concepts in Finance and Business Mathematicsand Statistics
2. To familiar the students with applications of Statistics and Mathematics in Business
3. To acquaint students with some basic concepts in Statistics.
4. To learn some elementary statistical methods for analysis of data.
5. The main outcome of this course is that the students are able to analyze the data by using some elementary statistical methods

Unit No.	Unit Title	Contents	Purpose/Skills to be developed
1	**Interest and Annuity**	**Interest:** Concept of Present value and Future value, Simple interest, Compound interest, Nominal and Effective rate of interest, Examples and Problems **Annuity:** Ordinary Annuity, Sinking Fund, Annuity due, Present Value and Future Value of Annuity, Equated Monthly Installments (EMI) by Interest of Reducing Balance and Flat Interest methods, Examples and Problems.	1. To understand the concept of Simple interest, compound interest, effect of compounding. 2. To understand the concept of Annuity and its applications for EMIs and Amortization Schedule.
2	**Shares and Mutual Funds**	**Shares:** Concept of share, face value, market value, dividend, brokerage, equity shares, preferential shares, bonus shares. Examples and Problems **Mutual Funds:** Concept of Mutual Funds, Problems on calculation of Net Income after considering entry load, Dividend, Change in Net Asset Value (NAV) and exit load. Averaging of price under the Systematic Investment Plan (S.I.P.). Examples and Problems	1. To understand the concept of shares and mutual funds. 2. To understand contribution of shares and mutual funds in systematic investment plans 3. To solve problems related to shares and mutual funds
3	**Population and Sample**	Definition of Statistics, Scope of Statistics in Economics, Management Science and Industry. Concept of population and sample, methods of data collection: Census and sampling with illustration. Methods of random sampling – SRSWR, SRSWOR, Stratified, Systematic (Description of sampling procedures only).	1. Collection of data 2. Analyzing and interpreting data. 3. Knowing different method of sampling

Topic No.	Total Lectures	Innovative methods to be used	Expected Outcome
1	16	ICT	Students will be able to apply concepts of interests and annuities to calculate EMI, prepare amortization schedule, calculate insurance premiums etc
2	8	ICT	Students will be able calculate dividend, brokerage on shares and mutual funds. Also students will be able to identify the contribution of shares and mutual funds in systematic investment plans and to select best investment options
3	8	ICT	Students will be able to recognize and classify different types of data. Students will be able to take a sample of appropriate size using suitable method of sampling.
4	16	ICT	Students will be able to calculate measures of central tendency and measures of dispersion. Students will be able to use appropriate measure of central tendency or measure of dispersion for given data to given problems from business or economics.

Teaching methodology

Semester: I

Computer Concepts and Application - I

Course Code – 114 (B) **No. of Credits :- 03**

Objective:

1. To make the students familiar with Computer environment.
2. To make the students familiar with the basics of Operating System and business communication tools.
3. To make the students familiar with basics of Network, Internet and related concepts.
4. To make awareness among students about applications of Internet in Commerce.
5. To enable make awareness among students about e-commerce and M commerce.

Unit 1 Introduction to Computer and Operating system **[12]**

Introduction to Computer
Definition, Block Diagram, Computer Hierarchy, (Classification), Characteristics of Computer

Computer System Hardware
Computer Memory
Input and Output Devices

Definition – Software
Software Types - System Software, Application Software

Definition of Operating System

Types of Operating Systems,
Functions of Operating Systems

Working with Windows Operating System:

Introduction to Free and Open Source Software

Definition of Computer Virus, Types of Viruses, Use of Antivirus software.

Unit 2 Office automation tools [12]

Definition of Information Technology (IT)
Benefits of Information Technology (IT)
Applications of Information Technology (IT)

Office automation tools

MS-Word: *Introduction, Starting MS-Word, MS-Word Screen and its Components, Elementary Working with MS-Word*

MS-Excel: *Introduction, Starting MS-Excel, Basics of Spread sheet, MS-Excel Screen and Its Components, Elementary Working with MS-Excel*

MS-PowerPoint: *Introduction, Starting MS-PowerPoint, Basics of PowerPoint, MS-PowerPoint Screen and Its Components, Elementary Working with MS PowerPoint*

Data Processing: Files and Records, File Organization (Sequential, Direct/Random, Index)

Unit 3 Introduction to Computer Network [12]

Introduction
Importance of Networking
Computer Network (LAN, WAN, MAN)

Network Components (Hub, Switch, Bridge, Gateway, Router, Modem)

Unit 4 Computer applications in Commerce [12]

Computer Applications in Business – Need and Scope

Computer Applications in various fields of Commerce:
Personnel Administration, Accounting, Cost and Budgetary Management, Purchasing, Banking, Insurance and Stock-broking, e-governance

E-Commerce

Defining e-Commerce, Main Activities of Electronic Commerce, Benefits of E-Commerce; Broad Goals of Electronic Commerce; Main Components of E-Commerce; Functions of Electronic Commerce – Communication, Process Management, Service Management, Transaction Capabilities;

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Semester: I

Organizational Skills Development- I

Course Code – 115 - A

No. of Credits :- 03



Objectives of the course

1. To introduce the students to the emerging changes in the modern office environment
2. To develop the conceptual , analytical , technical and managerial skills of students efficient office organization and records management
3. To develop the organizational skills of students
4. To develop Technical skills among the students for designing and developing effective means to manage records , consistency and efficiency of work flow in the administrative section of an organsation
5. To develop employability skills among the students

Depth of the program – Fundamental Knowledge

Unit No.	Unit Title	Contents	Purpose Skills to be developed
1	Concept of Modern Office	a. Modem Office :- Definition, Characteristics, importance and functions b. Office environment:- Meaning and Importance c. Office Location :-Meaning, Principles and factors affecting Office location d. Office Layout :- Meaning, Principles and factors affecting Office Layout	1. Conceptual Clarity on the meaning of a modern office 2. Developing understanding on the internal and external factors of an office environment 3. Developing analytical and technical skills to contribute towards planning office location and layout
2	Office Organisation and Management	a. Office Organisation : Definition, Importance, Principles and Types of Organisation b. Office Management:- Definition, Functions c. Scientific Office Management :- Meaning, Aims, Techniques of Scientific Office Management and Steps for installation of Scientific Office Management	1. Conceptual clarity on the meaning of Scientific office management 2. Development of understanding in various techniques for scientific management

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	12	Power Point Presentation	Online Videos	Making a model of office layout in groups	Conceptual Clarity on meaning of Modern Office, internal and external factors of an office environment
2	12	Power Point Presentation			Conceptual clarity on the meaning of Scientific office management and understanding various techniques for scientific management
					documents for effective records creation and maintenance
					1. Analytical skills for process improvement in office work.

Teaching Methodology

Course Code – 116 - C

Semester - I

Marketing and Salesmanship-I

(Fundamentals of Marketing)

Objectives of the Course

1. To introduce the basic concepts in Marketing.
2. To give the insight of the basic knowledge of Market Segmentation and Marketing Mix
3. To impart knowledge on Product and Price Mix.
4. To establish link between commerce, business and marketing.
5. To understand the segmentation of markets and Marketing Mix.
6. To enable students to apply this knowledge in practicality by enhancing their skills in the field ofMarketing.

Unit No.	Unit Title	Contents	Purposed Skills To Be Developed
1	Introduction to Market and Marketing	1.1 Meaning and Definition of Market 1.2 Classification of Markets 1.3 Marketing Concept: Traditional and Modern 1.4 Importance of Marketing 1.5 Functions of Marketing: Buying, Selling, Assembling, Storage, Transportation, Standardization, Grading, Branding, Advertising, Packaging, Risk Bearing, Insurance, Marketing Finance, Market Research and Marketing Information. 1.6 Selling vs. Marketing	The basic knowledge of Market and Marketing will be developed amongst students.
		b. Digitalization of records:- Advantages and Problems of Digitalization c. Form Design:- Objectives, types of forms, Significance, Principles of form designing d. Office Manual – Definition, Contents Types , benefits and limitations	
4	Office work	Office work :-Meaning and Characteristics, Flow of work :- Significance, Features of Ideal flow of work ,benefits of flow of work ,problems in smooth flow of work , suggestions for even flow of work	

K. J. SOMAIYA COLLEGE Dept. of Commerce VIDYAVIHAR

		ii. Importance iii. Types of Distribution Channels – consumer goods and Industrial Goods iv. Factors Influencing selection of Channels		
		4.2 Promotion Mix 4.2.1 Meaning of Promotion Mix 4.2.2 Elements of Promotion Mix- Personal Selling, Public Relation and Sales Promotion 4.2.3 Factors Affecting Market Promotion Mix 4.2.4 Promotion Techniques or Methods		

K. J. SOMAIYA COLLEGE
Dept. of Commerce
KOPARGAON

Course No. 5 – Value Education

Objectives of the course:

The course is designed to inculcate the values which are an utmost need of the hour to overcome various challenges. The students will learn to adopt and implement the suitable values at appropriate time, understand various challenges in value adoption in this contemporary world, use the 'Reflection method' to explore values from inside out.

The course is expected to aquatint students with the core values such as physical, mental and spiritual aspects of personality, developing respect for the dignity of individual and the society, inculcation of spirit of patriotism and national integrity and developing tolerance towards understanding of different religious faiths as well. The course will help students to be a better human being and a strong pillar of society.

Course Contents ;-

1. **Values for excellence in life :**
   Developing Values, Personal Values, Family Values, Professional Values.

2. **Life Skills :**
   Motivational Skills, Communication Skills, Life style modification, Accessibility and Addiction, Environmental Awareness.

3. **Spiritual Education :**
   Different schools of meditation, exploring the self, universal concept of the supreme, changing the belief system, Self Esteem, Stress free living.

Methods of Instruction

- Lecture
- Class discussion
- Role plays
- Guest speakers
- Written assignments
- Videos

Certification :

The college needs to provide 'Course Completion Certificate' to every student who completes the course successfully. The certificate must contain the grade obtained by the student in the examination.

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K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

F.Y.B.Com 2019 Pattern (CBCS) (Sem. –II)



Sr.No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	F.Y.B.Com 2019 Pattern	Financial Accounting	Software Used In Accounting	Professional Ethics
			Final Accounts Of Charitable Trust (Clubs, Hospitals, Libraries Etc.)	Professional Ethics
			Valuation Of Intangibles	Professional Ethics Professional Ethics
			Accounting For Leases	Professional Ethics
2	F.Y.B.Com 2019 Pattern	Business Economics	Cost And Revenue	Professional Ethics
			Pricing Under Perfect Market Conditions	Professional Ethics
			Pricing Under Imperfect Market Conditions	Professional Ethics
			Factor Pricing	Professional Ethics Professional Ethics
3	F.Y.B.Com 2019 Pattern	Business Mathematics & Statistics	Matrices And Determinants (Up To Order 3 Only)	Professional Ethics
			Linear Programming Problems (LPP) (For Two Variables Only)	Professional Ethics
			Correlation And Regression	Organisational Behaviour
			Index Numbers	Human Values
4	F.Y.B.Com 2019 Pattern	Computer Concepts And Application	Introduction To E-Commerce Tools	Professional Ethics
			Introductions To E-Marketing	Professional Ethics Professional Ethics
			Electronic Payment System	Professional Ethics
			Introduction To M-Commerce	Professional Ethics Professional Ethics
5	F.Y.B.Com	Organizational	Office Manager	Professional Ethics

	2019 Pattern	Skills Development	Management Reporting (Office Reports)	Professional Ethics
			Work Measurement And Standardization Of Office Work	Professional Ethics
			Office Automation	Professional Ethics
6	F.Y.B.Com 2019 Pattern	Marketing And Salesmanship	Salesmanship	Professional Ethics
			Process Of Selling	Professional Ethics
			Rural Marketing	Human Values
			Recent Trends In Marketing	Professional Ethics

K. J. SOMAIYA COLLEGE KOPARGAON Dept. of Commerce

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K. J. Somaiya College, Kopargaon

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Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

Syllabus for F.Y.B.Com

Semester-II, Paper-II

Subject Name: - Financial Accounting- II

Course Code - 122

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Objectives of the course

This course is intended to introduce the basic theory, concepts and practice of financial accounting and to enable students to understand information contained in the published financial statements of companies and other organizations. It includes the preparation of accounting statements, but their uses and limitations will also be emphasized.

Depth of the program – fundamental Knowledge

Objective of the Program

1. To impart knowledge of various software used in accounting
2. To impart knowledge about final accounts of charitable trusts
3. To impart knowledge about valuation of intangible assets
4. To impart knowledge about accounting for leases

Unit No.	Unit Title	Contents	Purpose Skills to be developed
1	**Software used in Accounting**	1. Types of Accounting Software 2. Use of Accounting Software 3. Installation of Accounting Software 4. Advantages and disadvantages of Accounting Software Voucher entry and Report Generation including GST transactions	• Students are expected to acquaint themselves with Computerised accounting, its application and utility.

2	**Final Accounts of Charitable Trust (Clubs, Hospitals, Libraries etc.)**	1. Meaning and Characteristics 2. Accounting Records 3. Income and Expenditure Account 4. Receipt and Payment Account 5. Balance Sheet and Adjustments	• Understanding the accounting process of accounting of charitable trusts • Recording basic accounting transactions and prepare annual financial statements; and • Analyzing , interpreting and communicating the information contained in basic financial statements and explain the limitations of such statements
3	**Valuation of Intangibles**	1. Valuation of Goodwill (Problem) 2. Valuation of Brands 3. Valuation of Patents, Copyright and Trademark etc.	• Learning the concept of intangible assets and the methods of their valuation.
4	**Accounting for Leases**	1. Types of Lease (Finance Lease and Operating Lease) 2. Finance Lease (Hire Purchase and installment) (Theory) 3. Operating Lease 4. Royalty, 5. Minimum Rent, 6. Short Workings, 7. Recoupment Of Short Working. 8. Lapse of Short Working Journal Entries and Ledger Accounts in the Books of Landlord and Lessee	• Understanding the process and methods of leasing.

Revised syllabi (2019 Pattern) for Three Years B. Com. Degree course (CBCS)

First Year B. Com

Semester-II Course Code - 123

Business Economics (Micro) - II

Objectives:

1. To understand the basic concepts of micro economics.
2. To understand the tools and theories of economics for solving the problem of decision making by consumers and producers.
3. To understand the problem of scarcity and choices.

Depth of the program – Fundamental Knowledge

Objectives of the Program

1. To impart knowledge of business economics
2. To clarify micro economic concepts
3. To analyze and interpret charts and graphs
4. To understand basic theories, concepts of micro economics and their application

Unit No.	Unit Title	Contents	Purpose skills to be developed
1	**Cost and Revenue**	1.1 Concepts and Types of Cost- Economic Cost and Accounting Cost, Private Cost and Social Cost, Actual Cost and Opportunity Cost, Explicit Cost and Implicit Cost, Incremental Cost and Sunk Cost, Fixed Cost and Variable Cost 1.2 Relation between Total Cost, Average Cost and Marginal Cost 1.3 Cost Curves in Short run and Long run 1.4 Concept of Total Revenue, Average Revenue and Marginal Revenue	• To understand the concept and types of cost • To make the students know about short run and long run cost concepts • To impart knowledge about types of revenue Skills: Interpretation of cost curves, integrate cost and revenue concepts, draw inferences

2	**Pricing Under Perfect Market Conditions**	2.1Pure Competition: Meaning and Features 2.2 Features of Perfect Competition 2.3 Price Determination in Perfect Competition 2.4 Equilibrium of Firm and Industry in Short Run and Long Run	• To help the students understand the concept of pure and perfect competition • To impart knowledge about equilibrium of firm and industry in short and long run. Skills: Understanding, writing skills, critical thinking			
3.	**Pricing Under Imperfect Market Conditions**	1.1 Meaning of Imperfect Competition 1.2 Monopoly: Features and Equilibrium, Price Discrimination 3.3 Monopolistic Competition- Features and Equilibrium. 3.4 Oligopoly: Concept and Features 3.5 Duopoly: Concept and Features 3.6 Comparison of Perfect and Imperfect Competition	• To develop ability to understand the market structures under imperfect competition • Ability to compare perfect and imperfect competition *Skills: Understand complex relations, problem solving skill, analytical skill*			
4	**Factor Pricing**	4.1 Marginal Productivity Theory of Distribution 4.2 Rent- Meaning, Ricardian Theory of Rent, Modern Theory of Rent, Concept of Quasi Rent 4.3 Wages- 4.3.1 Meaning and Types of Wages- a) Minimum Wages b) Money Wages c) Real Wages d) Subsistence Wages e) Fair Wages 4.3.2 Backward Bending Supply Curve of Labour	• *To understand the theory of marginal productivity* • *To understand the concept and theories in factor pricing* *Skills: Critical thinking, logical thinking, apply information processing skills*			
		4.3.3 Role of Collective Bargaining in Wage Determination 4.4 Interest-Meaning, Loanable Fund Theory, Liquidity Preference Theory 4.5 Profit- Meaning, Risk and Uncertainty Theory of Profit, Dynamic Theory of Profit, Innovation Theory of Profit				

Teaching methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	8	• Open book discussion, • Case studies	• You tube lectures • Online PPTs	Types of cost in industries Comparison of cost and revenues in industries Trends of cost and revenue in industries	• Will understand the concept and types of cost • Students will know about short run and long run cost concepts • Students will have knowledge about types of revenue
2	8	Digital lectures Interactive lectures	• You tube lectures • Online PPTs	Application of perfect competition markets in the markets like that of agricultural products, dairy products etc	• Students will understand the concept of pure and perfect competition • Students will know about the equilibrium of firm and industry in short and long run.

Dept of Commerce
YOPARGAON COLLEGE

Syllabus for B. Com. Semester: - II

Subject Name: - Business Mathematics and Statistics - II

Course code: - 124 (A)

K.J. Dept. of Commerce KOPARGAON

Depth of the program – Basic Knowledge of Mathematics and Statistics

Objective of the Program

1. To introduce the basic concepts in Finance and Business Mathematics and Statistics
2. To familiar the students with applications of Statistics and Mathematics in Business
3. To acquaint students with some basic concepts in Statistics.
4. To learn some elementary statistical methods for analysis of data.
5. The main outcome of this course is that the students are able to analyze the data by using some elementary statistical methods

Unit No.	Unit Title	Contents	Purpose Skills to be developed
1	**Matrices and Determinants (up to order 3 only)**	Definition of a Matrix, Types of Matrices, Algebra of Matrices, Determinants, Adjoint of a Matrix, Inverse of a Matrix via Adjoint Matrix, Homogeneous System of Linear equations, Condition for Consistency of homogeneous system, Solution of Non-homogeneous System of Linear equations (not more than three variables), Applications in Business and Economics, Examples and Problems.	1. To understand the concept of matrices and determinants. 2. To understand the application of determinant in solving linear equations 3. To understand applications of matrices and determinants in business and economics.
2	**Linear Programming Problems (LPP) (for two variables only)**	Definition and terms in a LPP, formulation of LPP, Solution by Graphical method, Examples and Problems	1. To understand the concept of LPP and its application in business and decision making. 2. To understand graphical method to solve business optimization problems with two variables.
3	**Correlation and Regression**	Concept and types of correlation, Scatter diagram, Interpretation with respect to magnitude and direction of relationship. Karl Pearson's coefficient of correlation for ungrouped data. Spearman's rank correlation coefficient. (with tie and without tie) Concept of regression, Lines of regression for ungrouped data, predictions using lines of regression. Regression coefficients and their properties (without proof). Examples and problems.	1. To use correlation for knowing the relationship between two variables. 2. To use regression for prediction

K. J. SOMAIYA COLLEGE
Dept. of Commerce
KOPARGAON

Course No. 1 – Computerised Accounting

Objectives of the course:

The course has been designed to acquaint students with the computerized accounting practices used in the industry. Practical knowledge about accounting software will be provided to the students' along with hands on experience in the computer laboratories. The course aims at enhancing skills and employability of students. This course is an extension of the existing curriculum of Financial Accounting.

Course Contents:

- Tally Fundamentals
- Accounts Masters – Groups, Ledgers, Voucher Types – Create, Display, Alter
- Accounting Voucher Types – Contra, Payment, Receipt, Journal, Sale, Purchase, Debit Note, Credit Note
- Data Export / Import,
- Finalization Adjustment entries
- Inventory Masters – Stock Groups, Unit of Measure, Godowns, Stock Items – Create, Display, Alter
- Invoicing – Enter Purchases / Sales / Debit Note / Credit Note in Invoice Mode – Accounting Invoice, Item Invoice, Additional expenses, Tax ledgers in Invoices
- Bank Reconciliation,
- Data Backup/Restore

Methods of Instruction

- Lecture
- Guest speakers
- Written assignments
- Laboratory practical

Certification :

The college needs to provide 'Course Completion Certificate' to every student who completes the course successfully. The certificate must contain the grade obtained by the student in the examination.

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		1.8 Salesmanship – a Profession **1.9** Qualities of Salesman	
2	**Process of Selling**	**2.1** Psychology of Salesmanship – Attracting Attention, Awakening Interest, Creating Desire and Action **2.2** Stages in Process of Selling – (i) *Pre-Sale Preparations* (ii) *Prospecting* (iii) *Pre-Approach* (iv) *Approach* (v) *Sales Presentation* (vi) *Handling of Objections* (vii) *Close* (viii) *After Sales Follow-up*	*Techniques of salesma* *skills will be develope*
3	**Rural Marketing**	**3.1** *Rural Marketing* 3.1.1 *Introduction* 3.1.2 *Definition of Rural Marketing* 3.1.3 *Features of Rural Marketing* 3.1.4 *Importance of Rural Marketing* 3.1.5 *Present Scenario of Rural Market* 3.1.6 *Challenges and Opportunities in Rural Marketing*	*Awareness and importance o* *Rural Marketing amongst* *students.*
4	**Recent Trends in Marketing**	**4.1** Digital Marketing **4.2** Green Marketing **4.3** Niche Marketing **4.4** E-marketing **4.5** Social Media Marketing- Challenges and Opportunities	Skills of Modern Marketing will be developed.

Unit 5	**Inventory Control**	
5.1 5.2 5.3	Stock Taking, Periodic and Perpetual Method. ABC Analysis. Inventory Ratios.	08
Unit 6	**Labour Cost, Remuneration And Incentives**	
6.1 6.2 6.3 6.4	Records &Methods Of Time Keeping and Time Booking Study of New Methods. **Methods Of Remuneration-** ❖ Time Rate System, ❖ Piece Rate system, ❖ Taylor's Differential Piece rate System. **Incentive Plan-** Halsay Premium Plan, ❖ Rowan Premium Plan. ❖ Group Bonus Schemes.	12
Unit 7	**Other Aspects Of Labour**	
7.1 7.2 7.3	Labour Turnover. Job Analysis & Job Evaluation Key. Merit Rating.	10
Unit8	**Direct Cost**	
8.1	Concept and Illustrations.	02
		Total 48

Note-

Allocation of Marks

50% for Theory

50% for Practical Problem.

❖ ***Teaching Methodology***

1. Class Room Lectures.
2. Guest Lectures.
3. Visit to Industries.
4. Group Discussion.
5. Collection of Records & Documents.

❖ ***Recommended Books :***

1. S.P. Lyengar - Cost Accounting Principles and Practice, Sultan Chand , & Sons Accounting Taxman's, New Delhi.
2. M.N. Arora - Cost Accounting Principles and Practice Vikas Publishing House Pvt.Ltd. New Delhi.
3. S.N. Maheshwari and S.N.Mittal- Cost Accounting, Theory and Problems, Mahavir book Depot, New Delhi.

K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

S.Y.B.Com 2019 Pattern (CBCS) (Sem. –III)

K.J. SOMAIYA COLLEGE Dept. of Commerce KOPARGAON

Sr. No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	S.Y.B.Com 2019 Pattern	Business Communication-I	Introduction Of Business Communication	Professional Ethics
			Business Letters	Professional Ethics Professional Ethics
			Soft Skills	Professional Ethics
			Resume Writing & Job Application Letters	Professional Ethics
2	S.Y.B.Com 2019 Pattern	Corporate Accounting –I	Accounting Standards	Professional Ethics Professional Ethics
			Profit Prior To Incorporation	Professional Ethics
			Company Final Accounts	Professional Ethics & Skill Enhancement
			Valuation Of Shares	Professional Ethics
3	S.Y.B.Com 2019 Pattern	Business Economics (Macro)	Introduction To Macro Economics	Skill Enrichment Professional Ethics
			National Income	Sustainability
			Theories Of Output And Employment	Professional Ethics
			Consumption, Saving And Investment:	Human Values
4	S.Y.B.Com 2019 Pattern	Business Management-I	Management 1.1 Meaning Def	Professional Ethics
			Understanding Management :Planning And Decision Making	Professional Ethics
			Management At Work : The Process Of Organizing And Staffing	Professional Ethics
			Result Orientation: Direction And Team Work	Professional Ethics Human Values
5	S.Y.B.Com 2019 Pattern	Elements Of Company Law	The Companies Act, 2 013	Professional Ethics
			Formation And Incorporation Of A	Professional Ethics

			Company	
			Principal Documents	Skill Enhancement
			Capital Of The Company	Professional Ethics
6	S.Y.B.Com 2019 Pattern	Cost And Works Accounting -I	Basics Of Cost Accounting	Professional Ethics
			Elements Of Cost And Cost Sheet	Professional Ethics
			Purchase Procedure	Skill Enhancement
			Inventory Control	Professional Ethics Professional Ethics

J. SOMAIYA COLLEGE Dept. of Commerce KOPARGAON

Head
Department of Commerce
K. J. Somaiya College, Kopargaon

Co ordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

K.J. SOMAIYA COLLEGE
Dept. of Commerce
KOPARGAON

Savitribai Phule Pune University
Faculty of Commerce & Management
S Y B Com (Semester III)
(Choice Based Credit System)
Revised Syllabus (2019 Pattern)

CORE COURSE – I

Course Code: 231

Subject: Business Communication-I

Total Credits: 04 (Theory 03 + Practical 01=04)

1. Objectives of the Course:

a. To understand the concept, process and importance of communication.
b. To acquire and develop good communication skills requisite for business correspondence.
c. To develop awareness regarding new trends in business communication.
d. To provide knowledge of various media of communication.
e. To develop business communication skills through the application and exercises.

Medium of Instruction: English

Unit No.	Unit Title	Contents	Skills to be developed
1	**Introduction of Business Communication**	1.1 Introduction, Meaning, Definition. 1.2 Characteristics, Importance of communication. 1.3 Principles of communication, Process of communication 1.4 Barriers to communication & Remedies. 1.5 Methods and Channels of Communication.	i. Conceptual Clarity and understanding the Meaning , Characteristics and Importance of communication. ii. To understand the Principles and Process of communication iii. To understand Barriers to communication
2	**Business Letters**	2.1 Meaning and Importance 2.2 Qualities or Essentials, Physical Appearance 2.3 Layout of Business	i. To understand the importance of business letters. ii. To understand Essentials

		Letter	Qualities of business letters.
3	**Soft skills**	3.1 Meaning, Need, Importance. 3.2 Elements of soft skills. a) Manners & Etiquettes, Grooming. b) Effective Listening & Speaking c) Interview Skills. d) Presentation e) Group Discussion. f) Problem-solving skills G)Time management abilities	i. To acquire the fundamental knowledge about soft skills ii. To understand the Elements of Soft Skills
4	**Resume writing & Job Application letters**	4.1 Introduction, essential elements of Bio data, Resume writing, Curriculum Vitae. 4.2 Meaning & Drafting of Job Application letter.	To understand Resume writing and Job application letter.

Teaching Methodology:

Topic No.	Total Lectures	Innovative Methods to be used	Film Shows and A.V. Application	Project	Expected Outcome
1	12	Lecture, PPT Presentation Poster Presentation, Group Discussion, Library visit ,Home Assignment ,Pre reading, Class discussion , library visit ,	Relevant You Tub Videos ,Relevant slide show, online Video Short Film Show	Individual assignment report	Understanding of basic knowledge of Business Communication

CORE COURSE – II

Subject: CORPORATE ACCOUNTING -I **Course Code: 232**

Total Credits: 03

K. J. Somaiya College Dept. of Commerce KOPARGAON

Preamble

In the modern economic environment, the corporate sector is one of the major contributors towards GDP of any country and is also one of the largest and fastest growing sectors for providing employment opportunities. In last decade, the corporate sector has seen a massive growth in economic terms i.e. the volume of turnover, income and expenses etc. and also in terms of expansion of business across the globe. Accounting plays a vital role in this growth and to ensure safeguard of the interest of the stakeholders and the society. It is, therefore, important to educate the students of commerce in the accounting practices adopted by the corporate organizations.

Objectives of the course:

1. To acquaint the student with knowledge about various Concepts , Objectives and applicability of some important accounting standards associated with to corporate accounting.
2. To develop understanding among the students on the difference between commencement and incorporation of a company and the accounting treatment for transactions during the two phases.
3. To update the students with knowledge for preparation of final accounts of a company as per Schedule III of the Companies Act 2013
4. To empower to students with skills to interpret the financial statements in simple and summarized manner for effective decision making process.
5. To acquaint the student with knowledge about various Concepts , Objectives and applicability of some important accounting standards associated with to corporate accounting.
6. To develop understanding among the students on the difference between commencement and incorporation of a company and the accounting treatment for transactions during the two phases.
7. To update the students with knowledge for preparation of final accounts of a company as per Schedule III of the Companies Act 2013
8. To empower to students with skills to interpret the financial statements in simple and summarized manner for effective decision making process.

Depth of the program – Fundamental Knowledge

Unit No.	Unit Title	Contents	Skills to be developed
1.	**Accounting Standards**	• Standards 5, 10, 14 Accounting and 21 • Its applicability with Practical Examples.	• To develop conceptual understanding about various Accounting Standards and its applicability in corporate accounting.

2.	**Profit Prior to Incorporation**	• Introduction to the process on incorporation of a company. • Difference between incorporation and commencement of a company. • Accounting of incomes and expenses during Pre- and Post-Incorporation period. • Basis of allocation and apportionment of income and expenses for the Pre- and Post-Incorporation period.	• To develop Conceptual understating about Pre- and Post-Incorporation period. • To develop analytical skills (by understanding the allocation and apportionment of incomes and expenses for the Pre- and Post-Incorporation)
3.	**Company Final Accounts**	• Preparation of Company Final Accounts- Forms and contents as per Provisions Schedule III of the Companies Act 2013 (with the amendments for the relevant academic year) • Related adjustments and their treatment.	• To understand Practical Application of financial statements along with various adjustments. • To understand revised format of company final accounts.
4.	**Valuation of Shares**	• Concept of Valuation, • Need for Valuation, • Special Factors affecting Valuation of Shares, Valuation – Methods of Valuation • Net Assets Method, • Yield Basis Method, • Fair Value Method	• To understand the concept and need of valuation of shares • To understand the methods of valuation of shares.

Teaching Methodology:

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	10	Use of e-contents, online lectures and quiz, PowerPoint Presentations	Lectures of experts available on YouTube and other digital platforms .	Individual assignment report	Developing understanding on applicability of various Accounting Standards

CORE COURSE – III

Subject: BUSINESS ECONOMICS (MACRO) **Course Code: 233**

Total Credits: 03

K.J. SOMAIYA COLLEGE ★ KOPARGAON ★ Dept. of Commerce

Preamble:

An approach to Macro Economics is to examine the economy as a whole. This paper aims to provide knowledge about macroeconomics that includes macro-economic variables and theories. It also aims to make students familiar about the various concepts of macro-economics, national income, macro-economic theories and its implicationsin the economy.

Scope of the programme –

Basic Knowledge of Macro Economics

Objectives –

- To familiarize the students to the basic theories and concepts of Macro Economics and their application.
- To study the relationship amongst broad aggregates.
- To impart knowledge of business economics.
- To understand macroeconomic concepts.
- To introduce the various concepts of National Income.

Unit	Name and Content of the Chapter	Purpose & Skills to be Developed
Unit 1	**Introduction to Macro Economics** 1.1 Meaning and Definition of Macro Economics. 1.2 Nature of Macro Economics. 1.3 Scope of Macro Economics. 1.4 Significance of Macro Economics. 1.5 Limitations of Macro Economics. 1.6 Macro Economic Objectives.	**Purpose:** . To make the students aware of concepts in macroeconomics **Skills:** Analyze & think critically, develop writing skills.
Unit 2	**National Income** 2.1 Meaning and Importance of National Income. 2.2 Concepts: 2.2.1 Gross National Product (GNP) 2.2.2 Net National Product (NNP) 2.2.3 Gross Domestic Product (GDP) 2.2.4 Per Capita Income (PCI) 2.2.5 Personal Income (PI) 2.2.6 Disposable Income (DI) 2.3 Measurement of National Income:	**Purpose:** To make the students aware of basic concepts in national income **Skills:** Analyze & think critically, quantitative aptitude and develop writing skills.

	Methods and Difficulties	
	2.4 Circular Flow of Income: Two sector model	
Unit 3	**Theories of Output and Employment:**	**Purpose:** To help the students to understand the concept of Employmentand theory Output. **Skills:** Understanding, writing skills, critical thinking.
	3.1 The Classical Theory of Employment: J.B.Say	
	3.2 Keynes Criticism on Classical Theories of Employment.	
	3.3 Keynesian Theory of Employment.	
Unit 4	**Consumption, Saving and Investment:**	**Purpose:** To understand the concepts of Multiplier and Accelerator. To impart knowledge of Consumption Function, Saving and Investment Function **Skills:** Understanding, ability to analyze, quantitative aptitude and writing skills.
	4.1 The Consumption Function: 4.1.1 Meaning 4.1.2 Marginal Propensity to Consume (MPC) 4.1.3 Keynes's Psychological Law of Consumption. 4.1.4 Determinants of Consumption.	
	4.2 The Saving Function: 4.2.1 Meaning, 4.2.2 Marginal Propensity to Save (MPS) 4.2.3 Determinants of Savings 4.2.4 Relationship between Consumption and Saving Function (MPC and MPS)	
	4.3 Meaning and Types of Investment: Gross, Net, Induced and Autonomous.	
	4.4 Marginal Efficiency of Capital and its Determinants.	
	4.5 Concepts of Investment Multiplier and Acceleration Principal.	

Teaching Methodology:

Unit No.	Total Lectures	Innovative methods to be Used	Film shows and AV Applications	Project	Expected Outcome
1	08	• Open book discussion Digital lectures Reading Projects	You tube lectures on macro economics	• Difference in goals of developed and developing	Students will understand basic concepts of macroeconomics

CORE COURSE – IV

Subject: BUSINESS MANAGEMENT -I **Course Code: 234**

Total Credits: 03

K. J. SOMAIYA ... Dept. of Commerce ★ KOPARGAON ★

1. Objectives of the course
   a. To provide basic knowledge and understanding about various concepts of Business Management.
   b. To help the students to develop cognizance of the importance of management principles.
   c. To provide an understanding about various functions of management.
   d. To provide them tools and techniques to be used in the performance of the managerial job.

2. Depth of the program – fundamental Knowledge

Unit No.	Unit Title	Contents	Purpose / Skills to be developed
1	Management :	• Meaning definition of Management • Need for Management study • Process and levels of management • Functions of management • Contribution of F.W. Taylor, Henry Fayol, Peter Drucker, Mintzberg and Michel Porter in development of management thoughts	1. Understanding how management works 2. Developing thought process as a manger 3. Understanding functions of Management 4. Understand the role of Management Thinkers in development of modern management process
2	Understanding Management : Planning and Decision Making	• Meaning, definition and nature of Planning • Forms and types of Planning • Steps in Planning • Limitations of Planning • Meaning and techniques of Forecasting • Meaning, Types and Steps in Decision Making	1. How to plan various management activities, programmes and events 2. Developing of decision making skills to evaluate various alternatives and situations 3. Understanding the concept of forecasting

Unit No.	Unit Title	Contents	Skills to be developed

3.	Management at Work : The process of organizing and staffing	• Meaning, Process and Principles of Organizing • Concept of Authority and Responsibility • Delegation of Authority • Difficulties in Delegation of Authority • Need and importance of Staffing • Recruitment : Sources and Methods	1. Understanding the importance and process of organisation 2. Understanding authority and process of delegation of authority 3. Understanding process of recruitment
4.	Result orientation :Direction and Team Work	• Meaning, Elements, Principles, Techniques and Importance of Direction. • Concept of Team Work, Group Dynamics and principles regarding interpersonal communication and Group Behaviour	1. How to direct a group / team? 2. Team building skills 3. Wining confidence of group members 4. How to initiate healthy discussions to achieve consensus?

Teaching Methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	12	PowerPoint Presentations, YouTube Videos	Films on Process of Management and Films on Management Thinkers	Poster Presentation on Management Thinkers and their role in present business management	Students will get an idea about the basic managerial process
2	12	PowerPoint Presentations, YouTube Videos	Documentaries	Student group activities which involve Planning and Decision Making	Students will get an idea about how planning works in real life.
3	12	PowerPoint Presentations, YouTube Videos	Lectures on industry experts and documentaries on organizing and staffing	Poster Presentation	Students will understand the process of implementation of both the concepts.
4	12	PowerPoint Presentations, YouTube	documentaries	Student group activities which involve direction and team work.	Students will understand importance of proper direction and

Dept. of Commerce
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CORE COURSE – V

Subject: ELEMENTS OF COMPANY LAW **Course Code: 235**

Total Credits: 03

Objectives of the Program

1. To develop general awareness of Elements of Company Law among the students.
2. To understand the Companies Act 2013 and its provisions.
3. To have a comprehensive understanding about the existing law on formation of new company in India.
4. To create awareness among the students about legal environment relating to the company law.
5. To acquaint the students on e-commerce, E governance and e-filling mechanism relating to Companies.
6. To enhance capacity of learners to seek the career opportunity in corporate sector.

Unit No	Unit Title	Contents	Skills
1.	**The Companies Act, 2013: Introduction and Concept**	**Company and its Formation** **1. Background and Features of company the Companies Act, 2013** **2. Company:** Meaning, Nature and Characteristics of Company. **3. Types of Companies:** On the basis of mode of formation, Number of members, liability and Control, **Public and Private Companies**: Distinction, Advantages, Disadvantages, Privileges and their Conversion into each other. **Other kinds of Companies**: One Person Company, Charitable Companies, Dormant Company, Sick Company, Small Company, Listed Company, Foreign Company and its business in India etc.	Understand the concept of company and Equip the students with knowledge of nature and types of companies.

2.	**Formation and Incorporation of a Company**	**Formation and Incorporation of a Company:** Stages in the Formation and Incorporation. 1. Promotion: Meaning of the term 'Promoter' / Promoter Group - Legal Position of Promoters, Pre-incorporation contracts. 2. Registration/ Incorporation of a company : - Procedure, Documents to be filed with ROC. Certificate of Incorporation- Effects of Certificate of Registration. 3.Capital Subscription/Raising of Capital 4.Commencement of business	Acquaint the students with procedure of formation of company.
3.	**Principal Documents**	**Principal Documents:** **Documents relating to Incorporation and Raising of Capital:** 1 **Memorandum of Association:** Meaning and importance- Form and contents- Alteration of memorandum. 2 **Articles of Association:** Meaning- Contents and form of Articles- Alteration of articles- Doctrine of constructive notice- Doctrine of Indoor Management. 3 **Prospectus:** Meaning, contents, Statutory requirements in relation to prospectus- Deemed Prospectus- Shelf prospectus - Statement in lieu of prospectus- Misstatement in a prospectus and Liabilities for Mis-statement.	To make students understand the role and importance of various documents like Memorandum
4.	**Capital of the Company**	**Capital of the Company** 1. Various Modes for Raising of Share Capital including private placement, public issue, rights issue, bonus shares, ESOS, Sweat Equity Shares, Buy-back of shares. 2. Allotment of Shares: Meaning- - Statutory provisions for allotment, improper and irregular allotment- Consequences of irregular allotment. 3. Calls On Shares: Meaning- Requisites of a valid call, Calls in advance, Share Certificates: Meaning, Provisions regarding issue of share certificates - Duplicate Share Certificate.	To give Comprehensive insight about the capital of Company and various aspects of shares.

K. J. SOMAIYA COLLEGE KOPARGAON
Dept. of Commerce

SPECIAL ELECTIVE COURSE – VI

Subject: Cost and Works Accounting -I(BASICS OF COST ACCOUNTING)

Course Code: 236(E)

Total Credits: 04 (Theory 03 + Practical 01=04)

Objectives:

1. **To prepare learners to know and understand the basic concepts of cost.**
2. **To understand the elements of cost.**
3. **To enable students to prepare a cost sheet.**
4. **To facilitate the learners to understand, develop and apply the techniques of inventory control.**

Unit No.	Unit Title	Contents	Skills to be developed
1	Basics of Cost Accounting	a) Concept of Cost, Costing, Cost Accounting and Cost Accountancy. b) Limitations of Financial Accounting. c) Origin of Costing. d) Objectives of Cost Accounting. e) Advantages & Limitations of Costing. f) Difference between Financial Accounting and Cost Accounting. g) Cost Units and Cost Centers. h) Role of a Cost accountant in an organisation	1. To understand the concept of cost, costing and cost accounting. 2. To trace the cost to cost centres and cost units. 3. To identify role of cost accountant in an organisation
2	Elements of Cost and Cost Sheet	a) Material, Labour and other Expenses. b) Classification of Costs. c) Preparation of Cost Sheet, Tender, Quotation and Estimates.	1. To Understand different elements of cost 2. To be able to prepare a cost sheet
3	Purchase Procedure	a) Need and Essentials of Material Control. b) Functions of the Purchase Department. c) Purchase Procedure. d) Purchase Documentation.	To understand the purchase procedure and its documentation

4	Inventory Control	a) Methods of Inventory control a. Stock Levels. b. Economic Order Quantity (EOQ). c. ABC analysis d. Perpetual and Periodic Inventory Control e. Physical verification b) Inventory Turnover Ratio	. To understand the different methods of inventory control. . To calculate EOQ , stock levels and inventory ratio

Teaching Methodology

Unit No	Total Lectures	Innovative Methods to be used	Films Shows and AV Applications	Practical	Expected Outcome
1	16	PowerPoint Presentations, Group discussions	YouTube Lectures and relevant multimedia compact discs(CD)	Poster Presentation	To remember and understand basic concept of cost accounting. Development of an overall outlook of Cost Accounting
2.	16	PPT, Quiz		Visit small industries to develop an understanding of various cost inputs	Ability to prepare a cost sheet
3	10	Invite a purchase manager in the classroom to provide practical knowledge about Purchase procedures and their documentation.		PowerPoint Presentations	1)Ability to understand which procedures are used for purchasing the material 2)Understand the documentation for purchase procedures
4	06	Invite a storekeeper in the classroom to provide practical knowledge about		Visit small units and understand which	Understanding methods used for controlling the

K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

S.Y.B.Com 2019 Pattern (CBCS) (Sem. –IV)

K. J. SOMAIYA COLLEGE ★ KOPARGAON ★ Dept. of Commerce

Sr. No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	S.Y.B.Com 2019 Pattern	Business Communication-I	Report Writing And Internal Correspondence	Professional Ethics
			Recent Trends In Business Communication	Professional Ethics
			Types And Drafting Of Business Letters	Professional Ethics
			Writing Formal Mails And Blog Writing.	Professional Ethics
2	S.Y.B.Com 2019 Pattern	Corporate Accounting – I	Holding Company Accounts	Professional Ethics
			Absorption Of Companies	Professional Ethics
			Accounting For Liquidation Of Companies	Professional Ethics
			Forensic Accounting	Professional Ethics
3	S.Y.B.Com 2019 Pattern	Business Economics (Macro)	Money	Skill Enrichment
			Inflation	Business Ethics
			Trade Cycle	Organisational Behaviour
			Public Finance	Skill Enrichment
4	S.Y.B.Com 2019 Pattern	Business Management -I	Improving Peoples' Performance : Motivating The Staff	Professional Ethics
			Organizing From Front Leadership Skills	Professional Ethics
			Achieving Success At Work : Coordination And Control	Professional Ethics
			Emerging Trends In Business Management	Professional Ethics
5	S.Y.B.Com 2019 Pattern	Elements Of Company Law	Management Of Company	Professional Ethics
			Key Managerial Personnel (Kmp)	Professional Ethics
			Company Meetings	Professional Ethics
			E Governance And Winding Up Company	Professional Ethics
6	S.Y.B.Com 2019 Pattern	Cost And Works Accounting - I	Material Accounting	Professional Ethics Professional Ethics
			Labour Cost And Payroll	Professional Ethics
			Other Aspects Of Labour	Professional Ethics
			Direct Cost And Introduction To Jit, Cam And Erp.	Professional Ethics Professional Ethics

Coordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

K.J. SOMAIYA COLLEGE
Dept. of Commerce
KOPARGAON

Savitribai Phule Pune University
Faculty of Commerce & Management
S Y B Com (Semester IV)
(Choice Based Credit System)
Revised Syllabus (2019 Pattern)

CORE COURSE – I

Subject: BUSINESS COMMUNICATION-II **Course Code: 241**

Total Credits: 04 (Theory 03 + Practical 01=04)

1. Objectives of the Course:

a. To understand the concept, process and importance of communication.
b. To acquire and develop good communication skills requisite for business correspondence.
c. To develop awareness regarding new trends in business communication.
d. To provide knowledge of various media of communication.
e. To develop business communication skills through the application and exercises.

Medium of Instruction: English

Unit No.	Unit Title	Contents	Skills to be developed
1	**Report Writing and Internal Correspondence**	Meaning and Significance; Structure of Reports; Negative, Persuasive and Special Reporting- 1. Informal Report – Proposals; 2. Formal Reports; 3. Project Report 4. Introduction and Essential elements of Report writing.(Reporting for a meeting) 5. Organization of Press Report. 6. Office Memo (Memorandums) 7. Office Orders 8. Office Circulars 9. Form Memos or Letters 10. Press Releases 11. Import Export Trade	i. To understand the Report Writing and Internal Correspondence. ii. To understand office Correspondence. iii. To study Import Export Trade Correspondence

		Correspondence	
2	**Recent Trends in Business Communication**	Internet: Email, Websites, **Social Media Network** (Twitter, Face book, LinkedIn, You tube, WhatsApp) , Google Doc, Google Form, Google Sheet, Google Slide, Google Class Room, Online Conference, Video conferencing, Meeting through Zoom App, Google meet App ,Cisco Webex meetings App.	To understand the Recent Trends in Business Communication
3	**Types and Drafting of Business Letters**	**1)** Enquiry Letters **2)** Replies to Enquiry Letters **3)** Order Letters **4)** Credit and Status Enquiries **5)** Sales Letters **6)** Complaint Letters **7)** Collection Letters **8)** Circular Letters	i. To acquire the fundamental knowledge about types of Business Letters ii. To create ability among the students for Drafting of Business Letters
4	**Writing Formal Mails and Blog writing.**	4.1: Essential elements of mail, Format of mail. 4.2: Introduction and meaning of Blog, Writing a blog.	To understand the Writing Formal Mails and Blog writing.

Teaching Methodology:

Topic No.	Total Lectures	Innovative Methods to be used	Film Shows and A.V. Application	Project	Expected Outcome
1	12	Lecture, PPT Presentation Poster Presentation, Group Discussion, Library visit ,Home Assignment ,Pre reading, Class discussion , library visit , internet resources, case study	Relevant You Tub Videos ,Relevant slide show, online Video Short Film Show	Report writing of students meeting	Understanding of basic knowledge of Report Writing and Internal Correspondence and Import Export Correspondence
2	12	Pre reading, Class discussion, internet resources, Lecture, Expert Lecture, PPT / Poster Presentation, Group Discussion,	Relevant You Tub Videos , Short Film Show, A.V Application	Project Report on types of Social Media	Learning the Recent Trends in Business Communication

CORE COURSE – II

Subject: CORPORATE ACCOUNTING-II **Course Code: 242**

Total Credits: 03

K. J. SOMAIYA COLLEGE Dept. of Commerce VIDYAVIHAR

Preamble

In the modern economic environment the corporate sector is one of the major contributors towards GDP of any country and is also one of the largest and fastest growing sectors for providing employment opportunities. In the last decade the corporate sector has seen a massive growth in economic terms i.e. the volume of turnover, income and expenses etc. and also in terms of expansion of business across the globe. Accounting plays a vital role in this growth and to ensure safeguard of the interest of the stake holders and the society at large. It is therefore important to educate the students of commerce in the accounting practices adopted by the corporate organizations.

Objectives of the course

1. To acquaint the student with knowledge of corporate policies of investment for expansion and growth through purchase of stake in or absorption of smaller units.
2. To develop the knowledge among the student about consolidation of financial statement with the process of holding.
3. To update the students with knowledge of the process of liquidation of a company
4. To introduce the students with the recent trends in the field of accountancy

Depth of the program – Fundamental Knowledge

Unit No.	Unit Title	Contents	Purpose Skills to be developed
1.	**Holding Company Accounts**	Calculation of Capital Profit, Revenue profit, Cost of Control. Preparation of consolidated Balance sheet of Holding Company with one subsidiary only. Adjustment of intercompany transactions, unrealized profit of stock.	• Conceptual Understanding of Holding Company Accounts • Practical Application skills • Analytical skills
2.	**Absorption of Companies**	Introduction , Meaning - Vendor and Purchasing Companies- Purchase Consideration, Accounting entries in the books of vendor Company and Journal entries and Preparation of Balance Sheet after Absorption in the books of	• Conceptual understanding on the concept of Absorption of companies • Practical application skills in the process of

		Purchasing Company	accounting Absorption
3.	**Accounting for Liquidation of Companies**	Meaning of Liquidation- Modes of winding up – (a) Preparation of Liquidator final statement of Account (b) Preparation of Statement of Affairs and Deficiency Account.	• Conceptual understanding on Liquidation of Companies • Practical application skills
4.	**Forensic Accounting**	Introduction , Meaning , Objectives , Types of Forensic Accounting , Nature and key principles of forensic accounting Ethical principles and responsibilities	• Conceptual skills • Acquisition of knowledge about forensic accounting and its implication.

Teaching Methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	14	Case Study	------	------	Developing understanding on accounting procedure for Holding companies
2	14	Case Study	You Tube and other online platforms for videos	Case study analysis	Conceptual understanding ,Practical application skills in the process of accounting for Absorption
3	12	Case Study , Simulative approach for mock liquidation of an Indian Company based on financial statements	Online Videos for cases	Individual assignment Preparation of Charts , PPT for the format of Statement of Affairs and Deficiency Account.	Practical understanding on Process of Liquidation on companies

CORE COURSE – III

Subject: BUSINESS ECONOMICS (MACRO)-II Course Code: 243

Total Credits: 03

K.J. SOMAIYA COLLEGE Dept. of Commerce KOPARGAON

Preamble –

An approach to Macro Economics is to examine the economy as a whole. This paper aims to provide knowledge about macroeconomics that includes macro-economic variables and theories. It also aims to make students familiar about the various concepts of macroeconomics like functions of money, trade cycleand macroeconomic policies and also about the concepts used in public finance.

Scope of the programme –

Basic Knowledge of Macro Economics

Objectives –

- To familiarize the students to the basic theories and concepts of Macro Economics and their application.
- To understand the theories of money.
- To understand the phases of trade cycle and policy measures to elongate the trade cycle.
- To understand various concepts related to public finance.
- To understand credit creation of banks and money measures of RBI.

Unit	Name and Content of the Chapter	Purpose & Skills to be Developed
Unit 1	**Money:** 1.1 Meaning and Functions of Money. 1.2 Demand for Money: 1.2.1 Classical Approach. 1.2.2 Keynesian Approach. 1.3 Supply of Money: 1.3.1 Credit Creation of Commercial Banks 1.3.2 Money Measure of RBI (M1, M2, M3, M4). 1.3.3 Credit Control Methods. 1.4 Value of Money: 1.4.1. Quantity Theory of Money. 1.4.2 Cash Balance Approach : Marshall, Pigou, Robertson and Keynes	**Purpose:** To understand the concept of money. To make the students know about Demand, Supply and Value of Money. **Skills**: Interpretation, comparative analysis, critical thinking, writing skills
Unit	**Inflation:**	**Purpose:**

2	2.1 Meaning and Definition 2.2 Causes of inflation 2.3 Consequences of Inflation 2.4 Demand Pull and Cost Push Inflation 2.5 Stagflation: Meaning and Causes	To understand the concept Inflation. To understand the stagflation and Phillips curve. **Skills:** Understanding, writing skills, critical thinking
Unit 3	**Trade cycle:** 3.1 Meaning and Definition of Trade Cycle 3.2 Characteristics of Trade Cycle 3.3 Phases of Trade Cycle 3.4 Control of Trade Cycle: Monetary Measures and Fiscal Measures	**Purpose:** To understand the concept and phases of trade cycle. To understand the policy measures **Skills:** Understanding, writing skills, critical thinking
Unit 4	**Public Finance:** 4.1 Meaning and Definitions. 4.2 Scope of Public Finance. 4.3 Importance of Public Finance. 4.4 Meaning and Types of Tax. 4.5 Public Expenditure: Meaning and Causes of Increasing Public Expenditure. 4.6 Public Debt: Meaning and Importance. 4.7 Budget: Meaning and Types.	**Purpose:** To understand Public Finance. To understand the Procedure of Budget. **Skills:** Understanding, Critical thinking and writing skills.

Teaching methodology:

Unit No	Total Lectures	Innovative methods to be used	Film shows and AVApplications	Project	Expected Outcome
1	14	• Open book discussion • Casestudies • Problem solvingbased learning	• You tube lectures • Films	• Implication of liquidity trap. • Credit control methods used by India.	• Studentswill understand concept and theories of money. • Will be able to critically evaluate supply of money in the economies.

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CORE COURSE – IV **Course Code: 1244**

Subject: BUSINESS MANAGEMENT-II

Total Credits: 03

Unit No.	Unit Title	Contents	Skills to be developed
1.	Improving peoples' performance : Motivating the staff	• Meaning, Importance and Theories of motivation • Maslow's Need Hierarchy Theory • Herzberg's Two Factor Theory • Douglas MC Gregor's Theory of X and Y • Ouchi's Theory Z • McClelland's Theory	1. Skills regarding how to motivate staff and other members of the team. 2. Skills regarding retaining motivational level 3. Understanding needs and expectations of group members and meeting them effectively.
2.	Organizing from front-Leadership Skills	• Meaning, Importance, Qualities and Functions of a leader • Leadership styles for effective management • Contribution of Mahatma Gandhi, Dr. Babasaheb Ambedkar and Pt. Jawaharlal Nehru in leadership.	1. How to lead group 2. Understanding followers and their views on various organizational matters. 3. Conflict Management
3.	Achieving success at work : Coordination and Control	• Meaning and need of coordination and control • Techniques and difficulties in establishing coordination and control • Steps in the process of control and it's techniques	1. How to coordinate group efforts 2. Minimizing resource waste 3. Skills to establish coordination between departments.
4.	Emerging trends in Business management	• Corporate Social Responsibility, • Corporate Governance And Corporate Citizenship, • Disaster Management And • Management of Change	1. How to introduce change 2. Significance of Disaster Management 3. Importance and implementation of CSR 4. Importance of Corporate Citizenship

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CORE COURSE – V

Subject: ELEMENTS OFCOMPANY LAW-II Course Code: 245

Total Credits: 03

Depth of the program – Fundamental Knowledge

Objectives of the Program

1. To develop general awareness among the students about management of company
2. To have a comprehensive understanding about Key managerial Personnel of company and their role in Company administration.
3. To acquaint the students about E Governance and E Filling under the Companies Act, 2013.
4. To equip the students about the various meetings of Companies and their importance.
5. To make students capable of becoming good human resource of the corporate sector.

Unit No	Unit Title	Contents	Purpose Skills to be developed
1	Management of Company	**Management of Company:** 1. Board of Directors: Definition, Powers, Restrictions, Prohibition on Board. 2. Director: Meaning and Legal position of Directors,. Types of Directors, Related Party Transactions(Sec.188) 3. Appointment of Directors, Qualifications and Disqualifications, Powers, Duties, Liabilities of Directors, Loans to Directors, Remuneration of Directors	To Equip the students with procedure and practices

2	**Key Managerial Personnel (KMP)**	**Key Managerial Personnel (KMP) ~~(U/S 203)~~** 1. Meaning, Definition and Appointments of Managing Director, Whole Time Director, Manager~~,~~ ~~CS~~ 2.Company Secretary (CS)- Term of office/ Tenure of appointment, Role of Company secretary 3.Distinction between Managing Director, Manager and Whole Time Director - Role (Powers, Functions of above KMP) 4.Corporate Social Responsibility (CSR) [U/S 135] – Concept who is Accountable, CSR Committee, Activities under CSR,	To have Comprehensive understanding about the Key Ma nagerial Persons and CSR
3.	**Company Meetings**	**Company Meetings:** 1. Board Meeting – Meaning and Kinds 2. Conduct of Meetings - Formalities of valid meeting [Provisions regarding agenda, notice, quorum, proxies, voting, resolutions (procedure and kinds) minutes, filing of resolutions, Virtual Meeting] 3. Meeting of Share Holders General Body Meetings, Types of Meetings A. Annual General Meeting (AGM), (Ss.96 to 99) B. Extraordinary General Meeting (EOGM).(Sec.100) 4. Provisions regarding convening, constitution, conducting of General Meetings contained in Ss.101 to 114	To acquaint students about
4.	**E Governance and Winding up Company**	**E Governance and Winding up of a Company** 1. E Governance –meaning, Importance of E Governance 2.E Filing – Basic concept of MCA, E Filing 3. Winding –up: Meaning of winding-up, Dissolution of company, Conceptual understanding of winding-up by the Tribunal, 4.Compulsory winding-up, Members' voluntary winding-up, Creditors' voluntary winding-up	To be able to appreciate the emerging E Governance and E- filing under the Companies Act, 2013. Learn the winding up of company.

[Note: Recent amendments in the Acts and relevant Landmark cases decided by courts are expected to be studied]

Teaching Methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome

K. J. Somaiya College of Arts, Commerce & Science KOPARGAON Dept. of Commerce

SPECIAL ELECTIVE COURSE – VI

Subject: COST& WORKS ACCOUNTING-II

Course Code: 246(E)

Total Credits: 04 (Theory 03 + Practical 01=04)

Objectives:

1. **To know the documents that are used in stores and how to calculate the issuing price of material.**
2. **To provide knowledge to students on classification and codification.**
3. **To equip students with knowledge regarding the ascertainment of labour cost.**
4. **To understand the concept of payroll.**
5. **To know the concepts of labour turnover and merit rating.**
6. **To understand recent trends in cost accounting.**

Unit No.	Unit Title	Contents	Skills to be developed
1	Material Accounting	Store Location and Layout. Classification and Codification of Material. Stores and Material Records. Bin Card & Store Ledger etc. Issue of Material and Pricing Methods for Issue of Material: FIFO. LIFO. Simple Average Methods. Weighted Average Methods. Use of computer in store Accounting.	1. To understand different pricing methods used for issuing the material. 2.To gain knowledge about the documents used in store departments.
2	Labour cost and Payroll	Meaning and definition of wages. Difference Between Wages and Salary Records and methods - time keeping and time booking. Methods of Wage Payment Time rate system. Piece rate system. Taylor's differential piece rate system. Incentive Plan. Halsey Plan. Rowan Plan. Group Bonus scheme. Performance based incentive plan. Payroll meaning and components	To Understand the difference between salary and wages. To know the methods of time keeping and time booking. To enable the student to calculate wages and incentives. To understand meaning and components of payroll
3	Other Aspects of Labour	a. Labour Turnover. b. Job Analysis & Job Evaluation. c. Merit Rating.	To understand the labour turnover, job analysis and evaluation
4	Direct Cost and	Direct Cost Concept and its accounting	To understand the concept of

K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

T.Y.B.Com 2019 Pattern (CBCS) (Sem. –V)



Sr. No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	T.Y.B.Com 2019 Pattern	Business Regulatory Framework - I	The Indian Contract Act, 1872	Professional Ethics
			The Indian Partnership Act,1932	Professional Ethics
			The Sale Of Goods Act, 1930	Professional Ethics
			Arbitration And Conciliation	Professional Ethics
2	T.Y.B.Com 2019 Pattern	Advanced Accounting – I	Accounting Standards & Financial Reporting	Professional Ethics
			Accounting For Capital Restructuring (Internal Reconstruction)	Professional Ethics
			Final Accounts of Banking Companies	Professional Ethics
			Investment Accounting	Professional Ethics
3	T.Y.B.Com 2019 Pattern	Indian & Global Economic Developme nt - I	Indian And Global Economy	Skill Enrichment
			Agricultural Development In India	Business Ethics Professional Ethics
			Industrial Development In India	Organisational Behaviour
			Service Sector And Infrastructural Development In India	Skill Enrichment Professional Ethics
4	T.Y.B.Com 2019 Pattern	Auditing & Taxation - I	Introduction To Principles Of Auditing And Audit Process.	Professional Ethics
			Vouching And Audit Report	Professional Ethics
			Company Audit And Tax Audit	Professional Ethics
			Audit Of Computerized Systems & Forensic Audit	Professional Ethics
5	T.Y.B.Com 2019 Pattern	Cost And Works Accounting . Special Paper	Overheads	Professional Ethics
			Accounting Of Overheads (Part-I)	Professional Ethics
			Accounting Of Overheads (Part-II)	Professional Ethics
			Activity Based Costing	Professional Ethics
6	T.Y.B.Com 2019 Pattern	Cost And Works	Marginal Costing	Professional Ethics
			Budgetary Control	Professional Ethics

		Accounting Special Paper III	Uniform Costing And Inter-Firm Comparison	Professional Ethics
			MIS And Supply Chain Management	Professional Ethics

K. J. SOMAIYA COLLEGE ★ Dept. of Commerce ★ KOPARGAON

Head
Department of Commerce
K. J. Somaiya College, Kopargaon

Co ordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

K. J. SOMAIYA COLLEGE ★ KOPARGAON ★ Dept. of Commerce

Savitribai Phule Pune University, Pune

Revised syllabi (2019 Pattern) for three years B. Com. Degree course

Credit Base Choice System (CBCS)

Syllabus for T.Y.B. Com. Semester –V

Subject Name: Business Regulatory Framework

Course code: - 351 **Credit - 3**

Depth of the program – Fundamental Knowledge

Preamble

Savitribai Phule Pune University and UGC has initiated several measures to bring efficiency and quality education to the students. Th important measures taken to enhance academic standards and quality in higher education include innovation and improvements in curriculun teaching-learning process, examination and evaluation systems, besides governance and other matters.

The Business Regulatory framework course provides the student with basic information about the Indian legal system and dispute resolutio and their impact on business. The understanding of legal system is a prerequisite for better decision making. The course gives exposure to students the areas of legal principles of business contract, aspects in the formation, running and winding up of partnership and LLP, the scope and the issu associated with partnerships, application of sale of goods act and E Contract regulations in India. This course focuses on orientation of students legal studies from the point of view of basic concepts of business law and legal system in India. The course will be useful to the commerce students understand and apply the business laws in commercial situations.

Objectives of the Program

1. To provide conceptual knowledge about the framework of business Law in India.
2. To orient the students about the legal aspect of business.
3. To create awareness among the students about legal environment relating to the Contract Law, Partnership Act, Sale of Goods Act in Indi
4. To understand the emerging issues relating to e-commerce, e-transaction issues and E Contracts

5. To seek the career opportunity in corporate sector relating to business law in India.
6. To acquaint students with the basic concepts, terms & provisions of Mercantile and Business Laws.

Course Contents

nit No	Unit Title	Contents	Purpose Skills to be developed
1	The Indian Contract Act, 1872	1. The nature of the contract, General Principles 2. Definitions and elements of Contract- consideration, other essential elements of a valid contract, 3. Legality of object and consideration. , Void Agreements. , Discharge of contract. 4. Performance of the contract and breach of contract and remedies (Including damages, meaning, kinds and rules for ascertaining damages)	Understand the concept of Contract and its contents. Equip the students with knowledge of nature and performance and breach of Contracts.
2	The Indian Partnership Act, 1932	1. General Nature of Partnership , Rights, and duties of partners, Types of partner 2. Registration and dissolution of a firm 3. Limited Liability Partnership Act 2008: Limited Liability Partnership (LLP); Concept, Nature and Advantages, Difference between LLP and Partnership Firm, Difference between LLP and company 4. Incorporation of LLP, Partners and their relations, Liability of LLP and Partners (Section 27). Financial Disclosure by LLP, Contributions (Section 32), Assignments and Transfer of Partnership Rights (Section 42) Conversation to LLP (Section 55), Winding-up and dissolution (Section 63 & 64)	Understand the nature of partnership ,Rights and duties of Partner Handling the registration and dissolution of the partnership. Aquint Knowledge about LLP
3	The Sale of Goods Act, 1930	1. Formation of the contract of sale , Concept and Essentials. Sale and agreement to sale. 2. Goods – Concept and kinds ,Conditions and Warranties 3. Transfer of ownership and delivery of goods. 4. Unpaid seller and his rights and Remedial Measures.	Compressive understanding about the sale of Goods Act. Acquaint knowledge about ownership and delivery of goods.
4.	**Arbitration and Conciliation:**	1. Concept of Arbitration & Conciliation. 2. Definition & Essentials of Arbitration Agreement. Power and Duties of Arbitration. Conciliation proceeding. (Provisions of Arbitration & Conciliation Act,1996 in nutshell with Amendment of 2021to be covered.)	To give Comprehensive insight about the emerging trend of Arbitration and conciliation and its regulatory mechanism

[Note: Recent amendments in the Acts and relevant Landmark cases decided by courts are expected to be studied]

Teaching Methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and Applications	Project	Expected Outcome
1	20	Indian Contract Act , Document , PPT, Narration, Case Study	You Tube about Contract Act	Report Review	Acquaint knowledge and maturity to understand Contract Law.

SOMAIYA COLLEGE * KOPARGAON * Dept. of Commerce

Revised Syllabus (2019 Pattern) for three years B. Com. Degree Course (CBCS)

T. Y. B. Com. (Semester- V)

Paper: ADVANCED ACCOUNTING – I

Code: 352 **No. of lectures: 48**

Preamble

In today's modern age, the Corporate, Banking and Investment sectors are the major contributors towards development of Indian Economy. In the la two decades, these sectors have seen the largest and fastest growing sectors and enormous growth in Indian economy. In this growth, accounting pla an energetic role and to ensure safeguard of the interest of the stakeholders and the society. It is, therefore, important to educate the students commerce in the accounting practices adopted by different organizations. It helps stakeholders make better business decisions and deal with problen by providing them with accurate financial information. By studying the Learning Path in Accounting – Advance Concepts you will gain a deep understanding of the accounting process and what it involves.

Objectives of the course

1. To acquaint the student with knowledge about various concepts, objectives, and applicability of some important accounting standards.
2. To develop the knowledge among the students about reorganization of business regarding restructuring the capital.
3. To update the students with knowledge for preparation of final accounts of a Banking Companies with the provisions of Banking Regulatic Act 1949.
4. To empower to students with skills to prepare the investment account in simple and summarized manner.

Objectives of the Program

1. To instill the knowledge about accounting procedures, methods and techniques.
2. To impart students' knowledge of various Advanced Accounting Concepts.

Depth of the program – Fundamental Knowledge

CONTENTS

Unit No.	Unit Title	Contents	Purpose skills to be developed
1	**Accounting Standards & Financial Reporting**	- Brief Review of Indian Accounting Standards - Introduction to AS- 3, AS-12 and AS-19 with simple numerical. - Introduction to IFRS - Fair Value Accounting.	- To develop conceptual understanding about variou Accounting Standards and its applicability and als introduce the students about IFRS – Fair Valu Accounting.
2	**Accounting for Capital Restructuring (Internal Reconstruction)**	- Meaning and Concept of Capital Restructuring, Types of Capital Restructuring, Meaning & of Internal Reconstruction - Accounting Entries: Alteration of Share Capital, Reduction of Share Capital, Reduction in Liabilities, Cancellation of Expenses, Losses etc. - Preparation of Balance Sheet after Internal Reconstruction	- To develop conceptual understanding abo accounting for capital restructuring in the form internal reconstruction. - To develop the skill & upgrade the knowledg regarding reorganization of venture capital and it recording.
3	**Final Accounts of Banking Companies**	- Introduction of Banking Company, Legal Provisions regarding Non-Performing Assets (NPA) - Reserve Fund - Acceptance, Endorsements & Other Obligations - Bills for Collection – Rebate on Bills Discounted – Provision for Bad and Doubtful Debts - Vertical form of Final Accounts as per Banking Regulation Act 1949. - Simple Numerical on Preparation of Profit & Loss A/c and	- To understand the various legal provisions regardir banking companies. - To understand the procedure regarding preparatio of final accounts of banking companies.

		Balance Sheet in vertical form.	
4	Investment Accounting	- Meaning & Introduction, Classification of Investments, - Meaning & Calculation of the Concept of Acquisition Cost & Carrying Cost of Investment, - Calculation of Profit/loss on disposal of investments.	- To understand the meaning of different cos incurred in investment business. - To develop the knowledge and skill regardir Investment Accounting.

Teaching Methodology

Unit No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	10	Use of e- contents, online lectures and PowerPoint Presentations	Lectures of experts available on YouTube and other digital platforms	Individual assignment report	Developing understanding on applicability of various Accounting Standards
2	12	Use of e- contents, online lectures and MCQ based Quiz, PowerPoint Presentations	Lectures of experts available on YouTube and other digital platforms	Individual assignment of solving practical problems	Knowledge about of the Accounting for Capital Restructuring
3	16	Use of e- contents, online lectures, MCQ based Quiz, PowerPoint Presentations	Study of the Final Accounts of Banking companies from its Annual Report	Individual assignment of solving practical problems	Conceptual Clarity and Practical understanding of preparation of final accounts of banking companies.
4	10	Use of e- contents, online lectures and PowerPoint Presentations	Lectures of experts available on YouTube and other digital platforms	Individual assignment of solving practical problems	Developing knowledge about Investment Accounting

Method of Evaluation

Savitribai Phule Pune University, Pune
Third Year, B.Com. (Core Course)
Revised Syllabi for Three Years B. Com. Degree Course
(CBCS-2019 Pattern) (w.e.f. 2021-22)

Semester - V **Course Code: 353**

Total Credits: 3 **Subject: Indian & Global Economic Development**

Preamble:

An approach to Indian and Global Economic Development is to examine the Indian economic development policies in context with glob economies. This paper aims to provide knowledge about economic development of India, economic development policies that are applied f development of economy in general and development of various sectors in particular. It also aims to develop ability of the students to analyze th development of Indian economy as compared to global economies through the comparison of different sectors like agriculture, Industry, service ar availability of resources and its quality.

Scope of the Programme –

Knowledge related to development policies of Indian Economy as compared to World Economies.

Objectives:

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Unit No.	Topic	Purpose & Skills to be Developed
Unit 1	**Indian and Global Economy** **1.1** Economic Development: Meaning and Indicators **1.2** Developed and Developing Countries: Meaning **1.3** Characteristics of Indian Economy as an Emerging Economy **1.4** Comparison of the Indian Economy with World Economy with reference to: National Income, Population, Agriculture, Industry and Service Sector	**Purpose:** To make the students aware of concept of Development. To help the students compare Indian Economy with other developed and competitive economies. **Skills:** Analyze & think critically, develop writing skills.
Unit 2	**Agricultural Development In India** **2.1** Indian Agriculture: Role and Progress **2.2** Low Productivity of Indian Agriculture: Causes and Measures **2.3** Agricultural Finance: Need and Sources **2.4** Agricultural Marketing: Problems and Measures **2.5** New Farm Act 2020 **2.6** Organic Farming and Contract Farming: Meaning and Advantages	**Purpose:** To give the knowledge about varied aspects of agricultural sector in India. **Skills:** Analyze & think critically, developing critical and analytical writing skills.
Unit 3	**Industrial Development in India** **3.1** Role of Industrialization in Indian Economic Development **3.2** New Industrial Policy 1991 **3.3** Role of Micro, Small and Medium Scale Enterprises (MSMEs) in India **3.4** Role and Problems of Public Sector Enterprises in India **3.5** New Schemes for Industrial Development: Make in India, Start- up India and Stand up India	**Purpose:** To give the knowledge about importance and status of Industrial Development in Indian Economy. To update the students about the latest policies for Industrial development in India. **Skills:** Analyze & think critically, developing critical writing skills.
Unit 4	**Service Sector and Infrastructural Development in India** **4.1** Role and Growth of Service Sector in India **4.2** Meaning and Effects of Digital Economy, E Commerce and E-Finance **4.3** Role of Infrastructure in Economic Development of India **4.4** Role of Public and Private Sector in Infrastructural Development	**Purpose:**To provide the knowledge about importance ssand status of Service Sector and Infrastructure Development in Indian Economy **Skills:** Analyze & think critically, developing critical writing skills.

1.To develop ability to analyze economic development process of India.
2. To impart knowledge about the relevance of economic practices in modern competitive world.
3. To help the students develop a sound theoretical foundation for their future academic ventures.

Course Outcomes:-

1.Students will be able to understand present Economic Scenario of Indian Economy as well as World Economy.
2.Students will be able to understand the various aspects of development in Agricultural, Industrial and service sector in India.
3.Student will be able to critically evaluate the role of India in international economy.
4. Students will be able to evaluate the working of international financial organization and institutions.

Teaching Methodology:

Unit No.	No. of Lectures	Innovative methods to beused	Film Shows and AV Applications	Project	Expected Outcome

Unit No.	Topic	Purpose & Skills to be Developed
Unit 1	**Indian and Global Economy** **1.1** Economic Development: Meaning and Indicators **1.2** Developed and Developing Countries: Meaning **1.3** Characteristics of Indian Economy as an Emerging Economy **1.4** Comparison of the Indian Economy with World Economy with reference to: National Income, Population, Agriculture, Industry and Service Sector	**Purpose:** To make the students aware of concept of *Development.* To help the students compare *Indian Economy with other developed* and competitive economies. **Skills:** Analyze & think critically, develop writing skills.
Unit 2	**Agricultural Development In India** **2.1** Indian Agriculture: Role and Progress **2.2** Low Productivity of Indian Agriculture: Causes and Measures **2.3** Agricultural Finance: Need and Sources **2.4** Agricultural Marketing: Problems and Measures	**Purpose:** To give the knowledge about varied aspects of agricultural sector in India. **Skills:** Analyze & think critically, developing critical and analytical writing skills.
Unit 3	**Industrial Development in India** **3.1** Role of Industrialization in Indian Economic Development **3.2** New Industrial Policy 1991 **3.3** Role of Micro, Small and Medium Scale Enterprises (MSMEs) in India **3.4** Role and Problems of Public Sector Enterprises in India **3.5** New Schemes for Industrial Development: Make in India, Start- up India and Stand up India	**Purpose:** To give the knowledge about importance and status of Industrial Development in Indian Economy. To update the students about the latest policies for Industrial development in India. **Skills:** Analyze & think critically, developing critical writing skills.
Unit 4	**Service Sector and Infrastructural Development in India** **4.1** Role and Growth of Service Sector in India **4.2** Meaning and Effects of Digital Economy, E Commerce and E-Finance **4.3** Role of Infrastructure in Economic Development of India **4.4** Role of Public and Private Sector in Infrastructural Development	**Purpose:**To provide the knowledge about importance ssand status of Service Sector and Infrastructure Development in Indian Economy **Skills:** Analyze & think critically, developing critical writing skills.

Course Outcomes:-

1. Students will be able to understand present Economic Scenario of Indian Economy as well as World Economy.
2. Students will be able to understand the various aspects of development in Agricultural, Industrial and service sector in India.
3. Student will be able to critically evaluate the role of India in international economy.
4. Students will be able to evaluate the working of international financial organization and institutions.

Teaching Methodology:

Unit No.	No. of Lectures	Innovative methods to beused	Film Shows and AV Applications	Project	Expected Outcome
Unit 3					1.To develop ability to analyze economic development process of India. 2. To impart knowledge about the relevance of economic practices in modern competitive world. 3. To help the students develop a sound theoretical foundation for their future academic ventures.
Unit 4					

K. J. SOMAIYA COLLEGE * KOPARGAON
Dept. of Commerce

Faculty of Commerce & Management
T Y B Com (Semester V)
(Choice Based Credit System)
Revised Syllabus (2021-22)

CORE COURSE – I **Course Code: 354**

Total Credits: 04 (Theory 03 + Practical 01=04) **Subject: Auditing**

Objectives of the Course:

1. To acquaint themselves about the Definition, Nature,Objectives and Advantages of Auditing, Types of Audit, Errors and Fraud, Audit Programme, Audit Note Book, Working Paper, Internal Control, Check.
2. To get knowledge about concept of Checking, Vouching, Verification and Valuation, Types of Audit Report and Auditing Assurance Standard.
3. To understand theprovision related Qualification, Disqualification, Appointment, Removal, Rights ,Duties and Liability of Company Auditor as per Provisions regarding Tax Audit as per Income Tax Act 1961 (Section 44 AA to 44AE).
4. To know the various new concepts in computerized system and Forensic Audit.

Unit No	Unit Title	Contents	Skills to be developed
1.	**Introduction to Principles of Auditing and Audit Process**	Definition, Nature-objects-Advantages of Auditing-Types of errors and frauds Various Classes of Audit. Audit programme, Audit Note Book, Working Papers, Internal Control-Internal Check-Internal Audit.	i) Understanding the concept of Auditing, Various type of Audit ii) Help to Find out Errors frauds and help to improve internal control system in business organization.
2.	**Checking, Vouching and Audit Report**	Test checking-Vouching of Cash Book-Verification and Valuation of Assets and Liabilities. Types of Audit Report-Audit Certificate-Difference between Audit Report and Audit Certificate. Auditing and Assurance Standards. (AAS- 1,2,3,4,5)	i) Know the procedure of vouching, Verification, and Valuation use for audit. ii) To know the terms used in Audit Report, Certificate and Auditing Assurance Standard.
3.	**Company Audit and Tax Audit**	**Company Audit** Qualification, Disqualifications, Appointment, Removal, Rights, Duties and liabilities of Company Auditor **Tax Audit** Provisions under Income Tax Act 1961 (Sec 44AA, 44AB, 44AD, 44ADA,44AE) Recent Amendment made as applicable as per Income Tax Act 1961	i) Understanding provisions for Work as Company Auditor as per Companies Act 2013. ii) Enhance Provisions under Income Tax Act 1961 used for Conduct Tax Audit.
4.	**Audit of Computerized**	**Auditing in an EDP Environment** General EDP Control –	i) Enhance the knowledge of Computerized Systems ii) Forensic Audit used for new techniques applicable for

Dept. of Commerce

Unit No.	Unit Title	Contents	Skills to be developed
	Systems& Forensic Audit	EDP Application Control- Computer Assisted Audit Techniques (Factors and Preparation of CAAT) **Forensic Audit** Definition, Importance of Forensic Auditor, Services Render by Forensic Auditor, Process of Forensic Auditing and Forensic Audit Techniques and Forensic Audit Report	new business trends.

Teaching Methodology:

Unit No	Total lectures	Innovative Methods to be used	Film Shows and A.V. Applications	Projects / Practical's	ExpectedOutcome
1	16	**Introduction to Principles of Auditing and Audit Process**	Lectures of experts available on You Tube About Errors, Frauds, Types of Audit.	Individual assignment of solving practical problems, report review	Acquaint with knowledge and maturitytounderstandconcept of Auditing, types of Audit and Audit Process.
2	12	**Checking, Vouching and Audit Report**	Lectures ofexpertsavailableon YouTube andother digitalplatforms.	Individual assignment of solving practical problems, report review	ConceptualClarity and Practicalunderstanding of Vouching Verification and valuation and Types of Audit Report.
3	10	**Company Audit and Tax Audit**	Lectures ofexpertsavailableon YouTube andother digitalplatforms. Website Review	Individual assignment of solving practical problems, report review	Practical knowledge about appointment, reappointment and other related provision. Practical knowledge about Tax Audit as per I.T. Act 1961 (Form 3CA, 3CB & 3CD)

SPPU, Pune

Revised Syllabi (2019pattern) for three years B.Com. Degree Course CBCS

T.Y. B.Com. (Semester V)

Subject Name -: Cost and Works Accounting, Special Paper II

Subject Title -:Overhead and Accounting for Overheads Course Code -: 355 – e

Objectives:

1. To provide knowledge about the concepts and principles of overheads.
2. To Introduce the cost accounting standards and the cost accounting standard board.
3. To understand the stages involved in the accounting of overheads.
4. To build an ability towards strategic overhead accounting under Activity Based Costing

Teaching Methodology

Unit No.	Total Lectures	Innovative Methods to be used	Films Shows and AV Applications	Practical	Expected Outcome
1	08	Powerpoint Presentations	Relevant Youtube	Group discussion	To remember and understand the concept of
					Students will be able to identify overheads as per various activities.
4	**Activity Based Costing**	4.1 Definitions-Stages in Activity Based Costing 4.2 Purpose and Benefits of Activity Based Costing 4.3 Cost Pools and Cost Drivers 4.4 Problems on Activity Based Costing [Simple Problems only]			a. Ability to understand the concept of Overhead and classification of overheads. b. Students will be able to relate the cost Accounting Standard with respective overheads.
1	**Overheads**	1.1 Meaning and definition of overheads. 1.2 Classification of overheads 1.3 Introduction to Cost Accounting Standard, Cost Accounting Standard Board 1.4. Introduction to of CAS 3, CAS 11, CAS 15 1.5 Cost Accounting Standard 3: Production and operation Overheads			
2	**Accounting of Overheads (Part-I)**	2.1 Collection and Allocation of overheads. 2.2 Apportionment and Reapportionment of overheads 2.3 Simple problem of primary distribution of Overhead 2.4 Simple Problem of Secondary distribution of overheads (Repeated & Simultaneous Equation method only)			a. *To understand the stages in the process of accounting overheads.* b. *Students will be able to calculate total departmental overheads after implementing Primary and Secondary Distribution.*
3	**Accounting of Overheads (Part-II)**	3.1 Absorption - Meaning, Rate and Methods of Overhead Absorption 3.2 Under and Over Absorption of overheads- Meaning, Reasons and Accounting treatment 3.3 Simple problems on the accounting treatment of under and overabsorption of Overheads			a. *Conceptual understanding of under and over absorption.* b. *Enable the learner with accounting treatment for under and over absorption.*

COLLEGE * KOPARGAON * Dept of

Teaching Methodology

Unit No.	Total Lectures	Innovative Methods to be used	Films Shows and AV Applications	Practical	Expected Outcome
1	08	Powerpoint Presentations	Relevant Youtube	Group discussion	To remember and understand the concept of

4	**Activity Based Costing**	4.1 Definitions-Stages in Activity Based Costing 4.2 Purpose and Benefits of Activity Based Costing 4.3 Cost Pools and Cost Drivers 4.4 Problems on Activity Based Costing [Simple Problems only]	a. Students will be able to identify overheads as per various activities.	

1	**Overheads**	1.1 Meaning and definition of overheads. 1.2 Classification of overheads 1.3 Introduction to Cost Accounting Standard, Cost Accounting Standard Board 1.4. Introduction to of CAS 3, CAS 11, CAS 15 1.5 Cost Accounting Standard 3: Production and operation Overheads	a. Ability to understand the concept of Overhead and classification of overheads. b. Students will be able to relate the cost Accounting Standard with respective overheads.	
2	**Accounting of Overheads (Part-I)**	2.1 Collection and Allocation of overheads. 2.2 Apportionment and Reapportionment of overheads 2.3 Simple problem of primary distribution of Overhead 2.4 Simple Problem of Secondary distribution of overheads (Repeated & Simultaneous Equation method only)	a. *To understand the stages in the process of accounting overheads.* b. *Students will be able to calculate total departmental overheads after implementing Primary and Secondary Distribution.*	
3	**Accounting of Overheads (Part-II)**	3.1 Absorption - Meaning, Rate and Methods of Overhead Absorption 3.2 Under and Over Absorption of overheads- Meaning, Reasons and Accounting treatment 3.3 Simple problems on the accounting treatment of under and overabsorption of Overheads	a. *Conceptual understanding of under and over absorption.* b. Enable the learner with accounting treatment for under and over absorption.	

T.Y. B.Com.

B.Com Degree Course Revised 2019 Pattern (CBCS)

Cost and Works Accounting Special Paper III

Course Code -: 356 –E (SEM-V)

Name -: Techniques of Cost Accounting

Objectives:

1. To prepare learners to understand the basic techniques in Cost Accounting
2. To understand the learner, application of Cost Accounting techniques in cost control and decision making.
3. To enable the learners to prepare various types of Budgets.
4. To learn the basic concept of Uniform Costing and Inter-firm comparison
5. To enhance the knowledge of students about MIS and Supply Chain Management.

Unit	Unit Title	Contents	Skills to be developed
No.			
1	Marginal Costing	1.1 Meaning and concepts- Fixed cost, Variable costs, Contribution, Profit-volume Ratio, Break-Even Point, Margin of Safety. and Angle of Incidence. 1.2 Cost-Profit-Volume Analysis- Assumptions and limitations of cost-profit volume analysis 1.3 Application of Marginal Costing Technique:- Make or buy decision, Acceptance of export order & Limiting factors. 1.4 Ethical and Non-Financial Considerations relevant to decision making. (simple Practical Problems based on concepts excluding decision making)	a. Understanding of important concepts in Marginal Costing. b. It will develop the ability of a the learner to make short-term decisions with the help of Marginal Costing. c. Develop the mindset of the student for making ethical decisions.
2	Budgetary Control	2.1 Definition and Meaning of Budget & Budgetary control 2.2 Objectives, essentials, and procedure of Budgetary control 2.3Advantages and Limitations of Budgetary control 2.4 Types of Budgets 2.5 Zero Base Budgeting (Simple practical problems based on cash and flexible	a.It will help the learner to understand the basics of Budget and Budgetary Control b. The learner will get an idea of how to prepare different types of Budgets

K.J.Somaiya College of Arts, Commerce & Science Kopargaon

Faculty of Commerce & Management

Cross Cutting Issues in Core Subjects

T.Y.B.Com 2019 Pattern (CBCS) (Sem. –VI)



Sr. No	Class	Subject	Course Syllabus	Cross Cutting Issue
1	T.Y.B.Com 2019 Pattern	Business Regulatory Framework	Negotiable Instruments Act,1881	Professional Ethics
			E-Contracts (E Transactions/E Commerce.	Professional Ethics
			The Consumer Protection Act,2019	Professional Ethics
			Intellectual Property Rights	Professional Ethics
2	T.Y.B.Com 2019 Pattern	Advanced Accounting – Ii	Final Accounts Of Co-Operative Societies	Professional Ethics
			Branch Accounting	Professional Ethics
			Recent Trends In Accounting	Professional Ethics
			Analysis Of Financial Statements	Professional Ethics
3	T.Y.B.Com 2019 Pattern	Indian & Global Economic Developme nt	Human Resources And Economic Development	Skill Enrichment Professional Ethics
			Foreign Capital And Economic Development	Business Ethics
			India's Foreign Trade And Balance Of Payment	Professional Ethics
			International Financial Institutions & Regional Economic Cooperation	Skill Enrichment
4	T.Y.B.Com 2019 Pattern	Auditing & Taxation - Ii	Income Tax Act1961- Important Definitions And Concepts.	Professional Ethics
			Sources And Computation Of Taxable Income Under The Various Heads Of Income	Professional Ethics Professional Ethics
			Computation Of Total Taxable Income (Tti)And Tax Liability	Professional Ethics
			E-Filing And E Provisions	Professional Ethics Professional Ethics
5	T.Y.B.Com 2019 Pattern	Cost And Works Accounting . Special Paper Ii	Methods Of Costing	Professional Ethics
			Contract Costing	Professional Ethics
			Process Costing	Professional Ethics Professional Ethics
			Service Costing	Professional Ethics
6	T.Y.B.Com 2019 Pattern	Cost And Works	Standard Costing	Professional Ethics Professional Ethics

			budget only)			
3	Uniform costing and Inter-firm Comparison	3.1 Meaning, objectives, advantages, and disadvantages of Uniform Costing. 3.2 Uniform Cost Manual 3.3 Meaning, pre-requisite, advantages, and disadvantages of Inter-firm comparison. (Theory Only)	a.It will acquaint the learner to understand essential concepts of Uniform Costing and Inter-Firm Comparison.			
4	MIS and Supply Chain Management	4.1 Management Information System- Introduction, features, and procedure, preparation. 4.2 Supply Chain Management(SCM)- Meaning, features, and Models of SCM. (Theory Only)	a.*The student will familiar with MIS and SCM* b. *The student will understand the basic concept of SCM*			

Teaching Methodology

Unit No.	Total Lectures	Innovative Methods to be used	Films Shows and AV Applications	Project	Expected Outcome

K.J. SOMAIYA COLLEGE ★ KOPARGAON ★ Dept. of Commerce

Savitribai Phule Pune University, Pune
Revised syllabi (2019 Pattern) for three years B. Com. Degree course
Credit Base Choice System (CBCS)

Syllabus for T.Y.B. Com.

Semester –VI

Course code: - 361

Credit - 3

Subject Name: Business Regulatory Framework

Depth of the program – Fundamental Knowledge

Preamble

This Course is designed to acquaint the commerce Students with the Legal frame work applicable to business enter prison in the Country. The understanding of legal system is a prerequisite for better decision making. The objective of this course is to acquaint the students with basics of intellectual property rights with special reference to Indian law and practice. The students will be able to understand the consumer Protection and Negotiable instruments and Arbitrates Law. This course focuses on orientation of students to legal studies from the point of view of basic concepts of business law and legal system in India. The course will be useful to the commerce students to understand and apply the business laws in commercial situations.

Objectives of the Program

1. To develop general awareness of Business Law among the students.
2. To understand the various statutes containing regulatory mechanism of business and its relevant provisions including different types of partnerships.
3. To have a understanding about the landmark cases/decisions having impact on business laws
4. To create awareness among the students about legal environment relating to the business activities and new ways dispute resolutions provided under Arbitration Act.
5. To acquaint the students on relevant developments in business laws to keep them updated.
6. To enhance capacity of learners to seek the career opportunity in corporate sector and as a business person.

Table of Contents

Unit No	Unit Title	Contents	Purpose Skills to be developed
1	**Negotiable Instruments Act,1881** **(14 Lectures)**	Concept of Negotiable Instruments: Characteristics, Meaning Important relevant definitions under the Act • Definitions, Essentials of promissory note, bill of exchange and cheque. Distinction between these instruments. Crossing of cheques – It's meaning and types. • Holder and holder in due course, Privileges of holder in due course. • Negotiation, endorsement, kinds of endorsement. • Liabilities of parties to negotiable instruments. • Dishonor of N. I., kinds, law relating to notice of dishonor.	To Equip the students with procedure and practices about negotiable instruments and liabilities of parties in case of dishonor of negotiable instruments.
2	**E-Contracts (E-Transactions/E-Commerce.):** **(06 Lectures**	• Significance of E-Transactions /E-Commerce. Nature, Formation, Legality. Recognition. (Chapter 4.Sec.11-13 of I T Act,2000 relating to attribution, acknowledgement, dispatch of E-Records) • Digital Signatures –Meaning & functions, Digital Signature, certificates [Sections 35-39] • Legal issues involved in E-Contracts and personal data protection (Sec.43 A)	Comprehensive understanding about the E-Contracts, E-Commerce and their legal aspects
3	**The Consumer Protection Act,2019** **(14 Lectures**	The Consumer Protection Act, 2019 • Salient features of the C.P. Act,2019 • Definitions-Consumer, Complainant, Services, Defect & Deficiency, Complainant, unfair trade practice, restrictive trade practice, unfair contract. • Consumer Protection Councils. • Procedure to file complaint & Procedure to deal with complaint in commissions & Reliefs available to consumer.(Sec.39) • Consumer Disputes Redressal Commissions. (Composition, Jurisdiction, Powers and Functions.)	To acquaint students about regulatory mechanism of Consumer Protection and Procedural aspect of Redressal of Consumers' grievances.
4.	**Intellectual Property Rights** **(14 Lectures)**	Intellectual Property Rights : (IPRs) • Meaning & importance of IPRs, International efforts in protection of IPR: WIPO (Objectives & activities) & TRIPS Agreement: Objectives • Definition and conceptual understanding of following IPRs under the relevant Indian current statutes. • Patent: Definition & concept, Rights & obligation of Patentee, its term. • Copyright: Characteristics & subject matter of copyright, Author & his Rights, term. • Trademark: Characteristics, functions, illustrations, various marks, term, internet domain name- Rights of trademark holder. • Design: Importance, characteristics, Rights of design holder.	To be able to appreciate the emerging developments in the area of intellectual property Laws and their impact on the Indian businesses.

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		• Geographical Indications, Confidential Information & Trade Secrets, Traditional knowledge—Meaning & scope of these IPRs.			

[Note: Recent amendments in the Acts and relevant Landmark cases decided by courts are expected to be studied]

Teaching Methodology

Topic No.	Total Lectures	Innovative methods to be used	Film shows and AV Applications	Project	Expected Outcome
1	14	Documentary making on Consumer Protection Act , Case Study, Narration, , Survey Analysis Article review.	You Tube about cases on negotiable instruments Act.	Report Review	To Equip the students with procedure and practices about negotiable instruments and liabilities of parties in case of dishonor of negotiable instruments.

K. J. SOMAIYA COLLEGE Dept. of Commerce KOPARGAON

Revised Syllabus (2019 Pattern) for three years B. Com. Degree Course (CBCS)

T. Y. B. Com. (Semester- VI)

Paper: ADVANCED ACCOUNTING – II

Code: 362 **No. of lectures: 48**

Preamble

In today's modern age, the Corporate as well as Co-operative sectors are the major contributors towards development of rural economy. In the last decade, these sectors have seen the largest and fastest growing sectors. Due to this growth various new trends are arisen. In this growth, accounting plays an energetic role and to ensure safeguard of the interest of the stakeholders and the society. It is, therefore, important to educate the students of commerce in the accounting practices adopted by different organizations. It helps stakeholders make better business decisions and deal with problems by providing them with accurate financial information. By studying the learning path in accounting – advance concepts will gain a deeper understanding of the accounting process.

Objectives of the course

1. To acquaint the student with knowledge about the legal provisions regarding preparation and presentation of final accounts of Co-operative Societies.
2. To empower to students about the branch accounting in simple.
3. To make aware the students about the conceptual aspects of various recent trends in the field of accounting especially forensic accounting, accounting of CSR activities, accounting of derivative contracts and Artificial Intelligence in Accounting.
4. To understand the procedure and methods of analysis of financial statements.

Objectives of the Program

1. To instill the knowledge about accounting procedures, methods and techniques.
2. To impart students' knowledge of various Advanced Accounting Concepts.

Depth of the program – Fundamental Knowledge

CONTENTS

Unit No.	Unit Name	Contents	Purpose skills to be developed
1	**Final Accounts of Co-operative Societies**	- Meaning and Introduction, - Allocation of Profit as per Maharashtra State Co-operative Societies Act. - Preparation of Final Accounts of Credit Co-op. Societies & Consumer Co-op. Societies	- To upgrade regarding legal provisions of co-operative accountin - To develop the skill regarding preparation & presentation of fi accounts of Credit Co-op. Societies & Consumer Co-op. Societie
2	**Branch Accounting**	- Concept of Branches & their Classification from accounting point of view. - Accounting treatment of dependent branches & independent branches. - Methods of charging goods to branches.	- To develop conceptual understanding about accounting fo different branches. - To ascertain whether the branch should be expanded or closed, to ascertain the requirement of cash and stock for each branch. - To develop the skill & upgrade the knowledge regarding methods of charging goods to branches.
3	**Recent Trends in Accounting**	- Forensic Accounting - Accounting for Corporate Social Responsibility - Accounting for Derivative Contracts - Artificial Intelligence in Accounting	- To develop conceptual understanding about forensic accounting, corporate social responsibility, derivative contracts and artificial intelligence in accounting.
4	**Analysis of Financial Statements**	- Ratio Analysis: Meaning - Objectives - Nature of Ratio analysis, Types of Ratios – Profitability, Liquidity, Leverage etc. - Simple Problems on following Ratios: - Gross Profit, - Net Profit, - Operating, - Stock Turnover, - Debtors Turnover, - Creditors Turnover, - Current Ratio, Liquid Ratio, - Debt-Equity Ratio, - Working Capital to Net worth, Assets Turnover Ratio.	- To understand the conceptual knowledge, objectives, methods & tools of analysis of financial statements. - To develop the analytical skill and decision-making skill of the students. - To diagnose the information contained in financial statements so as to judge the profitability, liquidity & solvency position of business organizations.

SOMAIYA COLLEGE Dept. of Commerce KOPARGAON

Savitribai Phule Pune University, Pune
Third Year, B.Com. (Core Course)
Revised Syllabi for Three Years B. Com. Degree Course
(CBCS-2019 Pattern) (w.e.f. 2021-22)

Semester - VI **Subject: Indian & Global Economic Development** **Course Code: 363**

Total Credits: 3

Preamble:

An approach to Indian and Global Economic Development is to examine the Indian economic development policies in context with global economies. This paper aims to provide knowledge about economic development of India, economic development policies that are applied for development of economy in general and development of various sectors in particular. It also aims to develop ability of the students to analyze the development of Indian economy as compared to global economies through the comparison of different sectors like agriculture, Industry, service and availability of resources and its quality.

Scope of the Programme –
Knowledge related to development policies of Indian Economy as compared to World Economies.

Objectives:

1. To develop ability of students to analyze economic development process of India.
2. To acquaint the students with the knowledge of recent trends in Human Development Index.
3. To acquaint students with the emerging issues in policies of India's foreign trade.
4. To update the students about International institutions and organizations.

Course Outcomes:-

1. Students will be able to understand the concept of Human Resource Development.
2. Students will be able to understand the role of foreign capital in Economic Development.
3. Students will be able to critically evaluate the Indian Foreign Trade Policy.
4. Students will be able to analyzethe role of International Financial Institutions.
5. Students will be able to evaluate the success of Regional Economic Cooperation's.

Unit No.	Topic	Purpose & Skills to be Developed
Unit 1	**Human Resources and Economic Development** **1.1** Role of Human Resources in Economic Development **1.2** Human Development Index and India **1.3** Concepts of Different Indexes in Quality of Life and Status of India **1.3.1** Gender Development Index **1.3.2** Gender Inequality Index **1.3.3** Human Poverty Index **1.3.4** Global Hunger Index	**Purpose:** To make the students aware of concepts related to Human Development and HDI **Skills:** Analyze & think critically, develop writing skills.
Unit 2	**Foreign Capital and Economic Development** **2.1** Role of Foreign Capital in Economic Development **2.2** Types of Foreign Capital **2.3** Foreign Investment in India Since 2001 **2.4** Limitations of Foreign Capital	**Purpose:** To give the knowledge to students about Foreign Capital and issues related to Foreign capital in India. **Skills:** Analyze & think critically, develop writing skills.
Unit 3	**India's Foreign Trade and Balance of Payment** **3.1** Role of Foreign Trade in Indian Economic Development **3.2** India's Foreign Trade Since 2001 **3.3** India's Recent Foreign Trade Policy (EXIM Policy) **3.4** Meaning and Components of Balance of Payment **3.5** India's Balance of Payment Since 2001 **3.6** Causes of Unfavorable Balance of Payment **3.7** Convertibility of Indian Rupee – Current and Capital Account	**Purpose:** To make aware to students about the situation of Foreign Trade and Balance of Payments. **Skills:** Analyze & think critically, develop writing skills.

Unit 4	***International Financial Institutions & Regional Economic Cooperation*** **4.1** International Bank for Reconstruction and Development (World Bank) - Objectives and Functions **4.2** International Monetary Fund (IMF) - Organization and Functions **4.3** World Trade Organization (WTO) - Introduction and Functions **4.4** South Asian Association for Regional Co-operation (SAARC) – Introduction and Functions **4.5** BRICS: Introduction and Functions	**Purpose:** To give the knowledge to students about International Financial Institutions and Regional Economic Cooperation **Skills:** Analyze & think critically, develop writing skills.

Teaching methodology:

UnitNo.	Total Lectures	Innovative methods to beused	Film shows and AV Applications	Project	Expected Outcome
1	10	• Open Book discussion • Casestudies • Problem solvingbased learning	• You tube lectures • Films	• Implication of HDI • Policies of Indian Government for improving Human Quality	• Students will understand concepts of Development • Will be able to critically evaluate status of India as compared to world
2	10	• Digital lectures • Project based learning	• You tube lectures • Online PPTs	• Role of Foreign Capital in Developing Countries • Concepts of Foreign Capital	• Will understand the concepts of Foreign Capital

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	Taxable Income under the various Heads of Income	Perquisites and their Valuation, Treatment of provident fund, Deductions from salary. **(Theory and Problems)** 2. **Income from House Property** -Basis of Chargeability, Types of property, Annual Value Self occupied and let out property, Deductions allowed (Theory and Problems) 3. **Income from Profits and Gains of Business and Professions** –Definition of Business , profession, vocation, speculative business, Methods of accounting, Deductions expressly allowed and disallowed **(Theory And Problems)** 4. **Income from Capital Gains** – Meaning, Chargeability-definitions- Capital assets, transfer, cost of acquisition, Cost of Improvement, Short term and long term capital assets and Capital gains, cost inflation Index, Deductions allowed. **(Theory only)** 5. **Income from other sources-** Chargeability Method of accounting, deductions, Amounts not deductible. **(Theory And Problems)**	different heads of Income and tax payable on the total income.
3.	**Computation of Total Taxable Income (TTI)and tax liability**	**Gross total Income-**Deductions u/s-80C, 80CCC to 80 U – Total Taxable Income, Income Tax calculation of Individual - (Rates applicable for respective Assessment year), Education cess and higher education cess, surcharge, etc.(calculation of tax payable as per old regime and new regime)	Understanding the calculation of total income and tax payable by individual person.
4.	**E-Filing and E-provisions**	**Due dates of filing return, E-filing of income tax return and forms used, advance tax , TDS(**Tax deducted at source),Assessment, AIR (Annual information return), **SFT(** Specified financial transactions).	Know the e-filing due dates, recent changes in income tax provisions.

(Note- Recent amendments made by finance bill every previous year and changes made before six months of examination will also be applicable.)

Savitribai Phule Pune University

Faculty of Commerce & Management

T Y B Com (Semester VI)

(Choice Based Credit System)

Revised Syllabus (2021-22)

CORE COURSE – I *Course Code: 364*

Subject: Auditing & Taxation - II

Total Credits: 04 (Theory 03 + Practical 01=04)

1. To understand the basic concepts of *Income Tax Act, 1961 and create awareness of direct taxation among the students.*
2. To understand the *income tax rules and regulations and its provisions.*
3. To *have a comprehensive knowledge of calculation various types of income.*
4. To *know the recent changes made by the finance bill (Act) every year and its impact on taxation of person.*
5. To acquaint the students on *Income tax department portal (ITD), e-filing and e-services mechanism relating to Assessee.*

Unit No	*Unit Title*	*Contents*	*Skills to be developed*
1.	***Income Tax Act-1961- Important Definitions and Concepts.***	***Introduction-*** *Features of Income Tax, Scope of Income Tax Act, and Importance of Income Tax payment for development of country.* **Definitions-**Income, Person, Assessee, *Deemed Assessee,* Assessment year, Pervious year, Agricultural Income, Exempted Income, Gross Total Income (*GTI*) , Total Taxable Income (TTI), Residential Status of an Assessee, PAN, TAN **Concept of** Capital receipts, revenue receipts and capital expenditure, revenue expenditure.	*Understanding the concept of Income and tax on Income.* *Acquaint the students of income tax provision and tax payable for the development of the country*
2.	**Sources and Computation of**	1. **Income from Salary** – Meaning of salary, Salient features of salary Allowances and tax Liability-	Know the procedure of computation of income under

2	**Contract Costing**	2.1 Meaning and Features of Contract Costing 2.2 Work-Certified and Uncertified, Escalation clause, Retention Money, Cost Plus contract, work-in-progress 2.3 Profit on incomplete contract	a.It will help the learner to understand the concept of contract costing b. learners will understand the process of calculation of profit on incomplete contracts	
3	**Process Costing**	3.1 Meaning and features of process costing 3.2 Preparation of process accounts including normal and abnormal loss/gain 3.3 Joint Products and By Products [Theory and Simple problems] 3.4 Cost Accounting Standard 19: Joint Cost	a. Students will get an idea of how to prepare process accounts. b. Understand the basic concept of CAS 19: Joint cost	
4	**Service Costing**	4.1 Meaning, Features and Applications of service costing 4.2 Cost Unit-Simple and Composite 4.3 Cost Sheet for Transportation Service 4.4 Cost Statement for Hospital and Hotel Organization 4.5 Cost Accounting Standard 13: Cost of service cost center	a. The student will be enabled to understand the concept of service costing b. Learners will be able to prepare a cost sheet for transportation services, hospital and hotel organisation. c. Understand the basic concept of CAS13:service cost center	

SOMAIYA COLLEGE ★ KOPARGAON ★
Dept. of Commerce

SPPU, Pune

Revised Syllabi (2019pattern) for three years B.Com. **T.Y. B.Com.**

Degree Course CBCS

Semester VI

Subject Name -: Cost and Works Accounting. Special Paper II ***Course Code -: 365 – E***

Subject Title -: Methods of Costing

Objectives:

1. *To provide knowledge about the various methods of costing.*
2. *To understand the applications of different methods of costing in manufacturing and service industries.*
3. *To enable students to prepare cost statements under different types of manufacturing industries and Service Industries*
4. *To build the applicability of cost accounting standards in the method of costing.*

Unit No.	**Unit Title**	**Contents**	**Skills to be developed**
1	**Methods of Costing**	1.1. Introduction to Methods of Costing. 1.2 Job Costing Meaning, Features, Advantages and Limitations (Simple problems Only) 1.3 Introduction of Batch costing-(theory Only)	a. *Lerner will understand the various methods of costing* b. Develop the ability to prepare a job cost sheet

2	**Contract Costing**	2.1 Meaning and Features of Contract Costing 2.2 Work-Certified and Uncertified, Escalation clause, Retention Money, Cost Plus contract, work-in-progress 2.3 Profit on incomplete contract	a.It will help the learner to understand the concept of contract costing b. learners will understand the process of calculation of profit on incomplete contracts
3	**Process Costing**	3.1 Meaning and features of process costing 3.2 Preparation of process accounts including normal and abnormal loss/gain 3.3 Joint Products and By Products [Theory and Simple problems] 3.4 Cost Accounting Standard 19: Joint Cost	a. Students will get an idea of how to prepare process accounts. b. Understand the basic concept of CAS 19: Joint cost
4	**Service Costing**	4.1 Meaning, Features and Applications of service costing 4.2 Cost Unit-Simple and Composite 4.3 Cost Sheet for Transportation Service 4.4 Cost Statement for Hospital and Hotel Organization 4.5 Cost Accounting Standard 13: Cost of service cost center	a. The student will be enabled to understand the concept of service costing b. Learners will be able to prepare a cost sheet for transportation services, hospital and hotel organisation. c. Understand the basic concept of CAS13:service cost center

SOMAIYA COLLEGE * KOPARGAON * Dept. of Commerce

SPPU, Pune

Revised Syllabi (2019pattern) for three years B.Com. **T.Y. B.Com.**

Degree Course CBCS

Semester VI

Subject Name -: Cost and Works Accounting. Special Paper II **Course Code -: 365 – E**

Subject Title -: *Methods of Costing*

Objectives:

1. *To provide knowledge about the various methods of costing.*
2. *To understand the applications of different methods of costing in manufacturing and service industries.*
3. *To enable students to prepare cost statements under different types of manufacturing industries and Service Industries*
4. *To build the applicability of cost accounting standards in the method of costing.*

Unit No.	Unit Title	Contents	Skills to be developed
1	**Methods of Costing**	1.1. Introduction to Methods of Costing. 1.2 Job Costing Meaning, Features, Advantages and Limitations (Simple problems Only) 1.3 Introduction of Batch costing-(theory Only)	a. Lerner will understand the various methods of costing b. Develop the ability to prepare a job cost sheet

T.Y. B.Com.

B.Com Degree Course Revised 2019 Pattern (CBCS)

Cost and Works Accounting Special Paper III

Name -: Techniques of Cost Accounting and Cost Audit

Course Code -: 366 – E (SEM-VI)

Objectives:

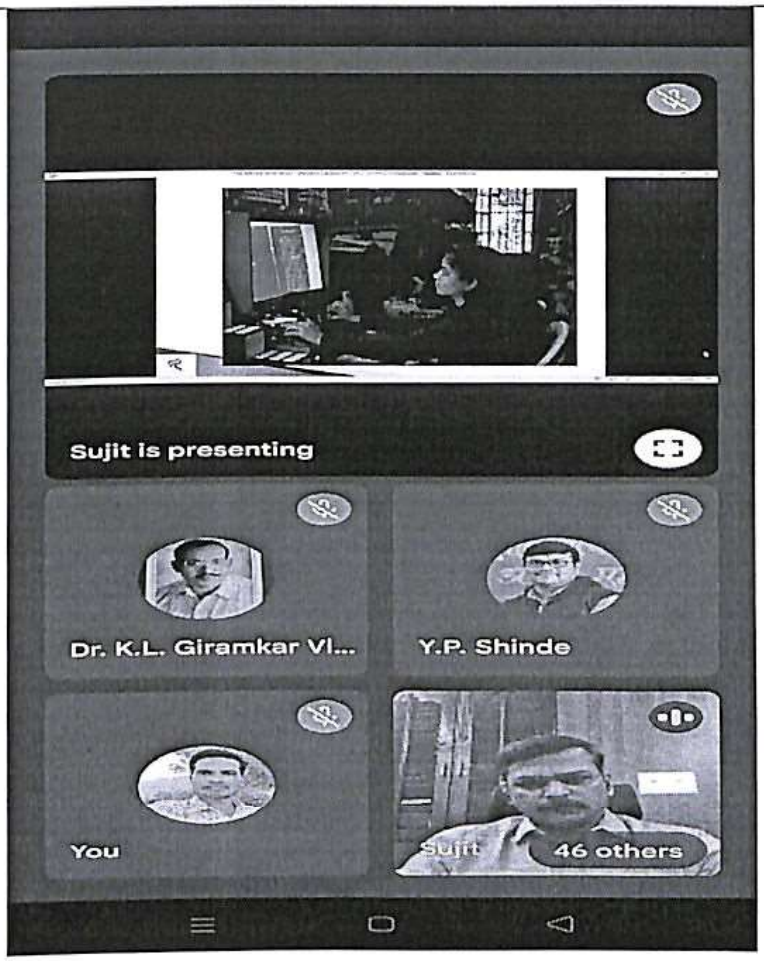
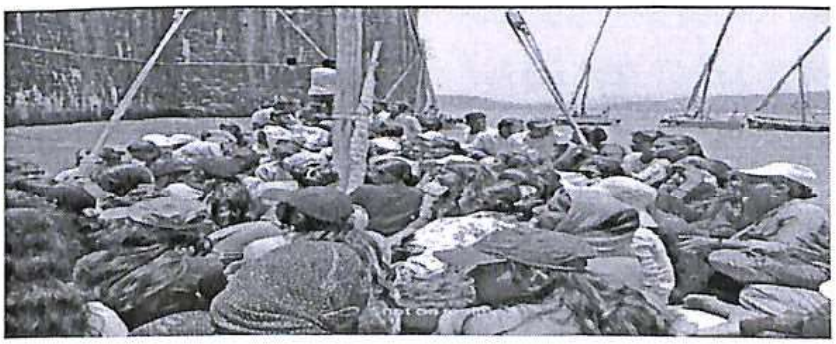
1. To impart knowledge about Standard Costing and Variance Analysis
2. To learn about pricing policy and its implementation.
3. To know the related Cost Accounting Standards and Cost Management practices in specific sectors
4. To provide a conceptual understanding of procedures and Provisions of Cost Audit.

Unit No.	Unit Title	Contents	Skills to be developed
1	Standard Costing	1.1 Definition and meaning of standard cost and Standard Costing. 1.2 Types of standards, setting up of Material, Labour Standards 1. 3 Difference between Standard Costing & Budgetary Control. 1.4 Advantages and Limitations of standard costing 1.5 Variance Analysis & its Significance 1.6. Meaning, types, and causes of material & labour variances. 1.7. Problems on Material & Labour variances.	1.The student will develop the ability to understand the basic concepts of Standard Costing 2.The learner will be able to calculate variances (Material and Labour)
2.	**Pricing Decisions** (Simple Problems Only)	2.1 Principles of Product Pricing 2.2 Pricing Policy 2.3 Pricing of New Products and Finished Products 2.4 Target Costing. Meaning ,Importance in Pricing decision 2.3 Pricing Methods a. Competition based b. Cost-based c. Value-based	1. Students will be able to understand the Principles of product Pricing and Pricing Policy. 2. Students will learn to calculate the Selling price under different pricing methods.

K. J. SOMAIYA COLLEGE ★ Dept. of Commerce ★ KOPARGAON

3	**Cost Accounting Standards and Cost Management for Specific Sector**	3.1 Cost Accounting Standards a. CAS-6 Material Cost b. CAS-7 Employee Cost 3.2 Cost Management for Specific Sector a. Agricultural Sector b. Information Technology (IT) Sector	1. Students will be able to understand the application of Cost Accounting Standards. 2.Learners will be able to understand Cost Management practices in the Agricultural and IT sectors
4	**Cost Accounting Record Rules & Cost Audit:**	4.1 Introduction to cost accounting record u/s 148 of the companies Act 2013. 4.2 Cost records and Verification of Cost Records 4.3 Cost Audit – History, Meaning, applicability, Scope, objectives & advantages of Cost Audit 4.4 Cost auditor – Qualification, disqualification, rights, and duties. 4.5 Preparation and Submission (XBRL) Cost Audit Report.	1. Learners will be able to understand the compliance about the preparation of Cost Accounting records U/S 148 of Companies Act 2013. 2.Students will get exposure to details of Cost Audit and Role of a Cost Auditor

Dept. of Commerce

11	guest lecture of Sujitkumar Ugale Assistant Director Archives Government of Mumbai Maharashtra , on 23 February 2022 for all students of department of History on the topic 'Maharashta Archeology'	Professional Ethics	
12	Department of History organized two days educational tour at Konkan Darshan: Aakvira Devi-Karle-Leni-Diveaagar-Janjira Fort on 5-6th May 2022. Thirty two students of department participated in this tour.	Professional Ethics, Human Values, Environment and Sustainability	 

K.J. SOMAIYA COLLEGE ★ KOPARGAON ★
Dept. of History

13	departme nt of History organized a course of Bramhi Script April 2023	Professional Ethics	

Head of Department

Head
Department of History
K. J. Somaiya College, Kopargaon

Semester IV: Optional Paper No. 19.

Credits :4

Course Title: History of Maharashtra in the 20th Century

Objectives

The purpose of the course is to enable the student to study the history of modern Maharashtra with an analytical perspective and to highlight the ideas, institutions, forces and movements in 20th century Maharashtra. It aims to introduce the student to the regional history within a broad national framework.

Course content

1. Nature of Freedom Movement in 20th Century Maharashtra
2. Social Reform Movement — 04
   a) Non- Brahmin Movement
   b) Dalit Movement — 08
3. Industrial and Economic development of Maharashtra
   a) Industrialization and Urbanization
   b) Cotton and Sugar Industry — 10
   c) Co-operative Movement
4. Movements
   a) Peasants Movements
   b) Workers Movements — 06
   e) Tribal Movement
5. Integration and Reorganization
   a) Hyderabad Mukti Sangram
   b) Sanyukta Maharashtra Movement — 08
6. Towards emancipation of Women
   Beginnings of Feminist Movement — 04

Select Readings

Bhagwat Vidyut, Stree Prashnachi Vatchal

Dixit Raja, Itihas, Samajvichar ani Keshavsut, Lokavangmaya Gruha, Mumbai, 2nd edn., 2005. (in Marathi)

Javdekar, S. D. Adhunik Bharat

F.Y.B.A. HISTORY

Under the Faculty of Humanities

Total Credits: 03

Semester-I Early India: From Prehistory to the Age of the Mauryas

Objectives:

The history of Early India is a crucial part of Indian history. It is a base for understanding the entire Indian history. The course is aimed at helping the student to understand the history of early India from the prehistoric times to the age of the Mauryas. It attempts to highlight the factors and forces behind the rise, growth and spread of civilization and culture of India along with the dynastic history. It also attempts to help the students to understand the contribution of Early Indians to polity, art, literature, philosophy, religion and science and technology. It also aims to foster the spirit of enquiry among the students by studying the major developments in early Indian history.

Unit I: Early India: Sources and Prehistory **[12]**

(a) Importance of Early History
(b) Sources and Tools of historical reconstruction – Archaeology (Material remains), Epigraphy (Inscriptions), Numismatics (Coins), Literary Sources, Foreign Accounts
(c) Palaeolithic, Mesolithic, Neolithic and Chalcolithic Cultures: A Brief Review

Unit II: Harappan Culture: Bronze Age Civilization **[12]**

(a) Geographical Extent, Town Planning, Trade, Religious Practices
(b) Art, Crafts and Technology: Pottery, Seals, Beads, Images, Terracotta Figurines Metallurgy, Script and Decline

Unit III: Vedic Culture, Religious Protest: Jainism and Buddhism **[12]**

(a) Vedic and Later Vedic Culture: Original home, Tribal Polity, Social Divisions, Rituals and Philosophy
(b) Jainism and Buddhism: Causes of Origin, Doctrines, Contributions and Importance

Semester-II

Early India: Post Mauryan Age to the Rashtrakutas

Objectives:

The history of India after the Mauryas is very important to understand the developments in early India after the Mauryas, which finally led to the transition to medieval India. The course is aimed at introducing the students to the developments in different parts of India through a brief study of regional kingdoms up to the tenth century C.E. It attempts to highlight the consequences of the foreign invasions, particularly on the polity, economy, society and art and architecture. The attempt is also to instill the spirit of enquiry among the students.

Unit I: Central Asian Contacts and the Age of the Shung-Satvahanas [12]

(a) The Indo-Greeks, The Shakas, The Parthians, The Kushanas: Economy, Society, Religion and Culture

(b) The Age of Shung-Satvahanas: Polity and Administration, Society, Economy, Culture

Unit II: Early History of South India [12]

(a) Period of Sangam Literature –Society and Culture, early polities

(b) Economy: Towns, Trade and Crafts

Unit III: North India: Gupta and Harshvardhan [12]

(a) The Gupta Empire – Brief Political History, Administration, Society, Trade, Science and Technology

(b) Harshvardhan: Administration, Religion, Education

Unit IV: Regional Kingdoms: A Brief History [12]

(a) The Chalukyas, Pallavas, Pandya - Struggle for Supremacy over Peninsular India

(b) Rashtrakutas, Palas, Parmaras- Tripartite Struggle

(c) Literature, Religion, Art and Architecture

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Savitribai Phule Pune University, Pune

Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21

Under the Faculty of Humanities

Discipline Specific Elective Course (DSE-1A)

Semester -III-Medieval India - Sultanate Period

Course objectives:

1.Demonstrate thinking skills by analyzing, synthesizing, and evaluating historical information from multiple sources.

2.Develop the ability to distinguish between fact and fiction while understanding that there is no one historical truth.

3.To Learn foundation of Delhi Sultanate and Sultanate Administration.

4.To understand the socio, economic condition of Delhi Sultanate

Course outcome:

1. Provides examples of sources used to study various periods in history.
2. Relates key historical developments during medieval period occurring in one place with another.
3. Analyses socio - political and economic changes during medieval period
4. Estimate the foreign invasion and the achievement of rulers

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/ Tests/Quiz/Maps./Field visit/ Group Discussion/ Seminar /use of e-learning

Unit I: Foundation of the Delhi Sultanate 12

a) Sources of Historiography of Sultanate Period

b) Invasions of Muhammad Ghori

c) Foundation of Delhi Sultanate: Qutbuddin Aibak

Unit II: The early Sultans of Delhi and their contributions 10

a) Iltutmish

b) Raziyya

c) Balban

Unit III: Expansion of Sultanate 16

a) AlauddinKhalji: Expansion and Administrative Reforms

b) Experiments of Muhammad-Bin-Tughlaq, Firuz Tughlaq: Administrative Reforms.

c) The Saiyyids, the Lodis and the decline of the sultanate.

Unit IV: Kingdoms of Vijayanagar and Bahamani 10

a) Rise of Vijayanagar Empire:Harihar, Bukka, Krishndevray

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21

Under the Faculty of Humanities

Core Course-I (CC- 1C)

Semester -III-History of the Marathas: (1630-1707)

Learning Objectives:

1. To introduce the students to the regional history of medieval Maharashtra and India.
2. To study political, social and conceptual history of the Marathas in an analytical way with thehelp of primary sources.
3. To evaluate contribution of Chhatrapati Shivaji Maharaj to the establishment of Swarajya, contribution of successors and later development of the Maratha kingdom.
4. To study administrative Institutions of the Maratha.

Learning Outcome:

1. Student will develop the ability to analysesources for Maratha History.
2. Student will learn significance of regional history and political foundation of the region.
3. It will enhance their perception of 17th century Maharashtra and India in context of Maratha history.
4. Appreciate the skills of leadership and the administrative system of the Marathas.

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/Tests/Quiz/ e-learning

Unit-I: Sources and Rise of the Maratha Power **12**

a) Literary Sources: Marathi and Foreign Sources (Portuguese,English,French)

b)Background of the rise of Maratha Power

c) ShahajiRaje, Rajmata Jijabai and Early Life ofChhatrapati Shivaji Maharaj

Unit-II: Foundation of Swarajya to the Coronation,Karnataka Expedition16

a) Relations with Adilshahi: Javali and Afzal Khan episode and its importance

b) Relations with Mughals: Campaign of Shayasta Khan,Sack of Surat, expedition of Jaisingh, Visit to Agra

c) Coronation and Karnataka Expedition

Unit-III: Administration under Chhatrapati Shivaji Maharaj ***08***

a) Military

b) Civil

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21

Under the Faculty of Humanities

Discipline Specific Elective Course (DSE-2A)

Semester -III-Glimpses of the Modern World - Part I

Learning Objectives:

1. This paper is designed to introduce the students to the history of the Modern World with its socio-religious, political and economic developments.
2. It will enable students to study interesting historical developments in the countries other than India, which had a significant impact on almost all over the Modern World.
3. It will enable students to understand the significant impact of the modern concepts such as Renaissance, Nationalism, Communism, Imperialism, etc.
4. It will get students acquainted with the major revolutions, and political developments which led to the World War I and its consequences.

Learning Outcomes:

1. It will enable students to develop the overall understanding of the Modern World.
2. The students will get acquainted with the Renaissance, major political, socio-religious and economic developments during the Modern World.
3. It will enhance their perception of the history of the Modern World.
4. It will enable students to understand the significance of the intellectual, economic, political developments in the Modern World.

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/Tests/Quiz/ e-learning

6

Unit I. The Modern Age

a) Renaissance - Background and Nature

b) Religious Reforms Movement - Martin Luther King **14**

Unit II. The Age of Revolutions

a) The American Revolution - Causes and Consequences

b) The French Revolution - Causes and Consequences

c) The Industrial Revolution - Causes and Consequences

14

Unit III. Nationalism

a) Unification of Italy

b) Unification of Germany

c) Japan - The Meiji Revolution

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for SYBA (Credit System) form the Academic Year 2020-2021

Under the Faculty of Humanities

Skill Enhancement Courses (SEC 2 A) – (2 Credits)

Semester III-4)Tourism Management

Course Objectives:

1. This paper is designed to introduce the students to Tourism Management.
2. It will get students acquainted with all the processes of Tourism Industry to work with great potential.
3. It will enable students to seek self-employment by starting their own tourism related business.

Course Outcome:

1. Students will get an overall understanding of the process of Tourism Management.
2. They will learn to work in the Tourism Management with great potential.
3. They will be able to seek self-employment by starting their own tourism related business.

Course Content:

Unit I Tourism

a) Definition and Nature of Tourism
b) Important Components
c) Topology of Tourism

Unit II Tourism recent trends

a) Concept of Domestic and International Tourism
b) Tourism Recent Trends.

Unit III Tourism as Industry

a) Tourism as an Industry
ii) Visitor, Tourist, Excursionist

Unit IV Tourism in India and Impact

a) Growth and development of tourism in India
b) Economics and Social impact
c) Physical and environmental impact

Unit V Filed Trip and Report Writing

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21

Under the Faculty of Humanities

Discipline Specific Elective Course (DSE-1B)

Semester -IV-Medieval India: Mughal Period

Course objectives:

1. Produce well researched written work that engages with both primary sources and the secondary literature.

2.To learn the Mughal ruler and incidents regarding Deccan policies.

3.To understand the analytical studies of Medieval South India

4.Maps- important centers in Mughal Empire under Akbar and Aurangzeb

Course outcome:

1. Draws comparisons between policies of different rulers.

2. Understanding Role of Akbar in the consolidation of Mughal rule in India.

3. Understand Aurangzeb's conflict with Rajputas, Maratha and weakening Mughals age.

4. Analyses factors which led to the emergence of new religious ideas and movements (bhakti and Sufi)

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/ Tests/Quiz/Maps/Field visit/ Group Discussion/ Seminar /use of e-learning

Unit I: Foundation of Mughal Empire **10**

a) Sources of Historiography of Mughal Period

b) Babur: The Foundation of Mughals Empire

c) Humayun Struggle withSher Shah Suri. Sher Shah: administrative reforms

Unit II: The Consolidation of the Mughal Empire **18**

a) Akbar: Extent of the Mughal Empire, Mansabdari System, Religious Policy

b) Expansion: Deccan Policy of Jahangir and Shah Jahan

c)The reign of Aurangzeb: Rajput Policy, Ahom conflicts, Sikh Policy, Deccan expeditions

Unit III: Administrative systems10

a) Central and Provincial Administration

b) Revenue System

c) Judicial System,Military administration

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21

Under the Faculty of Humanities

Core Course-I (CC- 2C)

Semester -IV- History of the Marathas: (1707-1818)

Learning Objectives:

1. To understand changed nature of Maratha Polity during the Peshwa Period.
2. To examine the dynamics of Maratha Confederacy and reciprocity.
3. To examine role of Marathas and regionality in National politics of 18th Century India.
4. To study administrative system, society and economy of the Peshawa period

Learning Outcome:

1. Students will be able to analyze the Marathas policy of expansionism and its consequences.
2. They will understand the role played by the Marathas in the 18th century India.
3. They will be acquainted with the art of diplomacy in the Deccan region.
4. It will help to enrich the knowledge of the administrative skills and profundity of diplomacy.

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/Tests/Quiz/ e-learning

Unit-I: Consolidation and Expansion of the Maratha Power 12

a) Conflict betweenMaharani Tarabai and Chhatrapati Shahu Maharaj

b) Rise of the Peshwas: Balaji Vishwanath-Chauthai and Sardeshmukhi

c) Peshwa Bajirao I: South and NorthExpedition

Unit-II: Strengthening of the Maratha Power 12

a) Peshwa Balaji Bajirao (Nanasaheb)

b) Third Battle of Panipat: Causes and Consequences

c) Causes of the defeat of the Marathas

Unit-III:Post Panipat Revival and Downfall 12

a) Peshwa Madhavrao I

b) Barbhai Council: Role of Mahadji Shinde and Nana Phadanvis

c) Downfall of Maratha Power

Savitribai Phule Pune University, Pune

Proposed Syllabus in History for SYBA (Credit System) form the Academic Year 2020-2021

Under the Faculty of Humanities

Skill Enhancement Courses (SEC 2 B) – (2 Credits)

Semester IV- 8) Travel Agency and Tour Business

Course Objectives:

1. This course is designed to create awareness about Travel Agency, Education and Job opportunities among the students.

2. It aims in training students on both Theory and Practical aspect and Travel Agency and creating professionals for tourism industry.

3. It will enable student to seek self-employment by starting their own Travel Agency related to business.

Course Outcome:

1. The students will understand the details of the business of Travel Agency.

2. They will be trained on both Theory and Practical aspect and Travel Agency and creating professionals for Tourism Industry.

3. It will enable student to seek self-employment by starting their own Travel Agency related to business.

Course Content:

Unit I. Concept of Travel Agency

a) Definition of travel agency
b) Main function of travel agency
c) Organizational Structure of a travel agency

Unit II. Role of Travel Agent

a) Types of Travel Agents
b) Responsibilities of Travel Agent
c) Procedure for Travel Agent and Tour Operators in India
d) Online Travel Agency

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for S.Y.B.A. (Credit System) from the academic Year 2020-21
Under the Faculty of Humanities
Discipline Specific Elective Course (DSE-2 B)
Semester -IV-Glimpses of the Modern World - Part II

Learning Objectives:

1. This paper is designed to introduce the students to the political history of the Modern World.
2. It will enable students to study remarkable historical developments in the various countries including India, which had a significant impact on almost all over the Modern World.
3. It will enable students to understand the significant impact of the modern concepts such as Dictatorship, Cold War, Nationalism, Communism, Imperialism, Polarization, etc.
4. It will get students acquainted with the major nationalist movements, the World War II and its consequences, the Cold War and its Consequences.

Learning Outcomes:

1. It will enable students to develop the overall understanding of the Modern World.
2. The students will get acquainted with the major nationalist movements, the World War II and its consequences, the Cold War and its Consequences.
3. It will enhance their overall perception of the history of the Modern World.
4. It will enable students to understand the significance of the strategic political developments in the Modern World.

Pedagogy: Lectures/Visual presentation/ Role play/ Critical analysis/Assignments/Tests/Quiz/ e-learning

Unit I. Nationalist Movements in Asia and Africa **12**

a) Dr. Sun-Yet-Sen

b) Mahatma Gandhi (Non-Cooperation Movement, Civil Disobedience Movement, Quit India Movement)

c) Dr. Nelson Mandela

Unit II. Rise of Dictatorship **12**

a) Italy - Mussolini

b) Germany – Hitler

c) Turkestan - Kemal Pasha

d) Militarism in Japan

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for T.Y.B.A. (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Core Course 3 :(3 Credit)
Semester V: Course Title: - Indian National Movement (1885-1947)

Learning Objectives:

1. The course is designed to make the students aware about the making of Modern India and the struggle for independence.
2. To make the students aware of the multi-dimensionality of Modern India.
3. To highlight the ideas, institutions, forces and movements that contributed to be shaping of Indian Modernity.
4. To acquaint the students with various interpretative perspectives.

Learning Outcomes:

1. It will enable students to develop an overall understanding of Modern India.
2. It will increase the spirit of healthy Nationalism, Democratic Values and Secularism among the Students.
3. Students will understand various aspects of the Indian Independence Movement and the creation of Modern India.

Pedagogy: Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning

Unit I: Rise and Growth of Indian Nationalism **12**

a) Causes for the Rise of Indian Nationalism
b) Foundation of Indian National Congress.
c) Moderate Nationalists and Assertive Nationalists
d) Revolutionary Nationalists.

Unit II: Mass Movement **9**

a) Non Co-Operation Movement.
b) Civil Disobedience Movement.
c) Quit India Movement.

Unit III: Towards Independence and Partition. **12**

a) Two Nation Theory: Establishment of Muslim League and Hindu Mahasabha, Growth of Communalism, Genesis of Pakistan.
b) Indian National Army.
c) Transfer of Power: The Cripps Mission, The Cabinet Mission, The Mountbatten Plan, Indian Independence Act and Partition.

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for TYBA (Credit System)
Form the Academic Year 2021-2022
Under the Faculty of Humanities
Skill Enhancement Courses (SEC 2 C) – (2 Credits)
Semester V -SEC: 11 Course Title: - Museology

Objectives:

1. To acquaint the students with the rise and development of Museum.
2. To impart to the students an understanding of the importance of material history through Museum.
3. To encourage the students to collect the material or sources of History for local, regional and National History through Museum.
4. To enable the students to collect Various Articles as a tool of History.

Course Outcomes:

1.The Students will understand the Concepts of Museum ad learn the basic Principles of Museology

2 The Students will gain Comprehensive Knowledge of the Process of Cringe and Conserving Museum of objects

Unit-I: Introduction

a) Definition

b) History of Museum **10**

c) Importance of Museum

Unit-II: Main Museums in Maharashtra.

a) Museums before Independence

b) Museums after Independence **10**

c) Role of Curator

Unit-III: Types of Museums

a) Arts Museums

b) Historical Museums. **10**

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for T.Y.B.A. (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Discipline Specific Elective Courses (DSE-3C)- (3 Credit)
Semester –V Course Title: Introduction to Historiography

Objectives:

1. To orient students about how History is studied, written and understood.
2. To explain methods and tools of data Collection
3. To study the types of Indian Historiography.
4. To describe importance of Inter-Disciplinary Research.
5. To introduce Students to the basics of Research.

Course Outcomes:

1. Students will be introduced to the information and importance of Historiography.
2. Students will be introduced to the different Methods and Tools of data collection.
3. Students can study the interdisciplinary approach of History .
4. Students will learn about the usefulness of History in the 21st century, its changing perspectives, the new ideas that have been invented, and the importance of History in a competitive World.
5. This curriculum develops Research abilityand process of Research Methodology in History

Pedagogy: Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning

Course Content: **11**

Unit -I: Meaning and Scope of History

a) Definition, Nature & Scope of History

b) History and Social sciences

(Political science, Geography, Economics, Sociology)

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for T.Y.B.A. (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Discipline Specific Elective Courses (DSE-4D)- (3) Credit

Semester –V Course Title: Maharashtra in the 19th Century

Course Objectives:

1. To Introduce the students to the history of 19th century in Maharashtra
2. To study Political, Social, Economic and conceptual History of the 19th Century Maharashtra in an analytical way with the help of primary sources.
3. To evaluate contribution of 19th century in Maharashtra to the establishment of Maharashtra state contribution of successors and later development of the 19th century Maharashtra
4. To study Socio-religious System of the 19th Century in Maharashtra.

Course Outcomes:

1. Student will develop the ability to analyse sources for 19th century Maharashtra History.
2. Student will learn significance of Regional History and Socio- religious reformism foundation of the region.
3. It will enhance their perception of 19th Century Maharashtra.
4. Appreciate the skills of leadership and the Socio-religious System of the Maharashtra.

Pedagogy:

Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning.

Course Content:

Unit-I. Foundation of British Power in Maharashtra 9

a) Background
b) British Administration.
c) Impact of British Power in Maharashtra.

Unit-II. Reformism in Maharashtra 16

a) Contribution of Intellectuals –Balshastri Jambhekar, Jagannath Shankarsheth Gopal Hari Deshmukh (Lokhitwadi) ,Mahatma Jyotiba Phule

Savitribai Phule Pune University, Pune
Proposed syllabus in History for TYBA (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Core Course 4 (3 Credit)

Semester VI: Course Title: - India After Independence- (1947-1991)

Objectives:

1. To make the students aware about the making of Contemporary India and events that panned out in the Post-Independence Era.
2. To make the students aware of the Multi-Dimensionality of Modern India.
3. To highlight the ideas, institutions, forces and movements that contributed to the shaping of Indian Modernity.
4. To acquaint the students with various Interpretative and Analytical perspectives.

Course Outcomes:

1. It will enable students to develop an overall understanding of the Contemporary India.
2. To increase the spirit of healthy Nationalism, Democratic Values and Secularism among the students.
3. Students will understand various aspects of India's domestic and foreign policies that shaped Post-Independence India.

Pedagogy: Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning

Unit I: Challenges after Independence 13

a) Consequences of Partition
b) Integration of Princely states- Kashmir, Junagadh, Hyderabad
c) Liberation of Portuguese and French Colonies- Goa, Pondicherry, Chandranagore
d)Indian Constitution – Salient Features
e) Linguistic Reorganization of States

Unit II: India's Foreign Policy 10

a) Non Aligned Movement
b) Indo-Pak Relations, Conflicts and the birth of Bangladesh
c) Indo-Sino Relations, Conflicts and Panchsheel
d) Indo-Sri Lanka Relations

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for TYBA (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Discipline Specific Elective Courses (DSE-3C) -(3 Credit)

Semester –VI, Course Title: Applied History

Course objectives:

1) To Introduce students to information and importance of Applied History.

2) To help students understand the usefulness of history in the 21st century, its changing perspectives, the new ideas that have been invented, and the importance of History in a Competitive World.

3) To inform the students about the historical significance of Archaeology and Archives and the opportunities in the field of Archaeology and Archives through this course.

4) To inform the students about the opportunities in the field of Media, Museums through this Course.

Course Outcomes:

1. Students will be introduced to the information and importance of applied history.
2. Student will learn about the Historical significance of Archaeology and Archives and opportunities in the field of Archaeology and Archives.
3. Through this course, students will be informed about the opportunities in the field of Media, Museums.
4. Students will learn about theusefulness of history in the 21st Century, its changing Perspectives, the new ideas that have been invented, and the importance of History in a Competitive World.

Pedagogy: Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning

Course Content

Unit-I. Applied History **14**

a. Applied History: Concept and Application
b. Application of History in Various Subjects
c. Co-relationship between Past and Present
d. Contemporary History: Meaning and Nature

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for TYBA (Credit System)
Form the Academic Year 2021-2022
Under the Faculty of Humanities
Skill Enhancement Courses (SEC 2 D) – (2 Credits)
Semester VI: 13 Course Title: - Archaeology

Course Objectives:

1. This paper is designed to introduce the students to the Key Concepts and practical approaches in Archaeology, highlighting their applications in interpreting the Human past.
2. It will enable students to understand the definition, aims and scopc of Archaeology and its development as a discipline will be introduced to the Students.
3. The nature of the Archaeological record and the unique role of science in Archaeology is explained to the students.
4. Legislation related to Archaeology and the role of Archaeology in Heritage Management is also discussed in this course.

Course Outcomes:

1. Students will learn to understand the definition, aims and scope of Archaeology so as to understand its applications in interpreting the human past.
2. They will be able to understand the nature of the archaeological record and the unique role of science in archaeology.
3. They will have an overall understanding of the Archaeology.

Course Content:

Unit- I: Definition, Aims and Scope of Archaeology **10**

a) Archaeology as the Study of the Past: Definition, Aims, and Scope
b) Significance of Archaeology
c) Archaeology and History: Differences and Similarities

Unit- II: Development of Archaeology in India **10**

a) Archaeological Survey of India
b) Tata Fundamental Research Institute Mumbai
c) Deccan College Pune

Unit-III: Value of Archaeology **10**

a) Cultural Heritage
b) Monuments

Savitribai Phule Pune University, Pune
Proposed Syllabus in History for TYBA (Credit system)
From the Academic Year 2021-22
Under the Faculty of Humanities
Discipline Specific Elective Courses (DSE-4D)- (3) Credit

Semester -VI, Course Title: History of Maharashtra in the 20th Century

Course Objectives:

1. To Introduce the students to the history of 20th Century in Maharashtra
2. To study Political, Social, Economic and Conceptual History of the 20th Century Maharashtra in an Analytical way with the help of Primary Sources.
3. To evaluate contribution of 20th Century in Maharashtra to the establishment of Maharashtra state contribution of successors and later development of the 19th century Maharashtra
4. To study Socio-Religious System of the 20th Century in Maharashtra.

Course Outcomes:

1. Student will develop the ability to analyses sources for 20th Century Maharashtra History.
2. Student will learn significance of regional history and Socio- Religious Reformism foundation of the region.
3. It will enhance their Perception of 20th Century Maharashtra.
4. Appreciate the skills of leadership and the Socio-Religious System of the Maharashtra.

Pedagogy:

Lectures / Visual Presentation / Critical Analysis / Assignments / Test/ e-learning

Course content

Unit I. Thoughts and work of Intellectuals

a) Pandita Ramabai
b) Rajarshri Chhatrapati Shahu Maharaj
c) Maharshi Vitthal Ramji Shinde
d) Maharshi Dhondo Keshav Karve
e) Maharaja Sayajirao Gaikwad.
f) Dr. Babasaheb Ambedkar
g) Karmaveer Bhaurao Patil

Semester I: Core Paper No. 1

Credits: 4

Course Title: HS: CC - 1: History: Theory and Method

Objectives

The paper is designed to provide adequate conceptual base, bring better understanding of history and its forces, help interrogate existing paradigms and challenge the outdated, help in developing critique, help research in terms of formulating hypotheses and develop broad frames of interaction with other social sciences and attain certain level of Interdisciplinary approach.

Course content

1. Philosophy, Nature and Functions of History

2. Scientific Method of Historical Research
   i. Formulation of Research Question
   ii. Stating the Hypotheses
   iii. Choosing a Research Design
   iv. Collection of Sources- Primary and Secondary sources
   v. Criticism of Sources – Internal and External
   vi. Analysis, Historical imagination and Interpretation
   vii. Conclusions
   viii. Report sharing – Footnotes and Bibliography

3. Early Theories of History
   i. Greek Thought – Quasi-Histories, Herodotus, Thucydides and Polybius
   ii. Roman Thought – Livy, Plutarch, Tacitus
   iii. Church- St Augustine's method of Textual Interpretation, Eusebius's chronological method
   iv. Indian Thought – Narrative method, Itihasa Purana Tradition
   v. Arab Thought- Ibn Khaldun's Causes of Lies in History

4. Modern Theories of History
   i. Rationalist
   ii. Romanticist
   iii. Positivist
   iv. Historical Materialism

5. Post-war Theories of History
   i. Socio-Economic Theories
   ii. Structuralism and Post Structuralism
   iii. Post-Modernism
   iv. Total History

Semester I: Core Paper No. 2

Credits: 4

Course Title: HS: CC - 2: Evolution of Ideas and Institutions in Early India

Objectives

The course intends to provide an understanding of the social, economic and institutional bases of early India. It is based on the premise that an understanding of early Indian history is crucial to understand Indian history as a whole.

Course content

1. Defining Early India
   - i. Historiography (colonial, nationalist)
   - ii. Terminology ('Hindu', 'Ancient', 'Early')
2. Sources: Perceptions, Limitations, Range
   - i. Archaeological
   - ii. Literary sources: Sanskrit, Prakrit, Pali; Religious, non-religious; Tamil Inscriptions
   - iii. Foreign accounts: Chinese, Roman
3. Political Ideas and Institutions: North and South India
   - i. Lineage Polities
   - ii. Pre-State formations in north and south India
   - iii. Early State Formations: Mahajanapadas, Maurya, Deccan and South India
   - iv. Administrative Institutions: Kingship, Administrative structures
4. Social ideas and institutions
   - i. Kin and Lineage society
   - ii. The emergence of caste based societies, marginalization and subordination
   - iii. Social protest and the emergence of new social and religious forms
   - iv. Social systems in the far south
5. Economy
   - i. Pre-historic to Chalcolithic developments
   - ii. Development of Agriculture and Trade
   - iii. Expanding Trade Economy - guilds, crafts, coinage
   - iv. Urbanisation

Select Readings

English

1. Altekar, A.S., State and Government in Ancient India, Motilal Banarasidas, Delhi. 2016.
2. Gurukkal, R., *Social Formations in Early South India*, Oxford University Press, 2010.
3. Jha, D.N., *Early India: A Concise History*, Manohar, 2004.
4. Jha, D.N., *Ancient India in a Historical Outline*, Manohar, 3rd enlarged edition, 2015.

Semester I: Core Paper No.3.

Credits: 4

Course Title: HS: CC 3: Maratha Polity

Objectives

The purpose of the course is to study the administrative system of the Marathas in an analytical way, to acquaint the student with the nature of Maratha Polity, to understand basic components of the Maratha administrative structure, to enable the student to understand the basic concepts of the Maratha polity.

Course content

1. Defining the term 'Maratha Polity'
2. Nature of Sources: Perceptions, Limitations, Range
   - i. Literary
   - ii. Foreign
   - iii. Archival
   - iv. Miscellaneous
3. Maratha State
   - i. Formation of the Maratha State
   - ii. Nature
4. Administrative Structure
   - i. Administrative Structure of the Deccani Kingdoms: a brief survey
   - ii. Principles underlying Maratha Administration
   - iii. Central: the institution of kingship, theory, problem of legitimacy, Ashta-PradhanMandal
   - iv. Provincial and Village: administrative units
   - v. Fiscal administration: Public income and expenditure
   - vi. Military System: forts, infantry, cavalry, navy
5. Socio-Political Power Structur
   - i. Religion
   - ii. Caste
   - iii. Gota
   - iv. Watan
6. Administration of Justice
   - i. Sources of law
   - ii. Judicial structure - central, provincial
   - iii. Judicial institutions - political, traditional
   - iv. Crime and punishment - police

Semester 2: Elective Course No. 2

Credits.4

Course Title: HS: EC-2: Social Background of Dalit Movement in Maharashtra

Objectives:
This paper is designed to emphasise the background of the Dalit movement which flourished in the twentieth century. It highlights the earlier forms of protest from the ancient till the medieval period, which laid the foundations for social protest and dissent in the pre- Ambedkar period.

Course Content

1. Historical Development of caste system

2. Defining the term 'Dalit' and 'Dalit consciousness'

3. Historical Background of Protest
   i. Early Manifestations- Lokayat, Buddhism,Jainism
   ii. Medieval Manifestations- Janabai, Chokhamela, Soyarabai, Karmamela, Banka and Bahinabai

4. Non-Dalit Contribution to the Dalit Movement
   i. Mahatma Phule, Savitribai Phule, Vitthal Ramji Shinde
   ii. Sayaji Maharaj, RajarshiShahu Maharaj

5. Pre-Ambedkar reformers and protest
   i. Gopal Baba Walangkar
   ii. Mukta Salve
   iii. Shivaram JanbaKamble
   iv. KisanFagujiBansode

Select Readings:

English:

1. Ambedkar B. R., *'Castes in India', Dr. Babasaheb Ambedkar Writings and Speeches*, Vol. I, Govt. of Maharashtra, Mumbai, 1987.
2. Ambedkar B. R., *'Who were the Shudras', Dr. Babasaheb Ambedkar Writings and Speeches*, Vol. VII, Govt. of Maharashtra, Mumbai, 1987.
3. Ambedkar B. R., *'Revolution and Counter Revolution in Ancient India', Dr. Babasaheb Ambedkar Writings and Speeches*, Vol. III, Govt. of Maharashtra, Mumbai, 1987.
4. Ambedkar B. R., *'The Untouchables', Dr. Babasaheb Ambedkar Writings and Speeches*, Vol. VII, Govt. of Maharashtra, Mumbai, 1987.

Semester 2: Core Paper No. 4

Credits: 4

Course Title: HS: CC - 4: Approaches to History

Objectives
The paper is designed to make the student aware about the various approaches to the discipline of History. With its roots in Indian history, the paper provides a historical review of the salient approaches that have developed over the last few centuries. It is hoped that the student will become aware of the idea that the same set of historical source materials can be interpreted in different ways depending upon the approach one takes in studying them.

Course content

1. Many Worlds of Indian History
   i. Political, Economic, Social, Cultural Histories
   ii. Food History, Micro-History, Family History, History and Memory

2. Early Approaches to Historical Sciences-
   i. Colonial
   ii. Nationalist
   iii. Cambridge
   iv. Marxist

3. Later Approaches to Historical Sciences
   i. Annales
   ii. Subaltern
   iii. Dakar
   iv. Feminist

4. Recent Developments
   i. Myths, Folklore, Oral History
   ii. Textual Criticism
   iii. Cognitive and Cultural Turn
   iv. Dalit and Non-Brahminical
   v. Environmental
   vi. Digital Turn

Select Readings:

1. Abrams, Lawrence, and Knoblauch, Kaleb, ed., *Historians without Borders: New Studies in Multidisciplinary History*, Routledge, 2018.
2. Elton, Geoffrey, *The Practice of History*, Methuen, 1967.
3. Ferro, Marc, *The Use and Abuse of History*, Routledge, 2003.
4. Sreedharan, E., *A Textbook of Historiography*, Orient Blackswan, 2004.
5. Tamm, Marek, and Burke, Peter, ed., *Debating New Approaches to History*, Bloomsbury, 2014.
6. Woolf, D.R., ed., *A Global Encyclopedia of Historical Writing*, Routledge, 2014.

Semester 2: Core Course No. 5

Credits: 4

Course Title: HS: CC - 5: Ideas and Institutions in Medieval India

Objectives

The course examines the nature of medieval Indian society, economy, state formations, and the main religious currents of the time. It is seen as a continuation of the course on ancient India. It is also seen to be crucial to an understanding of the nature of society, and the problems of the challenge to that society, through colonialism, at a later stage.

Course content

1. Defining medieval India

2. Sources: Perceptions, Limitations, Range
   i. Persian sources
   ii. Regional language sources
   iii. Foreign sources: Travellers' accounts, European records

3. The state in medieval India: perceptions and practice
   i. Modern theories of the medieval state: Theocracy, Feudal, Segmentary, Patrimonial-Bureaucratic
   ii. Medieval Theories of the State: Farabi, Ghazzali, Shukracharya, Barani, Abul Fazl, RamachandrapantAmatya
   iii. State formation in peninsular India - Chola, Bahamani, Vijayanagar

4. Administrative Systems
   i. Central and Provincial
   ii. Mansabdari
   iii. Agrarian systems

5. Society and Economy in Medieval India
   i. Social mobility and Stratification; the emergence of new classes: Administration, agrarian, mercantile
   ii. Religion and social change - Bhakti and Sufi
   iii. Trade - internal and external
   iv. Impact of the arrival of the Europeans

Semester 2: Elective Course No. 10

Credits: 4

Course Title: HS: EC - 10: Nature of Dalit Movement in Maharashtra

Objectives

The paper is developed to analyze the ideology and organization of the Dalit Movement in Maharashtra. Dr. Babasaheb Ambedkar led the Dalit Movement and achieved many kindsof justices to Dalits. He had to fight against inequality and atrocities imposed due to socio-economic and political structure of Hindu society. He had to fight on various fields at the same time such as political, social, economic, religious etc. The attempt here is to help students to understand the details of the most important and neglected socio-religious reform movement in Maharashtra with its root causes. The paper attempts to help students to understand the ideology of Dr. Babasaheb Ambedkar who was the unchallenged leader of the Dalit Movement.

Course Content

1. Ambedkarism: The Theory of Dalit Liberation- Dr. Babasaheb Ambedkar's Ideology
   i. Educational Thoughts of Dr. Babasaheb Ambedkar
   ii. Socio-religious Thoughts of Dr. Babasaheb Ambedkar
   iii. Political Thoughts of Dr. Babasaheb Ambedkar
   iv. Economic Thoughts of Dr. Babasaheb Ambedkar

2. Dalit Movement under the leadership of Dr. Babasaheb Ambedkar
   i. Newspapers: Mooknayak, Bahishkrut Bharat, Janata, Prabuddha Bharat
   ii. BahishkrutHitkarini Sabha, SamajSamta Sangh and People's Education Society
   iii. Mahad Satyagraha and Burning of Manusmruti
   iv. Kalaram Temple Entry Satyagraha

3. The Dalit Movement and Politics
   i. Southborough Committee on Franchise
   ii. Simon Commission
   iii. Round Table Conferences
   iv. Poona Pact
   v. Gandhi-Ambedkar Debate

4. Political Development of Dalit Movement
   i. Independent Labour Party
   ii. Scheduled Caste federation
   iii. Republican Party of India

Semester 2: Core Paper No. 6

Credits: 4

Course Title: HS: CC - 6: Socio-Economic History of the Marathas

Objectives

The purpose of the course is to study socio-economic history of the Marathas in an analytical way, to acquaint the student with the components of social structure and their functions, to understand the relationship between religion, caste, customs, traditions, class in 17th and 18th century Maratha Society, to enable the student to understand aspects of economic life, to trace the determinants of changes in social and economic life.

Course Content

1. Defining socio-economic history
2. Sources: Perceptions, Limitations, Range
   i. Literary
   ii. Foreign
   iii. Archival
   iv. Miscellaneous
3. Social institutions
   i. Village community
   ii. Social stratification and mobility
   iii. Caste and community
   iv. Marriage and family
   v. Fairs and festivals
   vi. Education
4. Agrarian System
   i. Types of land
   ii. Assessment of land
   iii. Methods of land revenue collection
5. Trade, Industries and handicraft
   i. Centres of trade
   ii. Trade routes
   iii. Major and minor industries
   iv. Types of coins
   v. Banking houses

SEMESTER III

Semester III: Core Paper No. 7

Credits :4

Course Title: Cultural History of Maharashtra

Objectives: This paper is designed to help the student situate and interpret the cultural manifestations across historical memory which have contributed to the creation of the geopolitical region of Maharashtra.

1. Defining the term 'Culture'
   a. Cultural History to Cultural Studies
   b. Material Culture and Cultural Material
   c. Critical theories and New Cultural Studies
2. Material Culture of Early Maharashtra
   a. Ecological, Geological and Archaeological settings of Early Maharashtra
   b. Cultural fusion –Caves of Ajanta, Ellora, Panhale Kaji, Junnar and Karle Bhaje
   c. Satavahana's Material Culture
3 Maharashtra as a place of cultural fusion
   a. Indo-Islamic Contacts and Mutual Cultural Impacts
   b. Religious and Philosophic cults- Shakta, Nath, Mahanubhav, Varkari, Sufi, Ramdasi and Datta
   c. Marathi Muslim, Khristi and Bene Israeli culture
4. Marathi cultural spheres
   a. Modernity and Cultural Production –Printing, Public sphere and Literature in Princely States (Under Sharphoji Raje Bhonsle, Sayajirao Gaikwad, Shahu Maharaj etc.)
   b. New Cultural Narratives-Satyashodhak, feminist and Dalit publics

Semester III: Core Paper No. 8

Credits:4

Course Title: Intellectual History of Modern World

Objectives: The paper is seen as a prerequisite for understanding the concepts that are used in history, to acquaint the student with the intellectual activity that played an important role in shaping events; the transition from medieval to modern times.

Content:

1. Humanism and Renaissance
    a. Philosophy
    b. Art and Architecture
    c. Literature
2. Protestant Reformation and Counter-reformation
    a. Lutheranism
    b. Calvinism
    c. Anglicanism
3. Revolution in Scientific thinking
    a. Copernican Revolution
    b. Galilean Revolution
    c. Newtonian Revolution
4. Enlightenment and the French Revolution
    a. Liberty
    b. Equality
    c. Fraternity
    d. Rational Modernity
5. Post-enlightenment Ideas
    a. Liberalism
    b. Capitalism
    c. Colonialism
    d. Nationalism
    e. Marxism
6. Twentieth Century Ideas

Semester III: Elective Paper No. 18

Credits :4

Course Title: East Asia: Japan (1853-2000)

Objectives: The course is designed to help the students to know Japanese history especially after the opening up of Japan; Japan's modernization and its impact; post World War II developments and Japan's role in world politics.

Course content

1. Feudal Japan
2. Meiji Restoration
3. Modernization and Rise of Japan
    a) Sino-Japanese War
    b) Anglo-Japan Pact
    c) Russo-Japanese War
    d) Japan and World War I
    e) Washington Conference
5. Decline of Constitutionalism
6. Militarism, World War II and US Occupation
7. Economic Resurgence of Japan and Foreign Policy

Select readings

1. Clyde and Beers
2. Hall , D.G.E. – History of Southeast Asia.
3. Pannikkar, K.M. – Asia and Western Dominance.
4. R. Layman- Japan's last bid for victory: The Invasion of India 1944
5. R.H.P. Mason- History of Japan
6. Reischauer, E.O. – Japan
7. Totman Conard- A History of Japan
8. https://vishwakosh.marathi.gov.in/18944/

Semester III: Core Paper No. 9

Credits :4

Course Title: Economic History of Modern India

Objectives

To acquaint the student with structural and conceptual changes in Indian economy after coming of the British, to make them aware of the exploitative nature of the British rule, to help them understand the process of internalization by Indians of new economic ideas, principles and practices.

Content

1. European economic interests in India and colonial economy
   a) Mercantilist phase
   b) Free trade phase
   c) Financial imperialism phase
2. Agrarian settlements
   a) Permanent settlement
   b) Ryotwari system
   c) Mahalwari system
   d) Commercialization of agriculture and its effects
3. Industry
   a) De-industrialization
   b) Development of modern industry: Textile, Mining, Iron and Steel, Shipping
   c) Railways
   d) Labour Issues and Factory Acts 1894-1942
4. Trade: internal and foreign
5. Fiscal System
6. Banking

Semester IV

Semester IV Core Course No 10

Credits 04

Course Title: Modern Maharashtra: A History of Ideas (1818-1960)

Objectives: The paper aims to let the students explore the ideas which have given Maharashtra its unique character. It also hopes to offer a specialised knowledge of the Intellectual History of Maharashtra based on a critical reading of the original textual sources.

Course Content

1. Critical Reappraisal of Religions
   a. Missionary
   b. Prarthana Samaj, Satyashodhak Samaj, Arya Samaj
   c. Reformist Critiques of Hinduism, Islam, Jain and the Parsee Religion.
2. Social Thought
   a. Caste Critiques of Mukta Salave, Jyotirao Phule,Shahu Maharaj, V. R. Shinde, V.D. Savarkar, B. R. Ambedkar.
   b. Critiques of Patriarchy – Tarabai Shinde, Jyotirao Phule, Rukhmabai, B.R. Ambedkar
   c. Critiques of conversion – Shripati Sheshadri, Pandita Ramabai and Mass Conversion to Buddhism 1956.
3. Economic Thought
   a. Char June Arthashastreeya Granth
   b. Lokhitwadi, Nowroji, Ranade, Tilak and Economic Nationalism
   c. Satyashodhak Thought, Gandhian Thought, Industrialists' Plans
   d. Panjabrao Deshmukh, B. R. Ambedkar and Nehruvian Concepts of economic progress
4. Cultural Thought
   a. Cultural Nationalism- Chiplunkar, Chapekar, Jinnah, Tilak, Golvalkar, Savarkar.
   b. Alternative Cultural Thoughts-Mukundrao Patil, Ganpati Maharaj-Ajaat, Prabodhankar Thakre.

Semester IV Core Course No 11

Credits 04

Course Title: Debates in Indian Historiography

Objectives: The course is designed to introduce the student to some of the issues that that have been debated by historians and to introduce some perspectives with reference to Indian History.

Content:

1. Why study Debates in Indian Historiography?
    a. Orientalism and epistemic violence
    b. Nationalist Response to Colonial Historiography
    c. Marxist and Subaltern Interpretations
2. Harappa Civilisation
    a. Naming Debate – Indus, Harappa or Sindhu-Saraswati?
    b. Debate about the Vedic Horse in Harappa
    c. Debate about the decline
3. The Aryan Debate
    a. Aryan Invasion or Migration?
    b. Out of India Thesis
    c. Aryan Race Fallacy
4. Debate on Patriarchy
    a. Uma Chakravarti,
    b. Kumkum Sangari
5. Urban Decay and Feudalism Debate
    a. Urban Decay or Urban Shift?
    b. Was there Feudalism in Indian History?
    c. How Feudal was Indian Feudalism?
6. Debates about the Indian National Movement
    a. Tara Chand and R.C. Mujumdar
    b. Bipan Chandra and Sumit Sarkar

Semester IV: Elective Course No. 28

Credits :4

History of Modern India (1857-1971)

Objectives:

The purpose of this course is to enable the student to study the history of 'Modern India' from an analytical perspective; to make the student aware of the multi-dimensionality of Modern India; to highlight the ideas, institutions, forces and movements that contributed to the shaping of Indian modernity; to acquaint the student with various interpretative perspectives; to help them in articulating their own ideas and views leading to research orientation.

Course Structure:

1. Key concepts in Modern India
    a. Capitalism
    b. Colonialism
    c. Modernity
    d. Rule of Law
    e. Individualism
    f. Utilitarianism
    g. Liberalism
    h. Indian Renaissance
    i. Indian nationalism
    j. Socialism
    k. Communalism
    l. Leftist Thought
2. Indian Revolutionary Movement
    a. In India
    b. In foreign countries
3. Issues and Movements in Modern India
    a. National Movement: a brief survey
    b. Land issues and Peasant movements up to 1920
    c. Labour movements

Semester IV: Core Course no. 12

Credits :4

Course Title: World after World War II (1945-2000)

Objectives

To acquaint the student with the post-World War II scenario and to enable them to understand contemporary world from the historical perspective.

Course content:

1. Cold War: Origin and Nature, Issues
    a) Berlin Crisis (1948)
    b) Korean War
    c) Cuban Crisis
    d) Military Alliances: NATO, CENTO, SEATO, ANZUS, Warsaw Pact
2. Non-Aligned movement
3. Issues in West Asia
    a) Oil Politics
    b) Arab-Israel conflicts
    c) Palestine issue
    d) Suez Crisis
    c) Kuwait – Iraq War and its Impact
4. Developments in South-east Asia
    a) Vietnam War
5. Towards a Uni-polar World (From Cold War to Uni-Polar World)
    a) Reunification of Germany
    b) Disintegration of the USSR and its consequences
    c) Geopoltics, Terrorism and Arm Industries
6. Globalisation and its Impact
    a) European Union
    b) BRIC

Course in Modi Script Studies

Duration: 60 Hours (4 credits)

Objective in terms of learning outcomes:

A student of history deciphers modi script, interpretes old modi documents and transcripts modi documents into devnagari for research purpose.

Course Content:

Sr. No.	Content	Practical	Hours
1.	Introduction of modi script, emergence, history, usage		2
2.	Modi Barakhadi, alphabets, vowels, consonants, compopund words, sentences. cursive modi lipi	Introduction to modi alphabets, reading and writing modi alphabets, making sentences, practice reading	6
3.	Skills in interpreting modi documents: Types of modi documents, linguistic features of modi documents, study of documents	Study various types of documents, read, interprete and transcript into devnagari, visit related websites for reading some historical modi documents in Maratha history such as letters, farmers' records etc.	12
4.	Dating methods- shaka, hijri, Fasali, Rajyabhisheka	Calculating dating, deciphering	10
5.	Document archives	Visit to Pune archives, BISM archives, Maratha History Museum-cum-archive of Deccan College, Pune	10

References:

1. **Tumhich Modi Shika : Author: Madhukar Kulkarni**
2. **Modi Vachan Lekhan : Author: G. R. Walimbe**
3. **Modi Shika : Author: Gangadhar Mahambare**
4. **Lekhanprashasti : Author: Anuradha Kulkarni**
5. **Sahaj Sopi Modi Lipi: Author: Shrikrushna Lakshman Tilak**
6. **चला शिकू या मोडी आपण कृष्णाजी म्हात्रे**

Websites: www.modilipi.com, www.modiscript.com

Introduction to Cyber Security / Information Security

Syllabus for 'Introduction to Cyber Security / Information Security' program* for students of University of Pune is given below.

The program will be of 4 credits and it will be delivered in 60 clock hours**.

*: Course material for this program will be developed by CINS

**: These clock hours also includes practical sessions and demonstrations wherever required.

SR. NO.	TOPIC	HOURS	MARKS
1	**Module 1: Pre-requisites in Information and Network Security**	**14**	**25**
	Chapter 1: Overview of Networking Concepts	3	
	Chapter 2: Information Security Concepts	3	
	Chapter 3: Security Threats and Vulnerabilities	5	
	Chapter 4: Cryptography / Encryption	3	
2	**Module 2: Security Management**	**13**	**25**
	Chapter I: Security Management Practices	7	
	Chapter 2: Security Laws and Standards	6	
3	**Module 3: Information and Network Security**	**13**	**25**
	Chapter 1: Access Control and Intrusion Detection	3	
	Chapter 2: Server Management and Firewalls	4	
	Chapter 3: Security for VPN and Next Generation Technologies	6	
4	**Module 4: System and Application Security**	**20**	**25**
	Chapter 1: Security Architectures and Models	5	
	Chapter 2: System Security	5	
	Chapter 3: OS Security	5	
	Chapter 4: Wireless Network and Security	5	

The syllabus

Course I

Introduction to Human Rights and Duties

Credit: 1

I) Basic Concept

a) Human Values- Dignity , Liberty, Equality , Justice, Unity in Diversity, Ethics and Morals

b) Meaning and significance of Human Rights Education

II) Perspectives of Rights and Duties

a) Rights: Inherent-Inalienable-Universal- Individual and Groups

b) Nature and concept of Duties

c) Interrelationship of Rights and Duties

III) Introduction to Terminology of Various Legal Instruments

a) Meaning of Legal Instrument- Binding Nature

b) Types of Instruments: Covenant-Charter-Declaration-Treaty-Convention-Protocol-Executive Orders and Statutes

IV) United Nations And Human Rights

a) Brief History of Human Rights- International and National Perspectives

b) Provision of the charters of United Nations

c) Universal Declaration of Human Rights- Significance-Preamble

d) Civil and Political Rights-(Art. 1-21)

e) Economic, Social and Cultural Rights-(Art.22-28)

f) Duties and Limitations-(Art. 29)

g) Final Provision (Art. 30)

K.J. Somaiya College of Arts, Commerce & Science
Estd. 1964
Kopargaon

Department of Chemistry

List of Courses addresses Crosscutting Issues as per New Syllabus (CBCS-2019 Pattern)

Sr. No.	Programme Name	Course Code	Name of Course	Addressed Issue (Professional Ethics, Gender, Human Values, Environment and Sustainability
1	B.Sc. Chemistry	CH-101	Physical Chemistry	Professional Ethics
2	B.Sc. Chemistry	CH-201	Inorganic Chemistry	Professional Ethics
3	B.Sc. Chemistry	CH-102	Organic Chemistry	Professional Ethics
4	B.Sc. Chemistry	CH-202	Organic Chemistry	Professional Ethics
5	B.Sc. Chemistry	CH-103	Chemistry Practical-I	Professional Ethics
6	B.Sc. Chemistry	CH-203	Chemistry Practical–II	Professional Ethics
7	B.Sc. Chemistry	CH-301	Physical and analytical Chemistry	Professional Ethics
8	B.Sc. Chemistry	CH-302	Inorganic and Organic Chemistry	Professional Ethics
9	B.Sc. Chemistry	CH-303	Chemistry Practical –III	Professional Ethics
10	B.Sc. Chemistry	CH-401	Physical and analytical Chemistry	Professional Ethics
11	B.Sc. Chemistry	CH-402	Inorganic and Organic Chemistry	Professional Ethics
12	B.Sc. Chemistry	CH-403	Chemistry Practical-IV	Professional Ethics
13	B.Sc. Chemistry	CH-501	Physical Chemistry-I	Professional Ethics
14	B.Sc. Chemistry	CH-502	Analytical Chemistry-I	Professional Ethics
15	B.Sc. Chemistry	CH-503	Physical Chemistry Practical-I	Professional Ethics
16	B.Sc. Chemistry	CH-504	Inorganic Chemistry-I	Professional Ethics
17	B.Sc. Chemistry	CH-505	Industrial Chemistry	Professional Ethics
18	B.Sc. Chemistry	CH-506	Inorganic Chemistry Practical-I	Professional Ethics
19	B.Sc. Chemistry	CH-507	Organic Chemistry-I	Professional Ethics
20	B.Sc. Chemistry	CH-508	Chemistry of Biomolecules	Professional Ethics
21	B.Sc. Chemistry	CH-509	Organic Chemistry Practical-I	Professional Ethics

22	B.Sc. Chemistry	CH-510	(A) Introduction of Medicinal Chemistry OR (B) Polymer Chemistry	Professional Ethics
23	B.Sc. Chemistry	CH-511	(A) Environmental Chemistry OR Chemoinformatics	Professional Ethics
24	B.Sc. Chemistry	CH-601	Physical Chemistry-II	Professional Ethics
25	B.Sc. Chemistry	CH-602	Physical Chemistry-III	Professional Ethics
26	B.Sc. Chemistry	CH-603	Physical Chemistry Practical-II	Professional Ethics
27	B.Sc. Chemistry	CH-604	Inorganic Chemistry-II	Professional Ethics
28	B.Sc. Chemistry	CH-605	Inorganic Chemistry -III	Professional Ethics
29	B.Sc. Chemistry	CH-606	Inorganic Chemistry Practical- II	Professional Ethics
30	B.Sc. Chemistry	CH-607	Organic Chemistry-II	Professional Ethics
31	B.Sc. Chemistry	CH-608	Organic Chemistry-III	Professional Ethics
32	B.Sc. Chemistry	CH-609	Organic Chemistry Practical-II	Professional Ethics
23	B.Sc. Chemistry	CH-610	(A) Chemistry of Soil and Agrochemicals OR (B) Introduction of Forensic Chemistry	Professional Ethics
24	B.Sc. Chemistry	CH-611	(A) Analytical Chemistry-II OR (B) Chemistry of Cosmetics and Perfumes	Professional Ethics
25	(M.Sc-I).Organic Chemistry	CHP-110	Physical Chemistry	Professional Ethics
26	M.Sc. Organic Chemistry	CHI-130	Inorganic Chemistry -I	Professional Ethics
27	M.Sc. Organic Chemistry	CHO-150	Organic Chemistry -I	Professional Ethics
28	M.Sc. Organic Chemistry	CHG-190	Section –I General Chemistry –I Section- II General Chemistry	Professional Ethics
29	M.Sc. Organic Chemistry	CHP-107	Basic Practical Chemistry -I	Professional Ethics
30	M.Sc. Organic Chemistry	CHP-210	Physical Chemistry -II	Professional Ethics
31	M.Sc. Organic Chemistry	CHI-230	Inorganic Chemistry -II	Professional Ethics
32	M.Sc. Organic Chemistry	CHO-250	Organic Chemistry -I	Professional Ethics
33	M.Sc. Organic Chemistry	CHG-290	Section –I General Chemistry –I Section- II General Chemistry	Professional Ethics
34	M.Sc. Organic Chemistry	CHP-227	Basic Practical Chemistry –I	Professional Ethics
35	(M.Sc-II).Organic Chemistry	CHO-450	Chemistry of Natural Products	Professional Ethics
36	M.Sc. Organic Chemistry	CHO-451	Advanced Synthetic Organic Chemistry	Professional Ethics
37	M.Sc. Organic Chemistry	CHO-452	Carbohydreates and Chiraon Approach / Chiral Drugs and Medicinal Chemistry	Professional Ethics
38	M.Sc. Organic Chemistry	CHO-453	Designing Organic Synthesis and Asymmetric Synthesis	Professional Ethics
39	M.Sc. Organic Chemistry	CHO-347	Single Stage Preparation	Professional Ethics
40	M.Sc. Organic Chemistry	CHO-350	Organic Reaction Mechanism	Professional Ethics
41	M.Sc. Organic Chemistry	CHO-351	Spectroscopic Methods in structure Determination	Professional Ethics
42	M.Sc. Organic Chemistry	CHO-352	Organic Stereochemistry	Professional Ethics
43	M.Sc. Organic Chemistry	CHO-353	Pericyclic Reactions, Photochemistry and Heterocyclic Chemistry	Professional Ethics

44	M.Sc. Organic Chemistry	CHO-447	Double Stage Preparations	Professional Ethics
45	M.Sc. Organic Chemistry	CHO-448	Project/Industrial Training / Green chemistry and Chemical Biology	Professional Ethics
46	All PG Programmes		Democracy, Election and Governance	Human Values
47	All PG Programmes		Human Rights - I	Human Values
48	All PG Programmes		Cyber Security -I	Human Values
49	All PG Programmes		Cyber security -II	Human Values
50	All PG Programmes		Cyber security -III	Human Values
51	All PG Programmes		Cyber security -IV	Human Values
52	All PG Programmes		Skill Development –I	Human Values
53	All PG Programmes		Skill Development –II	Human Values
54	All PG Programmes		Introduction to Constitution	Human Values
55	All PG Programmes		Introduction to Indian Constitution	Human Values
	All UG Programmes		EVS 231 – Environmental Awareness	Environment and Sustainability

Representative Example

Crosscutting issue: Professional Ethics

Programme Name – M Sc-I (Organic Chemistry)

Course Name – Fundamental of Physical Chemistry

Course Code – CCTP-1: CHP – 110

Unit No.	Contents	Lectures
1.	**Section -I** **Thermodynamics** -State function, path function, exact differential and inexact differential, internal energy and enthalpy, temperature dependent internal energy and enthalpy, reversible and irreversible adiabatic expansion. The entropy of irreversible changes, the Helmholtz and Gibbs function, Entropy and entropy change in an ideal gas with temperature and pressure, Clausius inequality, chemical potential, chemical potential of a substance in a mixture.	**05**
2.	**Change of State** -Partial molar quantities, methods for determination of molar quantities, ideal solutions. Raoult's and Henery's law, Thermodynamics of Gibbs function of mixing, colligative properties: Elevation in boiling point, depression in freezing point and osmosis.	**04**
3.	**Quantum Chemistry** -Applications of quantum chemistry-blackbody radiation, photoelectric effect, de Broglie hypothesis and uncertainty principle and its experimental evidence. Schrödinger wave equation, particle in one dimensional box. Normalization and orthogonality of wave function, particle in three dimensional box, hydrogen like atoms (no derivation). Operators: algebra of operators, commutative property, linear operators, commutator operator, the operator V and V	**08**
4.	**Chemical Bonding**-Valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital theory for di and tri atomic molecule, linear variation method, approximations underlying Huckel theory, applications to simple x-systems.	**07**
1.	**Section -II** **Chemical Kinetics and Reaction Dynamics** **Rate Laws**-Recapitulations of basic concept, the temperature dependent reaction rates, reaction moving towards equilibrium, consecutive reaction, parallel reactions, pre-equilibria, unimolecular reactions.	**06**
2.	**Kinetics of Complex Reactions**-Fast reactions: flash photolysis, flow technique, stopped flow technique, relaxation method, the steady state approximation, chain reactions free radical polymerization reaction between H, and Br, explosive reaction.	**03**

3.	**Molecular Reaction Dynamics**-Collision theory of bimolecular gas phase reactions, diffusion controlled and activation controlled reaction in solution, activated complex theory of reaction rate, Eyrings equation,	**05**
4.	**Enzyme Catalysis** -Michaelis mechanism, effect of pH and temperature on enzyme catalyzed reactions, limiting rate, Lineweaverburk and Eadie equation and plots, inhibition of enzyme action, competitive inhibition and non- competitive inhibition.	**04**
5.	**Molecular Thermodynamics** - Molecular energy levels, Boltzmann distribution law, partition functions and ensembles, translational, rotational and vibrational partition function of diatomic molecule, obtaining energy, heat capacity, entropy and equilibrium constants from partition functions, Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein statistics.	**06**

References:

1. Physical Chemistry by P.W.Atkin and De Paul
2. Physical Chemistry by T.Engel and P. Reid
3. Physical Chemistry and molecular approach by D. Mcquarie and J. Siman 4. Physical Chemistry for biological sciences by Raymond Chang (Universal books, 2000)
4. Physical Chemistry by Merron and C.F. Prouton
5. Physical Chemistry by G.M. Barrow 7. Quantum Chemistry by L. Levine 8. Quantum Chemistry by R.K. Prasad

Representative Example

Crosscutting issue: Professional Ethics

Programmer Name – M Sc-I (Organic Chemistry)

Course Name – Organomettallic Chemistry and Molecular Reaction Mechanism

Course Code – CCTP-1: CHG – 290

Unit No.	Contents	Lectures
1.	**Organometallic Chemistry** Organic ligands and nomenclature, 18 electron rule: counting electrons, ligands having extended pi system, bonding between Metal Atoms and organic pi systems: linear pi system, cyclic pi system, spectral analysis and characterization of organometallic complexes: IR and NMR, examples.	**08**
2.	**Organometallic Reactions and Catalysis Reactions involving gain and loss of ligands** Ligand dissociation and substitution, oxidative addition, reductive elimination, nucleophilic displacement, reactions involving modification of ligands: insertion, carbonyl insertion, 1-2 insertion, hydride elimination, abstraction, organometallic catalysis. Hydroformylation, Monsanto acetic acid process, Wacker Process, Hydrogenation by Willkinsons catalyst, Olefin metathesis, heterogeneous catalysis: Ziegler Natta Polymerization, Water gas reduction.	**08**
3.	**Coordination Compounds:** Reactions and Mechanism History and principles. Substitution reactions: Inert and labile complexes, mechanism of substitution, Kinetics Consequences of reaction pathway; dissociation, interchange. Association. Experimental evidences in Octahedral Substitution: dissociation, linear free energy relationship, associative mechanism, the conjugate base mechanism, the kinetic chelate effect. Stereochemistry of reactions: substitution in trans complexes, substitution in cis complexes, isomerisation of chelate rings, substitution reactions in Sq. Pl. Complexes.	**08**

Reference

1. Inorganic Chemistry: Gary Miessler and Donald A. Tarr, Third Ed., Pearson (Chapter-12, 13 and 14 pages: 422 to 561)
2. IUPAC Nomenclature of Organometallic Compounds of Transition Metals by Salzer http://publications.org/p/1999/71 08 pdf:7108salzer 1557.pdf

SEMESTER-I

CH- 101: Physical Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Chemical Energetics

Review of thermodynamics and the Laws of Thermodynamics. Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. Statement of Third Law of thermodynamics and calculation of absolute entropies of substances, problems [11]

2. Chemical Equilibrium:

Introduction: Free Energy and equilibrium - Concept, Definition and significance
The reaction Gibbs Energy, Exergonic and endergonic reaction. The perfect gas equilibrium, the general case of equilibrium, the relation between equilibrium constants, Molecular interpretation of equilibrium constant. The response of equilibria to conditions- response to pressure , response to temperature, Van't Haff equation, Value of K at different temperature, Problems [11]

3. Ionic Equilibria

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts– applications of solubility product principle. [14]

Learning Outcome

1. Chemical Energetics

1. Students will be able to apply thermodynamic principles to physical and chemical process
2. Calculations of enthalpy , Bond energy, Bond dissociation energy , resonance energy
3. Variation of enthalpy with temperature –Kirchoff's equation
4. Third law of thermodynamic and its applications

2. Chemical Equilibrium

Knowledge of Chemical equilibrium will make students to understand

1. Relation between Free energy and equilibrium and factors affecting on equilibrium constant.
2. Exergonic and endergonic reaction
3. Gas equilibrium, equilibrium constant and molecular interpretation of equilibrium constant
4. Van't Haff equation and its application

3. Ionic equilibria

Ionic equilibria chapter will lead students to understand

1. Concept to ionization process occurred in acids, bases and pH scale
2. Related concepts such as Common ion effect hydrolysis constant, ionic product, solubility product
3. Degree of hydrolysis and pH for different salts , buffer solutions

CH- 102: Organic Chemistry

(2 Credits, 36 Lectures of 50 min.)

Fundamentals of Organic Chemistry

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals. Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule. **[09]**

Stereochemistry

Introduction, classification, Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Conformations with respect to ethane, butane and cyclohexane. Configuration: Geometrical - *cis – trans*, and E / Z Nomenclature (for upto two C=C systems). Optical isomerism Enantiomerism, Diastereomerism and Meso compounds). Concept of chirality (upto two carbon atoms). Threo and erythro; D and L; nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) **[14]**

Aliphatic Hydrocarbons

Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.

Alkanes: (Up to 5 Carbons) *Preparation:* Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Alkenes: (Up to 5 Carbons) *Preparation:* Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions:* cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation.

Alkynes: (Up to 5 Carbons) *Preparation:* Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalide *Reactions:* formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysis and oxidation with hot alk. $KMnO_4$. **[13]**

CH- 103: Chemistry Practical Course I

(1.5 Credits, 46.8 Lectures of 50 min.)

Section A: Chemical and Lab Safety (Compulsory)

1. Toxicity of the compounds used in chemistry laboratory.
2. Safety symbol on labels of pack of chemicals and its meaning
3. What is MSDS sheets? Find out MSDS sheets of at least hazardous chemicals ($K_2Cr_2O_7$, Benzene, cadmium nitrate, sodium metal, etc.)
4. Precautions in handling of hazardous substances like Conc. acids, ammonia, organic solvents, etc.

Section B: Physical Chemistry

a. Thermochemistry (Any three)

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO_3, NH_4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH.

b. Ionic equilibria (Two experiments)

1. Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage to the glass electrode) using pH-meter.

OR

1. Measurement of the pH of buffer solutions and comparison of the values with theoretical values.
2. Preparation of buffer solutions **(Any One)**
   (i) Sodium acetate-acetic acid and determine its buffer capacity
   (ii) Ammonium chloride-ammonium hydroxide and determine its buffer capacity

Section C: Organic Chemistry (Five experiments)

1. To determine type and detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing up to two extra elements) **(Three)**
2. Separation of constituents of mixtures by Chromatography: Measure the R_f value in each case **(Two)**
   (a) Identify and separate the components of a given mixture of 2 amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acids) / pigments from plant extract/ 2 organic compounds by paper chromatography
   (b) Identify and separate the sugars present in the given mixture by paper chromatography.

Note: Combination of two compounds/plant extract to be given

Learning Outcome

1. The students are expected to understand the fundamentals, principles, and recent developments in the subject area.
2. It is expected to inspire and boost interest of the students towards chemistry as themain subject.
3. To familiarize with current and recent developments in Chemistry.
4. To create foundation for research and development in Chemistry.

Reference Books

1. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
2. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
3. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
4. Eliel, E.L. *Stereochemistry of Carbon Compounds*, Tata McGraw Hill education, 2000.
5. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
6. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
7. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
8. Samuel Glasstone, *Thermodynamics for Chemists*, Affiliated East West Private Limited.
9. B S Bahl, G D Tuli, Arun Bahl, Essentials of Physical Chemistry
10. Peter Atkins and Julio de Paula, Elements of Physical Chemistry, Sixth edition (2013), *Oxford* press
11. Ball D. W., Physical Chemistry, Thomson Press , India (2007)
12. Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
13. Atkins' Physical Chemistry –Thermodynamics and Kinetics, 11th Edition, Oxford Press
14. Thomas Engel, Philip Reid; *Physical Chemistry*, Pearson Education (2006)
15. J. N. Gurtu, A. Gurtu; *Advanced Physical Chemistry,* Pragati Edition
16. Mortimer R. G., Physical Chemistry, 3rd Edition, Elsevier, Noida (UP)
17. Samuel H. Maron and Carl F. Prutton, *Principal of physical Chemistry*, 4th Edition, *Collier* Macmillan Ltd.

SEMESTER-II

CH-201: Inorganic Chemistry (2 Credits, 36 Lectures of 50 min.)

1. Atomic Structure

Origin of Quantum Mechanics: Why study quantum mechanics? Quantum mechanics arose out of interplay of experiments and Theory Energy quantization- i) Black body radiation ii) The photoelectric effect iii) Wave particle duality-a) The particle character of electromagnetic radiation b) the wave character of particle, iv) diffraction by double slit v) atomic spectra, Review of-Bohr's theory and its limitations, Heisenberg Uncertainty principle.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it, Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenic wavefunctions (atomic orbitals) and their variations for1*s*, 2*s*, 2*p*, 3*s*, 3*p* and 3*d* orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1*s* and 2*s* atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers *ml* and *ms*. Shapes of *s*, *p* and *d* atomic orbitals, nodal planes. Discovery of spin, spin quantum number (*s*) and magnetic spin quantum number (*ms*). **[14]**

2. Periodic table and Periodicity of Elements

Periodic table: periodic table after 150 years, review on the eve of international year of periodic table[IYPT].

Periodicity of elements: Rules for filling electrons in various orbitals, Electronic configurations of the atoms. ,Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations
Long form of periodic table-s, p, d and f block elements,
Detailed discussion of following properties of elements with reference to s and p block

a) Effective nuclear charge, shielding or screening effect
b) Atomic and ionic radii
c) Crystal radii
d) Covalent radii
e) Ionization energies
f) Electronegativity, Pauling's / electronegativity scale
g) Oxidation states of elements

[10]

3. Chemical Bonding

Attainment of stable electronic configurations, Types of Chemical bonds: Ionic, covalent, coordinate and metallic bonds

Ionic Bond: General characteristics of ionic bonding, Types of ions, Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy,

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Text book of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R.Chand & Co.: New Delhi (2011).
6. Prof. Robert H. Hill Jr., David C. Finster Laboratory Safety for Chemistry Students, 2nd Edition Wiley ISBN: 978-1-119-02766-9 May 2016
7. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards, Updated Version, ISBN 978-0-309-13864-2 | DOI 10.17226/12654, THE NATIONAL ACADEMIES PRESS Washington, D.C.

Learning Outcome

1. Importance of chemical safety and Lab safety while performing experiments in laboratory
2. Determination of thermochemical parameters and related concepts
3. Techniques of pH measurements
4. Preparation of buffer solutions
5. Elemental analysis of organic compounds (non instrumental)
6. Chromatographic Techniques for separation of constituents of mixtures

6. Describe VB approach, Hybridization with example of linear, trigonal, square planer, tetrahedral, TBP, and octahedral.
7. Discuss assumption and need of VSEPR theory.
8. Interpret concept of different types of valence shell electron pairs and their contribution in bonding.
9. Application of non-bonded lone pairs in shape of molecule
10. Basic understanding of geometry and effect of lone pairs with examples such as ClF_3, Cl_2O, BrF_5, XeO_3 and $XeOF_4$.

CH- 202: Analytical Chemistry (2 Credits, 36 Lectures of 50 min.)

1. **Introduction to Analytical Chemistry**
   What is analytical Chemistry, the analytical perspectives, Common analytical problems. **[03]**

2. **Calculations used in Analytical Chemistry**
   Some important units of measurements-SI units, distinction between mass and weight, mole, millimole and Calculations, significant figures
   Solution and their concentrations- Molar concentrations, Molar analytical Concentrations, Molar equilibrium concentration, percent Concentration, part per million, part per billion, part per thousand, Solution –dilatant volume ration, functions , density and specific gravity of solutions, problems
   Chemical Stoichiometry – Empirical and Molecular Formulas, Stoichiometric Calculations, Problems. **[10]**

3. **Qualitative Analysis of Organic Compounds**
   Types of organic compounds, characteristic tests and classifications, reactions of different functional groups, analysis of binary mixtures.
   Analysis – Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.
   Purification of organic compounds- Introduction, recrystallization, distillation, sublimation **[05]**

4. **Chromatographic Techniques –Paper and Thin Layer Chromatography**
   Introduction- Introduction to chromatography, IUPAC definition of chromatography.
   History of Chromatography- paper chromatography, Thin Layer Chromatography, Ion exchange Chromatography, Gas permeation Chromatography, affinity chromatography, Gas chromatography, Supercritical fluid chromatography, High Performance Liquid Chromatography, Capillary electrophoresis, Classification of chromatographic methods – according to separation methods, according to development procedures.
   Thin Layer Chromatography: Theory and principles, outline of the method, surface adsorption and spot shape, Comparison of TLC with other forms of chromatography, adsorbents, preparation of plates, application of samples, development.
   Paper Chromatography- Origin, overview of technique, sample preparation, types of paper, solvents, equilibrium, development, sample application and detection, Identification, Quantitative methods, applications of paper chromatography **[14]**

Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bond: Valence Bond Approach, Hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonal bipyramidal and octahedral arrangements. VSEPR theory, Assumptions, need of theory, application of theory to explain geometries of molecules such as i) ClF_3 ii) Cl_2O iii) BrF_5 iv) XeO_3 v) $XeOF_4$ [12]

Learning Outcome

1. Atomic Structure

1. Various theories and principles applied to revel atomic structure
2. Origin of quantum mechanics and its need to understand structure of hydrogen atom
3. Schrodinger equation for hydrogen atom
4. Radial and angular part of hydrogenic wave functions
5. Significance of quantum numbers
6. Shapes of orbitals

2. Periodicity of Elements

1. Explain rules for filling electrons in various orbitals- Aufbau's principle, Pauli exclusion principle, Hund's rule of maximum multiplicity
2. Discuss electronic configuration of an atom and anomalous electronic configurations.
3. Describe stability of half-filled and completely filled orbitals.
4. Discuss concept of exchange energy and relative energies of atomic orbitals
5. Design Skeleton of long form of periodic table.
6. Describe Block, group, modern periodic law and periodicity.
7. Classification of elements as main group, transition and inner transition elements
8. Write name, symbol, electronic configuration, trends and properties.
9. Explain periodicity in the following properties in details:
   a. Effective nuclear charge, shielding or screening effect; some numerical problems.
   b. Atomic and ionic size.
   c. Crystal and covalent radii
   d. Ionization energies
   e. Electronegativity- definition, trend, Pauling electronegativity scale.
   f. Oxidation state of elements

3. Chemical Bonding

1. Attainment of stable electronic configurations.
2. Define various types of chemical bonds- Ionic, covalent, coordinate and metallic bond
3. Explain characteristics of ionic bond, types of ions, energy consideration in ionic bonding, lattice and solvation energy and their importance in the context of stability and solubility of ionic compounds.
4. Summarize Born-Lande equation and Born-Haber cycle,
5. Define Fajan's rule, bond moment, dipole moment and percent ionic character.

5. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry,* John Wiley & Sons (2014).
6. McMurry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
7. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry,* Orient Longman, New Delhi (1988).
8. Finar, I.L. *Organic Chemistry* (Vol. I & II), E.L.B.S.
9. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Pearson, 2010.
10. Bahl, A. & Bahl, B.S. *Advanced Organic Chemistry,* S. Chand, 2010.
11. A Braithwait and F. J. Smith, *Chromatographic method*, 5th edition, Kluwer Academic publishers
12. G D Christian -Analytical Chemistry
13. Qualitative Organic Analysis 4th Edn by A I Vogel (ELBS)
14. Vogel's Quantitative Analysis
15. Douglas A Skoog, Donald M West, F James Holler ,Stainly R Crounch , *Fundamentals of Analytical Chemistry*, 9th edition
16. David Harvey, *Modern Analytical Chemistry*, McGraw Hill Higher education
17. Gurudeep R Chatwal, Sham K Anand, *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House.
18. Barrow, G.M. *Physical Chemistry* Tata McGraw-Hill (2007).
19. Kotz, J.C., Treichel, P.M. & Townsend, J.R. *General Chemistry* Cengage Learning India Pvt. Ltd., New Delhi (2009).

21. Petrucci, R.H. *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985).
22. *Atkins' Physical Chemistry,* 10th edition (2014), Oxford University Press
23. Thomas Engel, Philip Reid; *Physical Chemistry* , Pearson Education (2006)
24. J. N. Gurtu, A. Gurtu, *Advanced Physical Chemistry,* Pragati Edition
25. McQuarrie, D. A., & Simon, J. D., *Physical Chemistry: A molecular approach*. Sausalito, CA: University Science Books (1997)
26. Atkins, P., & de Paula, J., *Physical Chemistry for the Life Sciences*. New York: W. H. Freeman and Company (2006)
27. McMahon, D. (2005). *Quantum Mechanics Demystified*. NewYork: McGraw-Hill Professional
28. Ladd, M. *Introduction to Physical Chemistry* (3rd ed). Cambridge, UK: Cambridge University Press (1998)

5. **pH meter**
Introduction, pH meter, Glass pH electrode, combination of pH electrode-Complete Cell, Standard Buffer –reference for pH measurement, Accuracy of pH measurement, Using pH meter –How does it works? Applications of pH meter. **[04]**

Learning Outcomes

1. **Introduction to Analytical Chemistry**
   i. Analytical Chemistry –branch of chemistry
   ii. Perspectives of analytical Chemistry
   iii. analytical problems
2. **Calculations used in Analytical Chemistry**
   i. Calculations of mole, molar concentrations and various units of concentrations which will be helpful for preparation of solution
   ii. Relation between molecular formula and empirical formula
   iii. Stoichiometric calculation
   iv. Define term mole, millimole, molar concentration, molar equilibrium concentration and Percent Concentration.
   v. SI units, distinction between mass and weight
   vi. Units such as parts per million, parts per billion, parts per thousand, solution-dilatant volume ratio, function density and specific gravity of solutions.
3 **Qualitative Analysis of Organic Compounds**
Basics of type determination, characteristic tests and classifications, reactions of different functional groups.
   i. Separation of binary mixtures and analysis
   ii. Elemental analysis -Detection of nitrogen, sulfur, halogen and phosphorous by Lassiagen's test.
   iii. Purification techniques for organic compounds.
4. **Chromatographic Techniques – Paper and Thin layer Chromatography**
   i. Basics of chromatography and types of chromatography
   ii.Theoretical background for Paper and Thin Layer Chromatography
5. **pH metry**
   i. pH meter and electrodes for pH measurement
   iii. Working of pH meter
   iv. Applications of pH meter

Reference Books:

1. Lee, J.D. *Concise Inorganic Chemistry* ELBS, 1991.
2. Cotton, F.A., Wilkinson, G. & Gaus, P.L. *Basic Inorganic Chemistry*, 3rd ed., Wiley.
3. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. *Concepts and Models in Inorganic Chemistry*, John Wiley & Sons.
4. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Education India, 2006.

CH- 203: Chemistry Practical –II (1.5 Credits, 46.8 Lectures of 50 min.)

Section A: Inorganic Chemistry

Wherever required standardization of volumetric reagent must be performed.

I] Synthesis of commercially important inorganic compounds (any two)

1) Synthesis of potash alum from aluminium metal (scrap Aluminium metal)
2) Synthesis of Mohr's Salt $[(FeSO_4)\ (NH_4)_2SO_4]\cdot 6H_2O$
3) Preparation of Dark red inorganic pigment: Cu_2O
4) Synthesis of $FeSO_4\cdot 7H_2O$

Note:
   i. In synthesized compound student must confirm the particular cation and anion by performing qualitative tests.
   ii. Costing of product for 100 g pack can be calculated on the basis of cost of raw materials used and percent yield of the product.
   iii. Synthesized compounds should be collected from all students and stored properly. They should be used in other experiments such as Mohr's salt for determination of water of crystallization. Potash alum and $FeSO_4$ can be given in IQA experiments or for estimations at SY and TY level.

II] Volumetric Analysis (Any Two)

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of basicity of boric acid or oxalic acid or citric acid hence determination of their equivalent weight.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.

III] Analysis of Commercial products containing inorganic substances (any two)

1) Estimation of Ca from calcium supplementary tablet by complexometric titration.
2) Estimation of acid neutralizing capacity of antacids like Gelusil tablet/ Gellusil syrup etc.
3) Estimation of selectively Cu(II) from brass alloy by iodometrically (Use KIO_3 as primary standard for standardization of $Na_2S_2O_3$ and **not** $K_2Cr_2O_7$).

IV] To draw polar plots of s and p orbitals.

Section B: Organic Chemistry

I] Organic Purification Techniques

1. Purification of organic compounds by i) crystallization (from water and alcohol) ii) distillation (Two Compounds), iii) Sublimation (micro technique).

II] Organic preparations: Derivatives

2. Preparations: Mechanism of various reactions involved to be discussed. Recrystallization, determination of melting point and calculation of quantitative yields to be done. (Any Two)

a) Bromination of Cinnamic acid using sodium bromide and Sodium bromate. (Green Chemistry Approach)

OR

a) Bromination of acetanilide using KBr and Ceric ammonium nitrate in aqueous medium. (Green Chemistry Approach)
3) Semicarbazone derivatives of aldehydes and ketones
4) Oxime and 2,4-dinitrophenylhydrazone of aldehyde/ketone
Note: Presence of extra element in the synthesized compound must be tested (Br and N in respective compound)
N. B.:

1. Use molar concentrations for volumetric /estimations/synthesis experiments.
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of microscale technique is recommended wherever possible**

Reference Books:

1. Svehla, G. *Vogel's Qualitative Inorganic Analysis*, Pearson Education, 2012.
2. Mendham, J. *Vogel's Quantitative Chemical Analysis*, Pearson, 2009.
3. Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., *Textbook of Practical Organic Chemistry*, Prentice-Hall, 5th edition, 1996.
4. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry* Orient-Longman, 1960.
5. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).

Learning Outcome

1. Inorganic Estimations using volumetric analysis
2. Synthesis of Inorganic compounds
3. Analysis of commercial products
4. Purification of organic compounds
5. Preparations and mechanism of reactions involved

Course Outcome

CH- 101: Physical Chemistry

After completing the course work learner will be acquired with knowledge of chemical energetics, Chemical equilibrium and ionic equilibria.

CH- 102: Organic Chemistry

Students will learn Fundamentals of organic chemistry, stereochemistry (Conformations, configurations and nomenclatures) and functional group approach for aliphatic hydrocarbons.

CH- 201: Inorganic Chemistry

Students will learn quantum mechanical approach to atomic structure, Periodicity of elements, various theories for chemical bonding.

The detailed Semester and Course wise of Syllabus is as follows:

SEMESTER-III

CH-301: Physical and Analytical Chemistry [Credit -2, 36 L]

Chapter No.	Chapter	No of Lectures
1	Chemical Kinetics	12
2	Surface Chemistry	06
3	Errors in Quantitative Analysis	05
4	Volumetric analysis	13

1. Chemical Kinetics: **[12 L]**

Introduction to kinetics, the rates of chemical reactions – definition of rates, rate laws and rate constants, reaction order and molecularity, determination of rate law, factors affecting reaction rates, integrated rate laws – zeroth-order reactions, first-order reactions, second-order reactions (with equal and unequal initial concentration of reactants), half-life period, methods for determination order of a reactions, Arrhenius equation- temperature dependence of reaction rates, interpretation of Arrhenius parameters, reaction dynamics - collision theory and transition-state theory of bimolecular reactions, comparison of the two theories, Problems.

(Ref. No: 1- 725-728, 731-733, 741-742, 780-784, 792-794, Ref. No: 2- 1033- 1067)

Learning Outcome:

After studying the Chemical Kinetics student will able to-

1. Define / Explain concept of kinetics, terms used, rate laws, molecularity, order.
2. Explain factors affecting rate of reaction.
3. Explain / discuss / derive integrated rate laws, characteristics, expression for half-life and examples of zero order, first order, and second order reactions.
4. Determination of order of reaction by integrated rate equation method, graphical method, half-life method and differential method.
5. Explain / discuss the term energy of activation with the help of energy diagram.
6. Explanation for temperature coefficient and effect of temperature on rate constant k.
7. Derivation of Arrhenius equation and evaluation of energy of activation graphically.
8. Derivations of collision theory and transition state theory of bimolecular reaction and comparison.
9. Solve / discuss the problem based applying theory and equations.

2. Surface Chemistry

[6L]

Introduction to surface chemistry - some basic terms related to surface chemistry adsorption, adsorption materials, factors affecting adsorption, characteristics of adsorption, types of adsorption, classification of adsorption isotherms. Langmuir adsorption isotherm, Freundlich's adsorption isotherm, BET theory (only introduction), application of adsorption, problems. *(Ref. No:1- 824-826, 832-837, Ref. No: 2- 1251-1264; Ref. No: 3- 932-938)*

Learning Outcomes

- Define / explain adsorption, classification of given processes into physical and chemical adsorption.
- Discuss factors influencing adsorption, its characteristics, differentiates types as physisorption and Chemisorption
- Classification of Adsorption Isotherms, to derive isotherms.
- Explanation of adsorption results in the light of Langmuir adsorption isotherm, Freundlich's adsorption Isotherm and BET theory.
- Apply adsorption process to real life problem.
- Solve / discuss problems using theory.

Reference Books (Physical Chemistry)

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of physical chemistry by B.R. Puri, L.R. Sharma, M.S. Pathania
3. Essentials of Physical chemistry by BahlTuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.
4. Physical-Chemistry-4th Edition - Gilbert W. CastellanNarosa (2004).
5. Principles of ChemicalKinetics-2rdEdition- James E. House
6. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
7. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
9. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
10. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co. New York, 1985).
11. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

3. Errors in Quantitative Analysis

[5 L]

Introduction to errors, limitations of analytical methods, classifications of errors, accuracy, precision, minimization of errors, significant figures and computation, methods of

expressing accuracy and precision: mean and standard deviations, reliability of results and numerical. *(Ref-1: 127-138, supplementary references- Ref-2: 62-75, Ref-3: 82-121)*

Learning Outcomes

- Define, explain and compare meaning of accuracy and precision.
- Apply the methods of expressing the errors in analysis from results.
- Explain / discuss different terms related to errors in quantitative analysis.
- Apply statistical methods to express his / her analytical results in laboratory.
- Solve problems applying equations.

4. Volumetric Analysis

[13 L]

Introduction to volumetric analysis, classification of reactions in volumetric analysis, standard solutions, equivalents, normalities, and oxidation numbers, preparation of standard solutions, primary and secondary standards. **Types of Volumetric Analysis methods: 1. Neutralization titrations**: Theory of indicators, neutralization curves for strong acid strong base, weak acid strong base, weak base strong acid. Preparation of approximate 0.1 M HCl and standardization against anhydrous sodium carbonate, determination of Na_2CO_3 content in washing soda. **2. Complexometric Titrations:** Definition of complexing agent and complexometric titration, EDTA-as complexing agent (structure of EDTA and metal ion-EDTA complex), Types of EDTA titration (direct and back titration), pH adjustment and amount of indicator in EDTA titration, metal ion indicators (general properties, solochrome black – T, Patton and Reeder's indicator only), standard EDTA solution, determination of Ca(II) and Mg(II), total hardness of water. **3. Redox Titrations:** Definition of oxidizing agent, reducing agent, redox titration, $K_2Cr_2O_7$ and $KMnO_4$ as oxidizing agents, 1,10-phenanthroline as indicator in reduction titration, diphenyl amine as oxidation indicator, $KMnO_4$ as self-indicator, Standard $KMnO_4$ solution and standardization with sodium oxalate, Determination of H_2O_2. **4. Precipitation titrations:** precipitation reactions, determination of end point (formation of coloured ppt, formation of soluble coloured compound, adsorption indicator), standard $AgNO_3$ soln., standardization of $AgNO_3$ soln. – potassium chromate indicator- Mohr's titration, determination of chloride and bromide, determination of iodide. Problems based on analysis.

(Ref-1: Pages-257-275, 286, 295, 309 -322, 328-332, 340-351, 364-372.; supplementary reference Ref-2: 382-302, 322-334, 366-374, 437-452)

Learning Outcome:

After studying the Volumetric Analysis student will able to-

1. Explain / define different terms in volumetric analysis such as units of concentration, indicator, equivalence point, end point, standard solutions, primary and secondary standards, complexing agent, precipitating agent, oxidizing agent, reducing agent, redox indicators, acid base indicators, metallochome indicators, etc.
2. Perform calculations involved in volumetric analysis.
3. Explain why indicator show colour change and pH range of colour change.
4. To prepare standard solution and **b.** perform standardization of solutions.
5. To construct acid – base titration curves and performs choice of indicator for particular titration.
6. Explain / discuss acid-base titrations, complexometric titration / precipitation titration / redox titration.
7. Apply volumetric methods of analysis to real problem in analytical chemistry / industry.

Reference Books: (Analytical Chemistry)

1. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical, 1989.
2. Analytical Chemistry, G. D. Christian, P. K. Dasgupta, K. A. Schug, 7th Ed, Wily, 2004.
3. Fundamentals of Analytical Chemistry- Skoog, west, Holler, Crouch, 9th Ed. Brooks / Cole, 2014/2004.
4. Basic Concept of Analytical Chemistry- S. M. Khopkar
5. Instrumental methods of chemical analysis- Chatwal Anand
6. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-302: Inorganic and Organic Chemistry [2credit, 36 L]

Chapter No.	Chapter	No of Lectures
1	Molecular Orbital Theory of Covalent Bonding	13
2	Introduction to Coordination chemistry	05
3	Aromatic hydrocarbons	05
4	Alkyl and Aryl Halides	07
5	Alcohols, Phenols and Ethers	06

1. Molecular Orbital Theory of Covalent Bonding [13 L]

Introduction to Molecular Orbital Method (MOT) and postulates of MO theory, LCAO approximation, s-s combination of orbitals, s-p combination of orbitals, p-p combination of orbitals, p-d combination of orbitals, d-d combination of orbitals, non-bonding combination of orbitals, Rules for linear combination of atomic orbitals, example of molecular orbital treatment for homonuclear diatomic molecules: Explain following molecules with respect to MO energy level diagram, bond order and magnetism: H_2^+ *molecule ion,* H_2 *molecule,* He_2^+ *molecule ion,* He_2 *molecule,* Li_2 *molecule,* Be_2 *molecule,* B_2 *molecule,* C_2 *molecule,* N_2 *molecule,* O_2 *molecule,* O_2^- *and* O_2^{2-} *ion,* F_2 *molecule,* Heteronuclear diatomic molecules: *NO, CO, HF.*

(Ref.-1:89-112, Ref-4: 278-292, Ref-5: 33-38)

Learning Outcome:

After studying the Molecular Orbital Theory student will able to-

1. Define terms related to molecular orbital theory (AO, MO, sigma bond, pi bond, bond order, magnetic property of molecules, etc).
2. Explain and apply LCAO principle for the formation of MO's from AO's.
3. Explain formation of different types of MO's from AO's.
4. Distinguish between atomic and molecular orbitals, bonding, anti-bonding and non-bonding molecular orbitals.
5. Draw and explain MO energy level diagrams for homo and hetero diatomic molecules. Explain bond order and magnetic property of molecule.
6. Explain formation and stability of molecule on the basis of bond order.
7. Apply MOT to explain bonding in diatomic molecules other than explained in syllabus.

2. Introduction to Coordination Compounds [5 L]

Double salt and coordination compound, basic definitions: *coordinate bond, ligand, types of ligands, chelate, central metal ion, charge on complex ion, calculation of oxidation state of central metal ion, metal ligand ratio*; Werner's work and theory, Effective atomic number, equilibrium constant *(**Ref-6: 138-140**), chelate effect, IUPAC nomenclature.*
*(**Ref.-1:** 194-200, 222-224; **Ref-4:** 483-492)*

Learning Outcome:

After studying the Introduction to Coordination Compounds student will able to-

1. Define different terms related to the coordination chemistry (double salt, coordination compounds, coordinate bond, ligand, central metal ion, complex ion, coordination number, magnetic moment, crystal field stabilization energy, types of ligand, chelate effect, etc.)
2. Explain Werner's theory of coordination compounds. Differentiate between primary and secondary valency. Correlate coordination number and structure of complex ion.
3. Apply IUPAC nomenclature to coordination compound.

Reference Books: (Inorganic Chemistry)

1. Concise Inorganic Chemistry, J. D. Lee, 5th Ed (1996) Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.
4. Principles of Inorganic Chemistry, Brian W. Pfennig, Wiley (2015)
5. Inorganic Chemistry, Catherine Housecroft, Alan G. Sharpe, Pearson Prentis Hall, 2008.
6. Basics Inorganic Chemistry, Cotton and Wilkinson

3. Aromatic Hydrocarbons: [5 L]

Introduction and IUPAC nomenclature, preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. *Reactions* (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).
*(**Ref-1:** 493-513)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Identify and draw the structures aromatic hydrocarbons from their names or from structure name can be assigned.

2. Explain / discuss synthesis of aromatic hydrocarbons.
3. Give the mechanism of reactions involved.
4. Explain /Discuss important reactions of aromatic hydrocarbon.
5. To correlate reagent and reactions.

4. Alkyl and Aryl Halides: [7 L]

Alkyl Halides (up to 5 Carbons): Introduction and IUPAC nomenclature, Types of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions. *Preparation:* from alkenes *and* alcohols. *Reactions:* hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs. substitution.

Aryl Halides: Introduction and IUPAC nomenclature, *Preparation:* (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer and Gattermann reactions. *Reactions (Chlorobenzene):* Aromatic nucleophilic substitution (replacement by –OH group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.
*(**Ref.-1:** 165-211 and 943-967)*

Learning Outcome:

After studying the Alkyl and Aryl Halides student will able to-

1. Identify and draw the structures alkyl / aryl halides from their names or from structure name can be assigned.
2. Explain / discuss synthesis of alkyl / aryl halides.
3. Write / discuss the mechanism of Nucleophilic Substitution (SN^1, SN^2 and SNi) reactions.
4. Explain /Discuss important reactions of alkyl / aryl halides.
5. To correlate reagent and reactions.
6. Give synthesis of expected alkyl / aryl halides.

5. Alcohols, Phenols and Ethers (Up to 5 Carbons): [6 L]

Alcohols: Introduction and IUPAC nomenclature, *Preparation:* Preparation of 1o, 2o and 3o alcohols: using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acid and esters. *Reactions:* with sodium, HX (Lucas test), esterification, oxidation (with PCC, alc. KMnO4, acidic dichromate, conc. HNO_3). Oppeneauer oxidation *Diols:* (Up to 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

Phenols (Phenol case): Introduction and IUPAC nomenclature, *Preparation:* Cumene hydroperoxide method, from diazonium salts. *Reactions:* Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten–Baumann Reaction. **Ethers (aliphatic and aromatic):** Cleavage of ethers with HI.

(*Ref-1: 213-244 and 889-912)*

Learning Outcome:

After studying the Alcohols and Phenols student will able to-

1. Identify and draw the structures alcohols / phenols from their names or from structure name can be assigned.
2. Able to differentiate between alcohols and phenols
3. Explain / discuss synthesis of alcohols / phenols.
4. Write / discuss the mechanism of various reactions involved.
5. Explain /Discuss important reactions of alcohols / phenols.
6. To correlate reagent and reactions of alcohols / phenols
7. Give synthesis of expected alcohols / phenols.

References: (Organic Chemistry)

1. Morrison, R.T. & Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition, **2002**, 283-308.

Other Reference Books for All Chapters:

2. Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Wothers *Organic Chemistry* - Oxford University Press, USA, 2nd Ed.
3. Bahl, A. and Bahl, B.S. *Advanced Organic Chemistry*, S. Chand, **2010**.
4. Graham Solomon, T.W., Fryhle, C.B. & Dnyder, S.A. *Organic Chemistry*, John Wiley and Sons (2014).
5. Mc Murry, J.E. *Fundamentals of Organic Chemistry*, 7th Ed. Cengage Learning India Edition, 2013.
6. Sykes, P. *A Guidebook to Mechanism in Organic Chemistry*, Orient Longman, New Delhi (1988).
7. Finar, I. L. *Organic Chemistry* (Vol. I and II), E.L.B.S.

CH-303: Practical Chemistry-III [2 credit, 72* L]

* 72 L distributed as 58 L for performing practicals and 14 L for internal evaluation.

For practicals, see the manual prepared by BOS of Chemistry. The examination will be held according to this manual.

Instructions

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of Microscale technique is recommended wherever possible**

A. Chemical Kinetics: Integrated rate method: (Any Three)

1. To Study the Acid catalysed hydrolysis of an ester (methyl Acetate) and determine the rate constant (k). (first order reaction)
2. To study the kinetics of saponification reaction between sodium hydroxide and ethyl acetate.
3. To compare the relative strength of HCl and H_2SO_4 or HNO_3 by studying the kinetics of hydrolysis of methyl acetate.
4. Energy of activation of the reaction between $K_2S_2O_8$ and KI by initial rate method

To determine the order of the reaction with respect to $K_2S_2O_8$ by fractional life method following the kinetics of per sulphate-iodide reaction.

References:

i) Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.

ii) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

iii) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

iv) Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publication.

B. Inorganic quantitative / qualitative analysis (Any two)

1. Estimation of Fe(III) from given solution by converting it to Fe(II) using Zn metal and then by titrating with standard solution of $K_2Cr_2O_7$-A Green Approach (Ref.-1,3).
2. Determination of $BaCO_3$ content in a given sample by precise determination of volume of CO_2 (Ref-2).
3. Separation and Identification of metal ions by Paper Chromatography (Ref.,4,5)

References:

1. Iron Analysis by Redox Titration A General Chemistry Experiment, *Journal of Chemical Education*, Volume 65, Number 2, February 1988.183.
2. A Precise Method for Determining the CO_2 Content of Carbonate Materials, *Journal of Chemical Education*, Vol. 75, No. 12, December 1998.
3. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.
4. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut.
5. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co.

C. Organic Qualitative Analysis (Two mixtures: solid-solid type)

1. **Separation of Two Components** from given binary mixture of organic compounds containing mono-functional group (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively.

D. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Test of –COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)
4. Preparation of Quinone from hydroquinone (Confirm the conversion by absence of phenolic –OH group in product, M.P and purity by TLC)

E. pH Metry (Compulsory)

4. To determine equivalence point of neutralisation of acetic acid by pH-metric titration with NaOH and to find best indicator for the titration.

F. Volumetric Analysis (Any two)

1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (*Standardization of acid must be performed with standard Na2CO3 solution, prepared from dried anhydrous AR grade Na_2CO_3*)
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express your results as average ± standard deviation. (*Standardization of base must be performed with standard KHP*)
3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method and total dissolve solids by conductometry. Express your results as average ± standard deviation. (*Standardization of Na_2EDTA must be performed with standard Zn(II) solution*)

SEMSER-IV

CH-401: Physical and Analytical Chemistry [Credit: 2, 36 L]

Chapter No	Chapter	No of Lectures
1	Phase Equilibrium	09
2	Ideal and Real Solutions	09
3	Conductometry	06
4	Colorimetry	06
5	Column Chromatography	06

[9L]

1. Phase equilibrium

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. *(Ref. No: 1, Page No- 119 - 126, Ref. No: 2, Page No – 661-675, Ref. No:4, Page No 344- 354).*

Learning Outcomes

- Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc.
- Explain meaning and Types of equilibrium such as true or static, metastable and unstable equilibrium.
- Discuss meaning of phase, component and degree of freedom.
- Derive of phase rule.
- Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system
- **Reference Books (Physical Chemistry)**

1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of Physical chemistry by B.R. **Puri**, L.R. **Sharma**, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
5. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
6. Principles of Chemical Kinetics- 2rd Edition- James E. House.

References:

1. Iron Analysis by Redox Titration A General Chemistry Experiment, *Journal of Chemical Education*, Volume 65, Number 2, February 1988.183.
2. A Precise Method for Determining the CO_2 Content of Carbonate Materials, *Journal of Chemical Education*, Vol. 75, No. 12, December 1998.
3. Vogel's Textbook Quantitative Chemical Analysis, 3rd and 6th Ed.
4. Advanced Practical Chemistry, Jagdamba Sing et al, Pragati Prakashan, Merrut.
5. Practical Chemistry, Panday, Bajpai, Giri, S.Chand and Co.

C. Organic Qualitative Analysis (Two mixtures: solid-solid type)

1. **Separation of Two Components** from given binary mixture of organic compounds containing mono-functional group (Ex. - carboxylic acid, phenols, amines, amide, nitro, etc.) and systematic identification of each component qualitatively.

D. Organic Preparations (Any two)

1. Preparation of benzoic acid from ethyl benzoate (Identification and confirmatory Test of –COOH group, M.P and purity by TLC)
2. Acetylation of primary amine (Green approach)
3. Base catalyzed Aldol condensation (Green approach)
4. Preparation of Quinone from hydroquinone (Confirm the conversion by absence of phenolic –OH group in product, M.P and purity by TLC)

E. pH Metry (Compulsory)

4. To determine equivalence point of neutralisation of acetic acid by pH-metric titration with NaOH and to find best indicator for the titration.

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1. Estimation of Aspirin from a given tablet and find errors in quantitative analysis. (*Standardization of acid must be performed with standard Na2CO3 solution, prepared from dried anhydrous AR grade Na_2CO_3*)
2. Determination of acetic acid in commercial vinegar by titrating with standard NaOH. Express your results as average ± standard deviation. (*Standardization of base must be performed with standard KHP*)
3. Determination of Hardness of water from given sample by complexometric titration (Using E.D.T.A.) method and total dissolve solids by conductometry. Express your results as average ± standard deviation. (*Standardization of Na_2EDTA must be performed with standard Zn(II) solution*)

SEMSER-IV

CH-401: Physical and Analytical Chemistry [Credit: 2, 36 L]

Chapter No	Chapter	No of Lectures
1	Phase Equilibrium	09
2	Ideal and Real Solutions	09
3	Conductometry	06
4	Colorimetry	06
5	Column Chromatography	06

[9L]

1. Phase equilibrium

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. *(Ref. No: 1, Page No- 119 - 126, Ref. No: 2, Page No – 661-675, Ref. No:4, Page No 344- 354).*

Learning Outcomes

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2. Principles of Physical chemistry by B.R. **Puri**, L.R. **Sharma**, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009, S. Chand and Company Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
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SEMSER-IV

CH-401: Physical and Analytical Chemistry [Credit: 2, 36 L]

Chapter No	Chapter	No of Lectures
1	Phase Equilibrium	09
2	Ideal and Real Solutions	09
3	Conductometry	06
4	Colorimetry	06
5	Column Chromatography	06

[9L]

1. Phase equilibrium

Introduction; definitions of phase, components and degrees of freedom of a system; stability of phases, criteria of phase equilibrium. Gibbs phase rule and its thermodynamic derivation, phase diagrams of one- component systems- water, carbon dioxide and sulphur systems, problems. *(Ref. No: 1, Page No- 119 - 126, Ref. No: 2, Page No – 661-675, Ref. No:4, Page No 344- 354).*

Learning Outcomes

- Define the terms in phase equilibria such as- system, phase in system, components in system, degree of freedom, one / two component system, phase rule, etc.
- Explain meaning and Types of equilibrium such as true or static, metastable and unstable equilibrium.
- Discuss meaning of phase, component and degree of freedom.
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- Explain of one component system with respect to: Description of the curve, Phase rule relationship and typical features for i) Water system ii) Carbon dioxide system iii) Sulphur system
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1. Atkins' Physical Chemistry by Peter Atkins, Julio de Paula, James Keeler -11th edition
2. Principles of Physical chemistry by B.R. **Puri**, L.R. **Sharma**, M.S. Pathania
3. Essentials of Physical chemistry by Bahl Tuli-Revised Multicolour Edition 2009. S. Chand and Company Ltd.
4. Principles of Physical Chemistry, Fourth Edition by S.H. Marron and C. F. Pruton
5. Physical-Chemistry-4th Edition - Gilbert W. Castellan Narosa (2004).
6. Principles of Chemical Kinetics- 2nd Edition- James E. House.

7. Barrow, G.M. Physical Chemistry Tata McGraw- Hill (2007).
8. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
9. Mahan, B.H. University Chemistry, 3rd Ed. Narosa (1998).
10. Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
11. Physical Chemistry by Thomas Engel, Philip Reid, Warren Hehre.

2. Ideal and real solutions **[9L]**

Introduction, chemical potential of liquids - ideal solutions, ideal dilute solutions - Raoult's and Henry's Law, liquid mixtures, phase diagram of binary systems : liquids - vapour pressure diagrams, temperature composition diagrams, liquid-liquid phase diagrams, solubility of partially miscible liquids-critical solution temperature, effect of impurity on partially miscible liquids, Problems. (***Ref. No: 1**, Page Nos- 150-153, 155-157, 166 – 175, **Ref. No: 2**, Page No. - 750-775, 696-705**Ref. No:4**, Page No. 261-292, 298- 302).*

Learning Outcomes

- Define various terms, laws, differentiate ideal and no-ideal solutions.
- Discuss / explain thermodynamic aspects of Ideal solutions-Gibbs free energy change, Volume change, Enthalpy change and entropy change of mixing of Ideal solution.
- Differentiate between ideal and non-ideal solutions and can apply Raoult's law.
- Interpretation of i) vapour pressure–composition diagram ii) temperature- composition diagram.
- Explain distillation of liquid solutions from temperature – composition diagram.
- Explain / discuss azeotropes, Lever rule, Henrys law and its application.
- Discuss / explain solubility of partially miscible liquids- systems with upper critical. Solution temperature, lower critical solution temperature and having both UCST and LCST.
- Explain / discuss concept of distribution of solute amongst pair of immiscible solvents.
- Derive distribution law and its thermodynamic proof.
- Apply solvent extraction to separate the components of from mixture interest.
- Solve problem by applying theory.

3. Conductometry **[6 L]**

Introduction, Electrolytic Conductance, Resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, variation of equivalent and specific conductance with concentrations, Kohlrausch's law and its applications, conductivity cell, conductivity meter, Whetstone Bridge, determination of cell constant,

conductometric titrations (strong acid-strong base, strong acid-weak base, weak acid strong base) and Numericals. ***Ref-1:** 398-402, 414-423, 433-434, **Ref-2:** 519-527, **SupplementaryRef-3:** 746-756, **Ref-4:** 528-532.*

Learning Outcomes

- Explain / define different terms in conductometry such as electrolytic conductance, resistance, conductance, Ohm's law, cell constant, specific and equivalent conductance, molar conductance, Kohlrausch's law, etc.
- Discuss / explain Kohlrausch's law and its Applications, Conductivity Cell, Conductivity Meter, Whetstone Bridge.
- Explain / discuss conductometric titrations.
- Apply conductometric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

[6 L]

4. Colorimetry:

Introduction, interaction of electromagnetic radiation with matter, essential terms: radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, Lambert-Beer's Law, molar absorptivity, deviations from Beer's Law, Colorimeter: *Principle, Construction and components, Working*. Applications–unknown conc. By calibration curve method, Determination of unknown concentration of Fe(III) by thiocynate method, Numericals. (***Ref-2:** 645-651, 658-661, 690, **Ref-3:** 97, 100, 159-172, **Ref-4:** 144-153, 157-160, **Ref-6**-Relevent pages).*

Learning Outcomes

- Explain / define different terms in Colorimetry such as radiant power, transmittance, absorbance, molar, Lamberts Law, Beer's Law, molar absorptivity
- Discuss / explain / derive Beer's law of absorptivity.
- Explain construction and working of colorimeter.
- Apply colorimetric methods of analysis to real problem in analytical laboratory.
- Solve problems based on theory / equations.
- Correlate different terms with each other and derive equations for their correlations.

[6 L]

5. Column Chromatography

Introduction, Principle of Column Chromatography, **Ion Exchange Chromatography:** Ion exchange resins, action of ion exchange resin (Ion exchange equilibria, Ion exchange capacity), Experimental technique, Application: i) Separation of

Metal ions / non-metal ions on Ion Exchange Chromatography (*Zn(II) and Mg(II), Cl⁻ and Br⁻*), ii) Purification of water, (***Ref-2:*** *186-192, 205-209*) **Adsorption Chromatography – Liquid solid chromatography**: Introduction, the technique of conventional chromatography, column packing materials, Selection of solvent for adsorption chromatography, Adsorption column preparation and loading, Application – Purification of anthracene (***Ref-5:*** *209-215, 221*), Size Exclusion Chromatography*(Supplementary - **Ref-4:** pages 111-153, 212-215, **Ref-6**-Relevent pages)*

Learning Outcomes

- Explain / define different terms in column chromatography such as stationary phase, mobile phase, elution, adsorption, ion exchange resin, adsorbate, etc.
- Explain properties of adsorbents, ion exchange resins, etc.
- Discuss / explain separation of ionic substances using resins.
- Discuss / explain separation of substances using silica gel / alumina.
- Apply column chromatographic process for real analysis in analytical laboratory.

References (Analytical Chemistry)

1. Principles of Physical Chemistry, S.H. Marron and C. F. Pruton4th ed., Oxford and IBH publishing company / CBS, new Delhi.
2. Vogel's Textbook of quantitative Chemical Analysis, 5th Ed. G. H. Jeffry, J. Basset, J. Mendham, R. C. Denney, Longman Scientific and Technical, 1989.
4. Basic Concept of Analytical Chemistry- S. M. Khopkar
5. Vogel's Text Book of Practical Organic Chemistry, Furniss, Hannaford, Smith, Tatchel, 5th Ed., Longman Scientific and Technical, 2004.
6. Analytical Chemistry, G.R. Chatwal, Sham Anand.

CH-402: Inorganic and Organic Chemistry [2 credit, 36L]

Chapter No.	Chapter	No of Lectures
1	Isomerism in coordination complexes	02
2	Valance Bond Theory of Coordination Compounds	04
3	Crystal field Theory	12
4	Aldehydes and ketones	05
5	Carboxylic acids and their derivatives	05
6	Amines and Diazonium Salts	04
7	Stereochemistry of Cyclohexane	04

1. Isomerism in coordination complexes [2 L]

Introduction, polymerization isomerism, ionization isomerism, hydrates isomerism, linkage isomerism, coordination isomerism, coordination position isomerism, geometric isomerism, optical isomerism.

*(**Ref-1:** 232-236)*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Isomerism in coordination complexes
2. Explain different types of isomerism in coordination complexes.

2. Valance Bond Theory of Coordination Compounds [4 L]

Aspects and assumptions of VBT, applications of VBT on the basis of hybridization to explain the structure and bonding in $[Ag(NH_3)_2]^+$, $[Ni(Cl_4)]^{2-}$, $[Ni(CN)_4]^{2-}$, $[Cr(H_2O_6)]^{3+}$, $[Fe(CN)_6]^{3-}$ (Inner orbital complex) and $[FeF_6]^{3-}$(outer orbital complex). Use of observed magnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT. (**Ref-2:** 592-597, **Ref-3:**350-351).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Apply principles of VBT to explain bonding in coordination compound of different geometries.
2. Correlate no of unpaired electrons and orbitals used for bonding.
2. Identify / explain / discuss inner and outer orbital complexes.
4. Explain / discuss limitation of VBT.

3. Crystal Field Theory **[12 L]**

Shapes of d-orbitals, Crystal field Theory (CFT): Assumptions, Application of CFT to i) Octahedral complexes (*splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes*) ii) Square planar complexes and iii) Tetrahedral complexes; spin only magnetic moment of Oh and Td complexes.

*(**Ref-1:**194-225).*

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Explain principle of CFT.
2. Apply crystal field theory to different type of complexes (Td, Oh, Sq. Pl complexes)
3. Explain: i) strong field and weak field ligand approach in Oh complexes ii) Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept. iii) Origin of colour of coordination complex.
4. Calculate field stabilization energy and magnetic moment for various complexes.
5. To identify Td and Sq. Pl complexes on the basis of magnetic properties / unpaired electrons.
6. Explain spectrochemical series, tetragonal distortion / Jahn-Teller effect in Cu(II) Oh complexes only.

Reference Books: (Inorganic Chemistry)

1. Concise inorganic chemistry, J. D. Lee, 5th Ed (1996), Blackwell Science
2. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008
3. Inorganic Chemistry by Miessler and Tarr, Third Ed. (2010), Pearson.

4. Aldehydes and Ketones (aliphatic and aromatic) **[5 L]**

(Formaldehyde, acetaldehyde, acetone and benzaldehyde)

Introduction and IUPAC nomenclature, *Preparation:* from acid chlorides and from nitriles. *Reactions* – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test, Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemenson reduction and Wolff Kishner reduction. Meerwein-Pondorff Verley reduction. (***Ref-1:** 657-700 and 797-816*)

Learning Outcome:

After studying the aldehydes and ketones student will able to-

1. Identify and draw the structures aldehydes and ketones from their names or from structure name can be assigned.
2. Explain / discuss synthesis of aldehydes and ketones.
3. Write / discuss the mechanism reactions aldehydes and ketones.
4. Explain /Discuss important reactions of aldehydes and ketones.
5. To correlate reagent and reactions of aldehydes and ketones
6. Give synthesis of expected aldehydes and ketones.
7. Perform inter conversion of functional groups.

5. Carboxylic acids and their derivatives **[5 L]**

Carboxylic acids (aliphatic and aromatic): Introduction and IUPAC nomenclature, *Preparation:* Acidic and Alkaline hydrolysis of esters. *Reactions:* Hell–Vohlard - Zelinsky Reaction.

Carboxylic acid derivatives (aliphatic): (up to 5 carbons) *Preparation:* Acid chlorides, Anhydrides, Esters and Amides from acids and their inter conversion. Reaction: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation. *(**Ref-1:** 713-745 and 753-785).*

Learning Outcome:

After studying the carboxylic acids and their derivatives student will able to-

1. Identify and draw the structures carboxylic acids and their derivatives from their names or from structure name can be assigned.
2. Explain / discuss synthesis of carboxylic acids and their derivatives.
3. Write / discuss the mechanism reactions carboxylic acids and their derivatives.
4. Explain /Discuss important reactions of carboxylic acids and their derivatives.
5. Correlate reagent and reactions of carboxylic acids and their derivatives
6. Give synthesis of expected carboxylic acids and their derivatives.
7. Perform inter conversion of functional groups.

6. Amines and Diazonium Salts: **[4 L]**

Amines (Aliphatic and Aromatic): Introduction and IUPAC nomenclature, *Preparation* from alkyl halides. Gabriel's Phthalimide synthesis, Hofmann Bromamide reaction. *Reactions:* Hofmann vs. Saytzeff elimination, Electrophilic substitution (Case Aniline): nitration, bromination, sulphonation.

Diazonium salts: Preparation from aromatic amines. (***Ref-1:** 821-877)*

Learning Outcome:

After studying the amines and diazonium Salts student will able to-

1. Identify and draw the structures amines from their names or from structure name can be assigned.
2. Explain / discuss synthesis of carboxylic amines.
3. Write / discuss the mechanism reactions carboxylic amines.
4. Explain /Discuss important reactions of carboxylic amines.
5. To correlate reagent and reactions of carboxylic amines.
6. Give synthesis diazonium salt from amines and reactions of diazonium salt.
7. Perform inter conversion of functional groups.

7. Stereochemistry of Cyclohexane: [4 L]

Bayer's strain theory, heat of combustion of cycloalkanes, structure of cyclohexane, axial and equatorial H atoms, conformations of cycloalkane, stability of conformations of cyclohexane, methyl and t-butyl monosubstituted cyclohexane, 1,1 and 1,2 dimethyl cyclohexane and their stability.

(Ref-1: 283-308).

Learning Outcome:

After studying the aromatic hydrocarbons student will able to-

1. Draw the structures of different conformations of cyclohexane.
2. Define terms such as axial hydrogen, equatorial hydrogen, confirmation, substituted cyclohexane, etc.
3. Convert one conformation of cyclohexane to another conformation and should able to identify governing structural changes.
4. Explain / discuss stability with respect to potential energy of different conformations of cyclohexane.
5. Draw structures of different conformations of methyl / t-butyl monosubstituted cyclohexane (axial, equatorial) and 1, 2 dimethyl cyclohexane.
6. Identify cis- and trans-isomers of 1, 2 dimethyl substituted cyclohexane and able to compare their stability.

Reference Books: (Organic Chemistry)

1. Morrison, R.T. and Boyd, R.N. *Organic Chemistry*, Prentice Hall of India, Sixth Edition, 2002, 283-308.

Other Reference Books for all chapters:

CH-403: Practical Chemistry-IV [2 credit, 72* L]

* 72 L will be distributed as 58 L performing practical and 14 L for internal evaluation.

Instructions:

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous Mixtures)**
4. **Use of Microscale technique is recommended wherever possible.**

Conductometry (Compulsory)

a) To determine the cell constant of the given cell using 0.01 M KCl solution and determine dissociation constant of a given monobasic weak acid.

b) To investigate the conductometric titration of any one of the following a) Strong acid against strong base b) Strong base against weak acid. (*standardization of base must be performed with KHP*)

Chromatography (compulsory)

1. Separation of binary mixture of cations by Column Chromatography by ion exchange resins / cellulose (any one mixture) (Co + Al, Cu + Mg, Zn+Mg). Separation of cations must be confirmed by qualitative test

References:

i. Vogel's Textbook Quantitative Chemical Analysis, 3rd, 6th Ed.

ii) Experiments in chemistry, D. V. Jahagirdar, Himalaya publication.

Ideal and Real solutions (Any two)

1. To study the variation of mutual solubility temperature with concentration for the phenol - water system
2. To study the effect of added electrolyte on the critical solution temperature of phenol-water system and to determine the concentration of the given solution of electrolyte.
3. To obtain the temperature-composition phase diagram for a two component liquid system with maximum (or minimum) boiling point and to determine the maximum (or minimum) boiling point and composition.

Adsorption (Compulsory)

1. To verify the Freundlich and Langmuir adsorption isotherm for adsorption of acetic acid on activated charcoal.

References:

i) i) Systematic experimental physical chemistry, S. W. Rajbhoj, T. K. Chondekar, Anjali publication.

ii) Practical Physical Chemistry, Vishwanathan and Raghwan , Viva book.

iii) Practical Chemistry, O. P. Pandey, D. N. Bajpai Dr. S. Giri, S Chand Publication

Synthesis of Coordination compounds (any two)

1. Synthesis of sodium cobaltinitrite (a laboratory chemical) from Co(II) salt and $NaNO_2$ salts. Comment on colour and magnetic properties of the complex. (Ref.-1, 2)
2. Synthesis of potassium Tris(oxalate)aluminium(III) using Al metal powder(Scrap aluminium). Comment on colour and magnetic properties of the complex. (Ref-2, 3, 4)
3. Synthesis of Tris(acetylacetone)iron(III) by green chemistry method by reaction between $Fe(OH)_3$ and acac. Comment on colour and magnetic properties of the complex. (Ref.- 5,6).
4. Synthesis of Tris(ethylenediamine)nickel(II) from Ni(II) salt, ethylediamine and sodium thiosulfate. Comment on colour and magnetic properties of the complex. (Ref.-7)

Inorganic colorimetric investigations (Any two)

1. Prepare standard solutions of $KMnO_4$ / $CuSO_4$, record their absorbance and Verify Beer's Law and determine unknown concentration. **(Compulsory)**
2. Prepare solution of Fe(III) and $SCN^-$of in different molar proportion, record their absorbance and calculate equilibrium constant of $[Fe(SCN)]^{2+}$ complex (Ref.-9,10)
3. Prepare solution of Fe(III)/Cu(II) and salicylic acid in different molar proportion and determine metal ligand ratio in Fe(III) or Cu(II)–Salicylic acid complex. (Ref.-11, 12, 13)

References

1. Handbook of Preparative Inorganic Chemistry, Volume 2, Second Edition, Edited By Georg Braue R, Academic Press, New York, London, 1965. (Page-1541)
2. Practical Chemistry, Panday, Bjpai, Giri, S.Chand and Co.
3. McNeese, T.J.; Wierda, D.A. Synthesis of Potassium Tris(oxalato)aluminate(III) Trihydrate. *Journal of Chemical Education*,1983, 60(11), 1001.
4. Inorganic Syntheses Vol -1 by H S Booth. First Ed, 1939. (page-36).
5. Novel Synthesis of Tris(acetylacetonato)-iron(III), *Journal of Chem. Soc. Dalton Trans.* 1983
6. Metal Acetylacetonate Synthesis Experiments: Which Is Greener?, *Journal of Chemical Education*, 2011, 88, 947–953, dx.doi.org/10.1021/ed100174f

The Detailed Semester and Course Wise Syllabus as follows:

SEMESTER-V

DSEC-I: CH-501: Physical Chemistry- I **[Credit -2, 36 L]**

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Quantum Chemistry	10
2	Investigation of Molecular structure	16
3	Photochemistry	10
	Total	**36**

1. Quantum Chemistry **[10 L]**

Introduction, de Broglie hypothesis, The Heisenberg's uncertainty principle, quantisation of energy, Operators, Schrodinger wave equation, well behaved function, Particle in a one-, two and three-dimensional box (no derivation), Physical interpretation of the ψ and ψ2, sketching of wave function and probability densities for 1D box, degeneracy, applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical

Expected learning Outcome:

After successfully completion, students will be able to:

1. Know historical of development of quantum mechanics in chemistry.
2. Understand and explain the differences between classical and quantum mechanics.
3. Understand the idea of wave function
4. Understanding of De Broglie hypothesis and the uncertainty principle
5. Understanding the operators: Position, momentum and energy
6. Solving Schrodinger equation for 1D, 2D and 3D model
7. Physical interpretation of the ψ and ψ2 and sketching the wave function
8. Applications to conjugated systems, zero-point energy and quantum tunnelling, Numerical Problems

Reference books:

1) Principles of Physical Chemistry by Puri, Sharma, Pathania,; (Page No: 21-110)
2) Essential of Physical Chemistry, Bahl and Tuli (S. Chand).; (Page No: 50-58)

2. Investigation of Molecular structure **[16 L]**

Introduction: Molar refraction and molecular structure, Dipole moment and molecular structure, electromagnetic spectrum, energy of molecules, Types of molecular spectra.

Microwave Spectroscopy: Introduction, Classification of molecules on the basis of moment of Inertia, Rotational spectra of rigid diatomic molecules, relative intensities of spectral lines, effect of isotopic substitution on the rotational spectra, Determination of bond length and moment of inertia from rotational spectra, Problems

Infrared Spectroscopy: Introduction, Simple Harmonic oscillator, Modes of vibration, force constant, Vibrational spectrum of a diatomic molecule: Vibrational Energy expression, Allowed vibrational energies, zero-point energy, Selection rule, Vibrational energy level diagram with transitions, spectrum depiction, Vibration-rotation Spectra: Born-Oppenheimer approximation. Energy expression for vibrational rotor, Selection rules, Vibrational-rotational energy level diagram with transitions, Nature of vibrational spectra, P, Q and R branches of lines of the IR spectra, Problems

Raman Spectroscopy: Introduction, Classical and Quantum theory of Raman effect, Rayleigh, Stokes and anti-stokes lines, Pure rotational Raman spectra of linear diatomic molecules

Expected learning Outcome: After studying this chapter, the student will be able to:

1. Understand the term additive and constitutive properties.
2. Understand the term specific volume, molar volume and molar refraction.
3. Understand the meaning of electrical polarization of molecule, induced and orientation polarization.
4. Dipole moment and its experimental determination by temperature variation method.
5. Electromagnetic spectrum, Nature of wave and its characteristics such as wavelength. wave number, frequency and velocity, Energy level diagram,
6. Classification of molecules on the basis of moment of Inertia,
7. Rotational spectra of rigid diatomic molecules, selection rules, nature of spectral lines.
8. Simple Harmonic oscillator model, Born-Oppenheimer approximation. Vibrational spectra of diatomic molecules selection rules, nature of spectral lines.
9. Explain the difference between Rayleigh, Stokes and anti-Stokes lines in a Raman spectrum.
10. Justify the difference in intensity between Stokes and anti-Stokes lines.
11. Draw the Stokes and anti-Stokes lines in a Raman spectrum
12. Raman spectra: Concept of polarizability,
13. Pure rotational Raman spectra of diatomic molecules, Energy Expression, Selection rule, Rotational energy level diagram, Rotational Raman spectrum and Problems

Reference books:

1. Fundamentals of molecular spectroscopy by C.N. Banwell and E. M. McCash.

(Page No: 33-59, 60-75, 111-119)

2. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000.

(Page No: 413-455)

[10 L]

3. Photochemistry

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grothus - Draper law ii) Stark-Einstein law, Quantum yield, Reasons for high and low quantum yield., Factors affecting Quantum yield, Experimental method for the determination of quantum yield, types of photochemical reactions - photosynthesis, photolysis, photocatalysis, photosensitization, Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Problems

Expected learning Outcome:

After studying this chapter, the student will be able to know and understand:

1. Difference between thermal and photochemical processes.
2. photochemical laws: Grothus - Draper law, Stark-Einstein law,
3. Quantum yield and reasons for high and low quantum yield,
4. factors affecting the quantum yield,
5. Experimental method for the determination of quantum yield
6. Photochemical reactions: photosynthesis, photolysis, photocatalysis, photosensitization
7. Various photochemical phenomena like fluorescence and phosphorescence, Chemiluminescence,
8. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).; (Page No: 1154-1178)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania,; (Page No: 1112-1135)
3. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000.

(Page No: 262-2810)

Additional Reference Books:

1. Physical Chemistry by G. M. Barrow, International student Edition,Mc Graw Hill.
2. University General Chemistry by C.N.R. Rao, Macmillan.
3. Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4. The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5. Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.
6. Quantum Chemistry by Donald A McQuarrie, Viva Student Edition

7. Quantum Chemistry by I. Levine.
8. Quantum Chemistry by R.K. Prasad

DSEC-I: CH-502: Analytical Chemistry- I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Gravimetry	09
2	Inorganic Qualitative Analysis	07
3	Thermal methods of analysis	06
4	Parameters of instrumental analysis	04
5	UV-Visible spectroscopy	10
	Total	36

1. Gravimetry

(9 L)

Introduction to gravimetric analysis; Precipitation methods; The colloidal state; Supersaturation and precipitate formation; The purity of the precipitate: Co-precipitation; ; Conditions of precipitation; Precipitation from homogeneous solution; Washing the precipitate; Ignition of the precipitate: quantitative separations based upon precipitation methods: Fractional precipitation; Organic precipitants (8-hydroxyquinoline, DMG, Cupferron, Nitron, and Benzoin-alfa oxime, Anthanilic acid), Gravimetric Calculations—How Much Analyte is there (Ref-3)

Applications of Gravimetry: Determination of Al(III) by 8-hydroxyquoline, Determination of calcium as oxalate; Determination of potassium as potassium tetraphenylborate, Determination of phosphate as ammonium molybdophosphate, Numericals,

Key Reference-1: 417-428, 433-444, 446, 451, 464, 485; [Supplementary Ref-2: Pp-342 to 362]

2. Inorganic Qualitative Analysis

(7 L)

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals. Ref-6

3. Thermal methods of analysis

(6 L)

General discussion, Thermogravimetry, Experimental factors affecting TG analysis, Instruments for thermogravimetry, Applications: Thermogravimetric analysis of $CaC_2O_4\ H_2O$, $CuSO_4\ 5H_2O$, Differential Thermal Analysis: Introduction, instrumentation for DTA and DSC, experimental and instrumental factors, applications: DTA of copper sulphate pentahydrate, Purity of

pharmaceutical by DSC, Key Reference-2: 503-522. [Supplementary reference, Ref-4: 884-890, Ref-1: 428-433]

(4 L)

3. Parameters of instrumental analysis

Techniques, Methods, Procedures, and Protocols, Selecting an Analytical Method, Accuracy, Precision, Sensitivity, Selectivity, Robustness and Ruggedness, Scale of Operation, equipment, Time, and Cost, Making the Final Choice, Developing the Procedure, Calibration and Standardization, Sampling, Validation, Protocols, Key Reference -5: 35-48

(10 L)

4. UV-Visible spectroscopy

Introduction, Theory of spectrophotometry and colorimetry-Beer's law, Application of Beer's Law, Spectrophotometry: Wavelength selection by prism and diffraction grating, Radiation source, cells, data presentation, single-beam spectrophotometer, Double-beam spectrophotometers, Choice solvent, general procedure for colorimetric estimation, simultaneous analysis, Applications: Estimation of metal ions from aqueous solution: Boron in steel, Chromium in steel with diphenyl carbazide reagent, ammonia in water, Chloride, Primary amine, Determination of phenol, spectrophotometric titration (example Cu(II) with EDTA), Determination of pKa value of indicator, Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method.. Numericals Key Reference-2: 658-717 and Ref-1: 645-725

References:

Ref-1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)
Ref-2: Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6th Ed. Pearson education
Ref-3: Analytical Chemistry by G. D. Christian, et al , Wiley, 6th Ed.
Ref-4: Principles of Instrumental Analysis: Holler, Skoog, Crouch 6th Ed. Thomson Publication
Ref-5: Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education
Ref-6: Vogel's Qualitative Inorganic Analysis, G. Svehla, Pearson, 7th Ed.

Course outcome: After completion of the course student should be able to

1. Define basic terms in gravimetry, spectrophotometry, qualitative analysis and parameters in instrumental analysis. Such as: Gravimetry, precipitation, solubility product, ionic product, common ion effect, precipitating agent, washing of ppt., drying and ignition of ppt., linearity range, detection limit, precision, accuracy, Sensitivity, Selectivity, Robustness and Ruggedness, electromagnetic radiations, spectrophotometry, Beers law, absorbance, transmittance, molar absorptivity, monochromator, wavelength of maximum absorbance,

metal ligand ration, qualitative analysis, group reagent, dry tests, wet test, confirmatory test, precipitation, thermogravimetry, thermogram, percent wt. loss, differential thermal analysis, etc.

2. Identify important parameters in analytical processes or estimations. Example: minimum analyte concentration in particular method, reagent concentration in particular analysis (gravimetry, spectrophotometry, thermogravimetry), reagent for particular analysis, reaction condition to convert analyte into measurable form, drying and ignition temperature for ppt in gravimetry, heating rate thermogravimetry, wavelength in spectrophotometry, group reagent, removal borate and phosphate in qualitative analysis, etc.
3. Explain different principles involved in the gravimetry, spectrophotometry, parameters in instrumental analysis, qualitative analysis.
4. Perform quantitative calculations depending upon equations student has studied in the theory. Furthermore, student should able to solve problems on the basis of theory.
5. Discuss / Describe procedure for different types analyses included in the syllabus.
6. Select particular method of analysis if analyte sample is given to him.
7. Differentiate / distinguish / Compare among the different analytical terms, process and analytical methods.
8. Demonstrate theoretical principles with help of practical.
9. Design analytical procedure for given sample.
10. Apply whatever theoretical principles he has studied in theory during practical session in laboratory.

DSEC-I: CH-503: Physical Chemistry Practical - I [Credit -2, 73 L]

Total 12 experiments to be completed.

1. Refractometry: (any two)

1) To determine the specific refractivity's of the given liquids A and B and their mixture and hence determine the percentage composition their mixture C.
2) To determine the molecular refractivity of the given liquids A, B, C and D.
3) To determine the molar refraction of homologues methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by -CH2 group.
4) Determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution

2. Spectrophotometry and Colorimetry (any three)

1) To titrate Cu^{2+} ions with EDTA photometrically.
2) To determine the indicator constant of methyl red indicator

3) To estimate of Fe^{3+} ions by thiocyanate method.
4) Cobalt by using R-nitroso salt method.
5) To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium calorimetrically.
6) Simultaneous determination of Cu^{2+} and Ni^{2+} ions by colorimetry/spectrophotometry method

3. Conductometry (any four)

1) Titration of a mixture of weak acid and strong acid with strong alkali.
2) To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conduct metric method.
3) To determine the normality of citric acid in given fruit by titrating it against standard NaOH solution by conductometric method.
4) To determine $\lambda\infty$ of strong electrolyte (NaCl or KCl) and to verify Onsager equation.
5) To estimate the amount of lead present in given solution of lead nitrate by conductometric titration with sodium sulphate.
6) To determine the relative strength of monochloro acetic acid and acetic acid conductometrically

4. Viscosity: (any one)

1. To determine the molecular weight of a high polymer by using solutions of different concentrations.
2. Determine the radius of glycerol molecule from viscosity measurement.

5. Photoflurometry

1. Analysis of Riboflavin from vitamin supplementary capsules / syrup / tablet sample by Photoflurometry

6. Table work

1. Analysis of the given vibration-rotation spectrum of HCl(g)

DSEC-II: CH-504: Inorganic Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Molecular Orbital Theory of Coordination Compounds	08
2	Inorganic Reaction Mechanism	06
3	Chemistry of transition elements	06
4	Chemistry of f-block elements	08
5	Metals, Semiconductors and Superconductors	08
	Total	36

1. Molecular Orbital Theory of Coordination Compounds (8L)

Electro-neutrality principle, multiple bonding ($d\pi$-$p\pi$ and $d\pi$-$d\pi$), Nephelauxetic effect and Nephelauxetic series (Recapulation from VBT and CFT), Need and introduction of MOT, Assumptions, MO treatment to octahedral complexes with sigma bonding, Formation of MO's from metal orbitals and Composite Ligand Orbitals (CLO), MO correlation diagram for octahedral complexes with sigma bonding, effect of π bonding on MO correlation diagram, Charge transfer spectra, Advantages of MOT over VBT and CFT.

Aims and objective/Learning Outcomes: A student should know:

i. Explain electroneutrality principle and different types of pi bonding.
ii. Able to explain Nephelauxetic effect towards covalent bonding.
iii. Explain MOT of Octahedral complexes with sigma bonding.
iv. Able to explain Charge Transfer Spectra.
v. Able to compare the different approaches to bonding in Coordination compounds.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 4th Edition pp226-231
2. Physical Inorganic Chemistry A Coordination Chemistry Approach S. F. A. Kettle Springer-Verlag Berlin Heidelberg GmbH, 1996 pp 95-120
3. Theoretical Inorganic Chemistry by Day and Selvin (Relevant Pages)

2. Inorganic Reaction Mechanism (6L)

Basic concepts of stability and lability, stability constants, Factors affecting lability, chelate effect. Classification of inorganic reactions, ligand substitution reactions: Intimate and stoichiometric mechanism of ligand substitution. Substitution Reactions in Four Coordinated

square planar complexes: Trans effect and Trans effect series, applications of trans effect, stereochemistry of substitution.

[Further reading: Student should also read about the relation between kinetics and mechanism. Reaction mechanisms in complexes with C.N.4, 5 and 6]

Aims and objective: A student should know:

i. To understand about inert and labile complexes and stability of complexes in aqueous solutions
ii. Classification of reactions of coordination compounds
iii. The basic mechanisms of ligand substitution reactions.
iv. Substitution reactions of square planer complexes.
v. Tran's effect and applications of Trans effect
vi. Stereochemistry of mechanism
vii. Gain the knowledge of inorganic reaction mechanisms available in the literature to solve chemical problems.

References:

1. Inorganic Chemistry – Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter & R. L. Keiter, 4th Edn. Harper Collins College Publ. New York, Chapt.13, p.537-576, (1993).
2. Martin L. Tobe and John Burgess, Inorganic Reaction Mechanisms, Addison Wesley Longman Inc., 1999.
3. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Lamgford – Oxoford, 5th Edn., 1994, pp507-517.
4. Inorganic Chemistry - Messler and Tarr - Pearson Publishers pages 412-420, 434-440

3. Chemistry of Transition elements [6L]

Position in periodic table, electronic configuration, trends in properties w.r.t.(a) size of atoms and ions (b) reactivity (c) catalytic activity (d) oxidation state (e) complex formation ability (f) colour (g) magnetic properties (h) non-stoichiometry (i) density, melting & boiling points. [Ref.-1]

Aims and objective: A student should know:

1. To know position of d-block elements in periodic table.
2. To know the general electronic configuration & electronic configuration of elements.
3. To know trends in periodic properties of these elements w.r.t. size of atom and ions, reactivity, catalytic activity, oxidation state, complex formation ability, color, magnetic properties, non-stoichiometry, density, melting point, boiling point.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th edition. Pages 859-863, 865-866,

4. Chemistry of f-block elements [8L]

Introduction of f-block elements- on the basis of electronic configurations, occurrence and reactivity, F-block elements as Lanthanide and Actinide series

I. Lanthanides:

Position in periodic table, Name and electronic configuration of lanthanides, Oxidation States, atomic and ionic radii, Lanthanide contraction, its causes and consequences on chemistry of Lanthanides and post lanthanide elements, Occurrence and separation: Bulk separation, Individual separation by modern methods *viz.*, Ion exchange and solvent extraction method, applications of lanthanides. [Reference-1]

II. Actinides:

Position in periodic table, names and their electronic configurations. IUPAC nomenclature system for super heavy elements, Oxidation States, Occurrence and general methods of preparation of transuranic elements *viz.*, Neutron Bombardment, Accelerated projectile bombardment and Heavy ion bombardment. Nuclear Fuels-Nuclear fission and fusion fuels, comparison between Lanthanides and Actinides. [Reference-1]

Aims and objective: A student should know:

1. The meaning of term f-block elements, Inner transition elements, lanthanides, actinides.
2. Electronic configuration of lanthanides and actinides.
3. Oxidation states of lanthanides and actinides and common oxidation states.
4. Separation lanthanides by modern methods.
5. Lanthanide contraction and effects of lanthanide contraction on post-lanthanides.
6. Use of lanthanide elements in different industries.
7. Transuranic elements.
8. Preparation methods of transuranic elements.
9. Nuclear fuels and their applications.
10. Why transuranic elements are called as the synthetic elements?
11. IUPAC nomenclature for super heavy elements with atomic no. 100 onwards.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th Edn. 874 – 875, 879-886, 891-893, 898-900.

5. Metals, Semiconductors and Superconductors [8L]

Introduction, Metallic bonding, Band theory in metals with respect to Na along with n (E) and N(E) diagrams, Electrical conductivity of metals (Na, Mg, Al), Valence electrons and conductivity of metals, Effect of temperature and impurity on electrical conductivity of metals,

Semiconductors, types of Semiconductors: I. Intrinsic II. Extrinsic, effect of temperature and impurity on semiconductivity, n & p type semiconductors ZnO and NiO, Superconductivity: Discovery, property, models, structure and superconductivity, low and high temperature superconductors, applications of superconductors.

Aims and Objectives: A student should be able –

1. The meaning of metal & semiconductor.
2. The difference between metal, semiconductor and insulator.
3. Metallic bond on the basis of band theory.
4. The energy band and energy curve.
5. Draw n (E) & N (E) curves.
6. Explain the electrical conductivity of metals with respect to valence electrons.
7. Explain the effect of temperature and impurity on conductivity of metals and semiconductors.
8. Intrinsic and extrinsic semiconductor.
9. The term valance band and conduction band.
10. n and p type of semiconductors.
11. Non-stoichiometry and semi conductivity.
12. Insulators on the basis of band theory.
13. The difference between Na, Mg, and Al in terms of valence electrons and conductivity.
14. Meaning of super conductors and their structure. o. Discovery and applications of superconductors.

References:

1. Solid State Chemistry: An Introduction, Lesley E. Smart, Elaine A. Moore, 3rd Edn. Relevant pages from Chapter 10, pp394-411
2. Solid State Chemistry and its Applications, Anthony R. West, Second Edition, Wiley 2014, PP 359-391
3. Chemistry by Raymond Chang - 5th edition (Related Pages)
4. New Guide to Modern Valence Theory by G.I. Brown - 3rdedition Pages 209-221

DSEC-II: CH-505: Industrial Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Modern Approach to Chemical Industry	06
2	Manufacture of Basic Chemicals	07
3	Sugar and Fermentation Industry	07
4	Soap and Detergents Industry	08
5	Dyes and Pigments	08
	Total	36

1. Modern Approach to Chemical Industry (6 L)

Introduction, basic requirements of chemical industries, chemical production, unit process and unit operations, Quality control and quality assurance, process control, research and development, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity and yield, copy-right act, patent act, trademarks. Ref. No.-7, Relent pages, Ref. - 10: www.wikipedia.org/wiki/copyright_act_of1976/patent act/ trademark

Aims and Learning objectives: The students are expected to learn;

i. Importance of chemical industry,
ii. Meaning of the terms involved,
iii. Comparison between batch and continuous process,
iv. Knowledge of various industrial aspects

2 Manufacture of Basic Chemicals (7 L)

a) Ammonia: Manufacture of ammonia by modified Haber-Bosch process, Physico-chemical principles involved and uses of ammonia.

b) Nitric acid: Manufacture of nitric acid by Ostwald's process, Physico-chemical principles involved and uses of nitric acid.

c) Sulphuric acid: Manufacture of sulphuric acid by contact process, Physico-chemical principles involved and uses of sulphuric acid.

Reference No.-1: Page No. 731 to 761, 809 to 844, Reference-3: 1128-1175, 1253-1263

Aims and Learning objectives: The students are expected to learn

i. Concept of basic chemicals,
ii. Their uses and manufacturing process.
iii. They should also know the physico-chemical principals involved in manufacturing process

3. Sugar and Fermentation Industry (7 L)

a. Sugar: Introduction, manufacture of cane sugar, extraction of juice, purification of juice, sulfitation and carbonation, evaporation, crystallization, separations of crystals, drying refining, grades, recovery of sugar from molasses, by-product of sugar industry,

Reference No.-1: Page No.1208- 1218

b. Fermentation Industry: Introduction, importance, conditions favorable for fermentation, Characteristics of enzymes, short account of some fermentation processes, Alcohol beverages, Manufacture of beer, manufacture of sprit, manufacture of wines, manufacture of vinegar, manufacture of power alcohol, ethyl alcohol from molasses.

Reference No.-1: Page No. 1176-1184

Aims and Learning objectives: The students are expected to learn

Sugar Industry: The students are expected to learn

i. Importance of sugar industry,
ii. Manufacture of direct iii. Consumption (plantation white) sugar with flow diagram.
iii. Cane juice extraction by various methods,
iv. Clarification by processes like carbonation, vi. Sulphitation, vii. Phosphatation, etc.
v. Concentration of juice by using multiple effect evaporator system,
vi. Crystallization of sucrose by using vacuum pan.

Fermentation Industry- The students are expected to learn

i. Importance,
ii. Basic requirement of fermentation process,
iii. Manufacturing of ethyl alcohol by using molasses and fruit juice.

4. Soap and detergents (8 L)

(a) Soap: Soap and Fatty Acids: Introduction, Chemistry, Manufacturing Technology, Raw Materials, Functional Properties of Soap, Manufacturing Processes, Saponification Reactor, Cooling, Soap Separator, Soap Extraction, Centrifugation, Neutralization, Direct Neutralization, Carbonate Neutralization, Partial Neutralizing with Soda Ash, Carbon Dioxide Separation, Raw Material Dosing, Caustic Soda, Completion of Neutralizing with Caustic Soda, Neutralization Soap Viscosity,

Reference-5: 980-997, Reference-1: 1243 -1250

(b) Detergents: Synthetic Detergents: Introduction, Characteristic Features of Surfactants, Raw Materials for Surfactant Production, intermediates for Surfactant Production, Anionic Surfactants, Non-ionic Surfactants, Amphoteric Surfactants, Cationic Surfactants, Detergent Additives, Production of Synthetic Detergents, and Washing action of soap and detergents.

Reference-5: 1006-1029, Reference-1: 252 – 1279

Aims and Learning objectives: The students are expected to learn

i. Different types of soap products,

ii. Chemistry of soap.

iii. Raw materials required for soap manufacture

iv. Meaning of the term's Surfactants, Types of surfactants

v. Raw materials for detergents

vi. Detergent builders, additives

vi. Washing action of soap and detergents

5. Dyes and Pigments **(8 L)**

(a) Dyes: Introduction, qualities of good dye, Colour constituents (Chromophore, auxochrome), classification of dyes according to their application, Synthesis and uses of following dyes: Nitroso dye-martius yellow, Azo dyes-Methyl orange and aniline yellow, Triphenylmethane dye-Crystal violet, Phthalein dye - Phenolphthalein, Xanthane-Fluorescein, Antha-quinnoe- Alizarin and Indigo dyes - Indigo.

Reference -1: pp 1545-1595

(b) Pigments: Introduction, classification and general properties of pigments.

Inorganic pigments:

i) Zinc oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process)

ii) Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process),

Reference-9: 80-87, 97 to 109.

Aims and Learning objectives: The students are expected to learn

Dyes - Students should know about

i. Dyes: introduction,

ii. Dye intermediates,

iii. Structural features of a dye;

iv. Classification of dyes,

v. Synthesis, Structures, properties and applications of dyes

Pigments: Students should know about

i. Introduction,

ii. Classification and general properties of pigment

iii. Production processes of zinc oxide and iron oxide

References:

1. Industrial Chemistry, B. K. Sharma, Goel publishing House, 18th Ed. (2014)
2. Riegeal's Hand book of industrial chemistry, James A. kent. 9th Ed. CBS publishers
3. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 458-463.
4. Advanced Inorganic Chemistry, Satyaprakash, Tuli, Basu pages 830-849
5. Handbook of Industrial Chemistry and Biotechnology, James A. Kent, Tilak V. Bommaraju, Scott D. Barnicki, Thirteenth Edition, Springer.
6. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.
7. Shreeve's chemical process industries 5th Edition, G.T. Austin, TATA McGraw-Hill Edition, chemical engineering series
8. Industrial Chemistry, Part-II, R. K. Das, Kalyani Publisher, Second Ed.
9. Inorganic Pigments by Gerhard Pfaff, Publisher-De Gruyter, 1st Ed.

www.wikipedia.org/wiki/copyright_act_of1976 , www.wikipedia.org/wiki/patentact and www.wikipedia.org/wiki/trademark

Industrial visit:

Visit to any one of the Chemical / Pharmaceutical / Polymer / Research Institutes / Sugar Factories / waste water treatment plant, etc. is essential and a systematic report is to be submitted by the student to the Department of Chemistry.

DSEC-II: CH-506: Inorganic Chemistry Practical - I [Credit -2, 73 L]

Total 12 experiments to be completed.

A. Gravimetric estimations (Any 3)

1. Gravimetric estimation of Fe as Fe2O3. Ref-1: 457
2. Gravimetric estimation of Ba as BaSO4 using homogeneous precipitation method. Ref-1: 448
3. Gravimetric estimation of Nickel as Ni – DMG. Ref-1: 462
4. Analysis of sodium bicarbonate from mixture by thermal decomposition method. Ref.-6
5. Determination of water of crystallization by thermal decomposition. Reference-5
6. Analysis of Food/Pharmaceutical sample for ash and sulphated ash example-Aspirin, Ref. -2.

B. Inorganic preparations (Any 3) (Ref-7, 8, 9)

Preparation of inorganic complexes and spot tests for metal ions and ligands:

1. Preparation of hexamminenickel(II) chloride, $[Ni(NH_3)_6]Cl_2$.
2. Preparation of Potassium trioxalatoferrate(III), $K_3[Fe(C_2O_4)_3]$.
3. Preparation of Manganese (III) acetylacetonate, $[Mn(acac)_3]$.
4. Preparation of tris(glycinato)nickelate(II), $[Ni(gly)_3]^-$
5. Preparation of Potassium dioxalatocuprate(II), $[Cu(C_2O_4)_2]^{2-}$.

C. Inorganic Qualitative Analysis (6 Expts.)

1. Inorganic Qualitative analysis (5 mixtures) [1 simple water soluble mixture, 2 mixtures containing borates and 2 mixtures containing phosphates]

(*DST manual green chemistry monograph procedure must be followed strictly*) Ref.-4

2. Limit test for iron, chloride and sulphate from pharmaceutical raw materials. Ref.-2; pp - 220

OR

2. Qualitative and confirmatory tests of inorganic toxicants of any four ions (Borate, copper, hypochlorite or nitrate or nitrite, Sb or Bi, Iodate, H_2O_2). Reference-3

References:

1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

2: Indian Pharmacoepia, Vol-2; 2007

3: Basics of Analytical toxicology, World Health Organization

4: Green Chem - [PDF Document] – FDOCUMENTS: (https://fdocuments.in/document/green-chem.html)

5:https://www.studocu.com/ec/document/universidad-de-investigacion-de-tecnologia-experimental-yachay/fisica-matematica/otros/the-gravimetric-analysis-of-barium-chloride-hydrate/8364963/view

6: https://effectiveness.lahc.edu/academic_affairs/sfcs/chemistry/Shared%20Documents/Decomposing%20Baking%20Soda.pdf

7: Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horword Publishing, Chichester) 1999.

8: Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House

9: Journal of chemical education: Synthesis of cis- $Cu(gly)_2$ Trans- $Cu(gly)_2$ and cis-ni(gly)$2H_2O$ and their characterization using thermal and spectroscopic technique – a Capstone laboratory experiment.

Structure of Practical Examination [35 Marks; Time: 3 hours]

Q1. Gravimetric estimation/Inorganic preparation/Inorganic Qualitative analysis.... *30 M*

Q2. Viva-Voce ..... *05 M*

DSEC-III: CH-507: Organic Chemistry - I [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Polynuclear and Heteronuclear Aromatic Compounds	08
2	Active Methylene Compounds	05
3	Rearrangement Reactions	12
4	Elimination reactions	11
	Total	**36**

1. Polynuclear and Heteronuclear Aromatic Compounds **[08 L]**

Introduction, Classification of aromatic compounds, Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene, Furan, Pyrrole, Thiophene, and Pyridine. Ref.1: Pages 759 – 779. Ref.3: Pages 952 – 962. 2.

2. Active Methylene Compounds **[05 L]**

Definition, Preparation of Ethylacetoacetate and Synthetic uses of ethylacetoacctate Preparation of Diethyl malonate and Synthetic uses of diethyl malonate, (preparation of non-hcteromolecules having upto 6 carbon). Ref.1: Pages 864 – 875. Ref.3: Pages 859 – 874. Ref.6: Pp 206 – 213.

3. Rearrangement Reactions **[12 L]**

Introduction, Types of rearrangement, Types of reactive intermediate involved in different rearrangements, Rearrangement – Beckmann, Baeyer-Villiger, Favorskii, Curtius, Lossen, Schmidt and Pinacol-Pinacolone with mechanism. Electrocyclic Rearrangements- Claisen, Cope and Mc-Lafferty rearrangements with mechanism. Ref.4: Pages 618-656. Ref.7: Pages 89-94, 105-107, 112-114, 122-125, 158-161. Ref.10: Pages 130-132.

4. Elimination reactions **[11 L]**

Introduction; Types of eliminations-1,1; 1,2 elimination, Mechanism with evidences of E1and E2, E1cB reactions, stereochemistry of E1 and E2 elimination, Orientations and reactivity in E1 and E2 elimination- Hoffmann and Saytzeff's orientation, Factors affecting the reactivity- effect of structure, attacking base and leaving groups. Ref.1: Pages 305-326. Ref. 3: Pages 260-265. Ref.4: Pages 472-496. Ref.6: Pages 188-194.

References

1) R.T. Morrison & R.N. Boyd: Organic Chemistry, 7th edition, Prentice Hall.

2) Organic Chemistry: Clayden, Greeves, Wothers, Warren, Oxford Press.

3) Organic Chemistry: Graham Solomans

4) E. S. Gould: Mechanism and Structure in Organic Chemistry

DSEC-III: CH-508: Chemistry of Biomolecules [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to molecular logic of life	03
2	Carbohydrates	07
3	Lipids	06
4	Amino acids and Proteins	08
5	Enzymes	06
6	Hormones	06
	Total	36

1. Introduction to molecular logic of life. (3L)

Unicellular and multicellular organisms, prokaryotes and eukaryotes. List of cell organelles and its functions. Molecules that constitute the organisation of cell and its organelles. types of bonds in biomolecules

2. Carbohydrates

Introduction, classification of carbohydrates, their structures and biological significance. Concept of anomers, epimers, reducing and non-reducing sugars, mutarotation, inversion. Reactions of glucose with acid, base, phenyl hydrazine, oxidizing agents, reducing agents and its significance, Glycosidic bonds. (7L)

3. Lipids

Introduction, classification of lipids, their structures and biological significance. Reactions of Lipids-Saponification Hydrolysis, emulsification, oxidation. Concept of saponification number, acid number, iodine number and their significance. Rancidity. Types of Lipoproteins and their significance. Blood group substances. (6L)

4. Amino acids and Proteins

Amino acids: classification of amino acids. Cocept of ampholytes, isoelectric pH, zwitter ions, titration curve of glycine. Reactions of amino acid with Ninhydrin, Sanger's, Dansyl chloride, Dabsyl chloride and Edmann's reagents and their significance. Peptide bond and its features. **Proteins:** Classification based on function, nutrition and composition. Structural organization of proteins- primary, secondary, tertiary and quaternary structures. (8L)

5. Enzymes

Classification of enzymes. Features of active site. ES complex formation, Enzyme specificity. Factors affecting enzyme activity. Basics of Enzyme kinetics. MM and LB equation and

Significance of Km. Types of Enzyme inhibitions. Concept of Conjugated enzymes- Holoenzyme, Apoenzyme, prosthetic groups. Coenzymes of vitamins. Industrial applications of enzymes. (6L)

6. Hormones

Introduction to endocrine glands and their hormones. Biochemical nature of hormones, Mechanism of action of lipophilic and hydrophilic hormones.

References

1. Lehninger's Principles of Biochemistry, by Nelson and Cox Macmillan Publisher 4th Edn.
2. Biochemistry by U. Satyanarayana
3. Harper's Illustrated Biochemistry, 26th Edition
4. Biophysical techniques by Upadhyay and Nath, 3rd revised edition.
5. Organic Chemistry, Morrison, R. T. & Boyd, R. N.
6. Organic Chemistry (Volume 1) Finar, I. L.
7. Organic Chemistry (Volume 2) Finar, I. L.

Learning Outcome:

1. **Introduction to molecular logic of life.** The student will understanding of Cell types, Difference between a bacterial cell, Plant cell and animal cell. Biological composition and organization of cell membrane, structure and function of various cell organelles of plant and animal cell. Concepts of biomolecules, Bonds that link monomeric units to form macromolecules
2. **Carbohydrates:** The student will understand the types of carbohydrates and their biochemical significance in living organisms, structure of carbohydrates and reactions of carbohydrates with Glucose as example. Properties of carbohydrates.
3. **Lipids:** The student needs to know the types of lipids with examples, structure of lipids, properties of lipids
4. **Amino acids and proteins:** The student will understand the structure and types of amino acids. Reactions of amino acids. Properties of amino acids. Peptide bond formation. Types of proteins. Structural features in proteins. Effect of pH on structure of amino acid, Determination of N and C terminus of peptide chain.
5. **Enzymes:** The student know the classes of enzymes with subclasses and examples. Enzyme specificity, Equations of enzyme kinetics Km and its significance, features of various types of enzyme inhibitions, industrial applications of enzymes.

6. **Hormones:** Basic concepts of Endocrinology. Types of Endocrine glands and their hormones. Biochemical nature of hormones. Mechanism of action of lipophilic and hydrophilic hormones.

DSEC-III: CH-509: Organic Chemistry Practical-I [Credit -2, 73 L]

Total 12 Experiments to be performed

A) Separation of Binary Mixtures and Qualitative Analysis (Any Six)

a) Solid-Solid (3 Mixtures) b) Solid-Liquid (2 Mixtures) c) Liquid-Liquid (1 Mixture) At least one mixture from each of the following should be given-Acid-Base, Acid- Phenol, AcidNeutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral- Neutral. (Solid-solid mixtures must be insoluble in water)

B) Preparations

a) Green Chemistry Preparations (Any Two)

1. Preparation of dibenzalpropanone from benzaldehyde and acetone using $LiOH.H_2O/NaOH$
2. Nitration of phenol or substituted phenols using $CaNO_3$.
3. Bromination of acetamide using ferric ammonium nitrate and KBr in aqueous medium.

b) Organic Preparations (Any Two)

1. Preparation of 1, 4- dihydropyrimidinone from ethyl acetoacetate, benzaldehyde and urea using oxalic acid as catalyst.
2. Preparation p-Iodonitrobenzene from p-Nitroaniline by Sandmeyer Reaction
3. Preparation P-chloro benzoic acid and p-chloro benzyl alcohol from p-chloro benzaldehyde.

C) Preparations of Organic Derivative (Any Two)

1. Amide derivative of Carboxylic acid
2. Glucosazone derivative of Glucose
3. Paracetamol from p-Aminophenol

Imp. Note: At the time of practical examination candidate should perform complete analysis of one binary mixture OR One preparation and one preparation of organic derivative.

- To develop skills required in chemistry such as the appropriate handling of apparatus and chemicals.
- The student will learn the laboratory skills needed to design, safely conduct and interpret chemical research.
- To expose the students to an extent of experimental techniques using modern instrumentation.
- The student will develop the ability to effectively communicate scientific information and research results in written and oral formats.

Learning Outcomes:

A) Separation of Binary Mixtures and Qualitative Analysis The students will be able to

1. Perform the quantitative chemical analysis of binary mixture, explain principles behind it.
2. Separate, purify and analyse binary water insoluble mixture.
3. Separate, purify and analyse binary water-soluble mixture.
4. Understand the techniques involving drying and recrystallization by various method.
5. Familiarize the test involving identification of special elements.
6. Learn the confirmatory test for various functional groups.

B) Preparations The students will be able to

1. Systematic working skill in laboratory will be imparted in student.
2. Learn the basic principles of green and sustainable chemistry.
3. Synthesis of various organic compounds through greener approach.
4. Do and understand stoichiometric calculations and relate them to green process metrics.
5. Learn alternative solvent media and energy sources for chemical processes.
6. Learn the preparations of derivative various functional groups aspects of electrical experiments.
7. Understand the techniques involving drying and recrystallization by various method
8. Expertise the various techniques of preparation and analysis of organic substances
9. Understand principle of Thin Layer Chromatographic techniques.
10. Understand the purification technique used in organic chemistry.

SEC-I: CH-510: Skills Enhancing Course-I [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-510 (A) : Introduction to Medicinal Chemistry

Chapter No.	Title	Number of Lectures
1	An Introduction to Drugs, their Action and Immunobiologicals	08
2	Bio-physicochemical Properties in Drug Action and Design	08
3	Drugs for Infectious Diseases	12
4	Drugs for Non -infectious Diseases	08
	Total	**36**

1. An Introduction to Drugs, their Action and Immunobiologicals (8L)

A. Introduction, Need of new drugs, Historical background of drug discovery and design, Sources of drugs, Classification of drugs, Introduction to drug action

(Ref.1 Pages 37-53, Ref.2 Pages 4-11, Ref.4 Pages 4-9)

B. Immunobiologicals: Vaccines: Introduction, Methods of vaccine production: Inactivated pathogens, Live/Attenuated Pathogens and Cellular Antigen from a pathogen, SARS-CoV-19

(Ref.3 Pages 165-168, Ref.9, Ref.10)

2. Bio-physicochemical Properties in Drug Action and Design (8L)

Introduction, Acidity/Basicity, Solubility, Ionization, Hydrophobic and hydrophilic properties, Lipinski Rule, **Terminology in Medicinal Chemistry:** Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, antimetabolites and therapeutic index. Importance of stereochemistry in drug action (Example: Ibuprofen), Concept of rational drug design: Structure activity relationship, Drug-receptor understanding

(Ref.1 Pages 57-75, 95-96 Ref.2 Pages 189-274, 384-392, Ref.4 Pages 29-61)

3. Drugs for Infectious Diseases (12L)

Introduction, Structures, Mode of Action and Applications:

A. Antimicrobial Agents: Classification on i) Type of action: Bacteriostatic and Bactericidal ii) Source (Natural, Synthetic and Semisynthetic) iii) Spectrum of activity: Narrow and Broad Spectrum iv) Chemical structure: β-lactams (Penicillin), Macrolides (Azithromycin), Sulphonamides (Sulfadiazine), and Tetracyclins (Chlortetracycline)

B. Anti-fungal and anti-viral agents: Example: Amphotericin-B, Acyclovir

(Ref.1 Pages 131-157, Ref.2 Pages 413-472, Ref.3 Pages 258-308, Ref.4 Pages 191-228)

4. Drugs for Non-infectious diseases (8L)

Introduction, Structures, Mode of Action, and Applications:

A. i) Anti-inflammatory and Analgesic Agents: Example: Aspirin, Paracetamol, and Ibuprofen, **ii) Psychoactive Agents:** Sedatives and Hypnotics: Example: Benzodiazepines,

B. Metallodrugs as Chemotherapeutic Agents: Examples: Aluminium based antacids, Salvarsan, Cis Platin, and Transition Metal Complexes

(Ref.3 Pp 443-457, 509-515,637-647, 776-792, Ref. 5, Ref.6, Ref.7, Ref. 8 Pp.69-70,481-491)

References:

1. Fundamentals of Medicinal Chemistry by Gareth Thomas, University of Portsmouth, UK.
2. An Introduction to Medicinal Chemistry, Patrick, G. Oxford. University Press (Vth Edition).
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical, Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale.
4. Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke, William O. Foye (VIIth Edition), Kluwer publication.

SEC-II: CH-511: Skills Enhancing Course-II [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-511 (A) : Environmental Chemistry

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Concepts and Scope of Environmental Chemistry	06
2	Hydrosphere and Water Pollution	10
3	Analytical Techniques in water Analysis	10
4	Water pollution and treatment methods	10
	Total	**36**

1: Concepts and Scope of Environmental Chemistry (06L)

Introduction, Environmental Pollution and Classification, Units of concentration, Segments of Environment, Biogeochemical cycles of C, N, P, S and O system

Reference: 1, 2, 3

Aims and objectives: -Students should know:

i. Importance and conservation of environment.

ii. Importance of biogeochemical cycles

2: Hydrosphere and Water Pollution (10L)

Water resources, Hydrological Cycle: stages of hydrological cycle and chemical composition of water bodies, Microbially mediated aquatic reactions, Classification of water pollutants Organic and Inorganic pollutants, Sewage and Domestic waste, Sediments, Detergents, Pesticides, Eutrophication, Sampling and monitoring water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

Reference: 1 Page no -47-62,

Aims and Objectives:- Students should know:

i. Water resources

ii. Hydrological Cycle

iii. Organic and inorganic pollutants

iv. Water quality parameters

3. Analytical Techniques in water Analysis (10 L)

Water quality parameters and standards, domestic water quality parameters, surface water, sampling, preservation, Monitoring techniques and methodology (pH, conductance, DO, ammonia, nitrate and nitrite, Cl, F, CN, Sulfide, sulphate, phosphate, total hardness, boron, metals and metalloids- As, Cd,

Cr, Cu, Fe, Pb, Mn, Hg (Exclude polarographic and AAS methods), COD, BOD, TOC, phenols pesticides, surfactants, tannis and lignins, E. Coli, Case studies of water pollution.
Ref-1: 225-278

4. Water pollution and treatment methods **(10 L)**

Water pollutants, Eutrophication, Waste water treatment (domestic waste water, aerobic treatment anaerobic treatment, upflow aerobic sludge bed, industrial waste water treatment, drinking water supplies, Trace elements in water, chemical speciation (Cu, Pb, Hg, As, Se, Cr)
Ref-1: 167-225

Reference-1: Environmental Chemistry – A. K. De, Third Edition (Wiley)

Additional References:

1. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
2. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
3. Environmental Chemistry – H. Kaur 2nd Edition 2007, Pragati Prakashan, Meerut, India
4. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
5. Basic Concepts of Analytical Chemistry: S. M. Khopkar, Wiley Eastern (1995)

CH-511 (B) : Cheminformatics

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to Cheminformatics	02
2	Representation of Molecules and Chemical Reactions	10
3	Searching Chemical Structures	06
4	Applications of Cheminformatics	18
	Total	36

1. Introduction to Cheminformatics **[02L]**

1.1. History and progression of cheminformatics
1.2. Significance of cheminformatics
1.3. Prospects of cheminformatics and Molecular Modelling

Learning Outcomes:

1. Students should understand the significance of cheminformatics in the modern practices of chemical science
2. Students should learn the necessity of cheminformatics in chemical science

Ref. 2. (Page no. 4-11 and relevant pages)

2. Representation of Molecules and Chemical Reactions: **[10L]**

2.1. Nomenclature

Semester-VI

DSEC-IV: CH-601 : Physical Chemistry-II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Electrochemical Cells	16
2	Crystal structure	10
3	Nuclear Chemistry	10
	Total	36

[16 L]

1. Electrochemical Cells

Electrochemical cells, reversible and irreversible cells with examples, The e.m.f. of electrochemical cell and its measurement, The Weston standard cell, Reference electrodes: The primary reference electrode and Secondary reference electrodes, The Nernst equation for E.M.F. of a cell. Types of reversible electrodes, the sign convention for electrode potentials, Thermodynamics of reversible cells and reversible electrodes, E.M.F. and equilibrium constant of cell reaction, Electrochemical series, Types of concentration cells, liquid junction potential, salt bridge, Applications of emf measurements: 1. Determination of pH of a solution by using hydrogen electrode, quinhydrone electrode and glass electrodes 2. Potentiometric titrations: i) Acid-base titrations, (ii) Redox titrations. (iii) Precipitation titration, Batteries: Primary and Secondary batteries, applications for Secondary Batteries, Fuel Cells: Types of fuel cells, advantages, disadvantages of fuels cells, comparison of battery Vs fuel cell

Expected learning Outcomes:

After studying this chapter, the student will be able to know and understand:

1. Electrochemical cells: Explanation of Daniell cell, Conventions to represent electrochemical cells
2. Thermodynamic conditions of reversible cell, Explanations of reversible and irreversible electrochemical cell with suitable example,
3. EMF of electrochemical cell and its measurement.
4. The Weston standard cell
5. The primary reference electrode: The standard hydrogen electrode (SHE) with reference to diagram, Construction, representation, working and limitation,
6. Secondary reference electrodes: (a) The calomel electrode, (b) The glass electrode (c) The silver-silver chloride electrode. Understanding of these electrodes with reference to diagram, representation, Construction, working

7. Nernst Equation for theoretical determination of EMF
8. Types of Reversible electrodes: Metal-metal ion electrodes, Amalgam electrodes, Gas electrodes, Metal-metal insoluble salt electrodes, Oxidation-reduction electrodes with respect to examples, diagram, representation, construction, working (electrode reactions) and electrode potential.
9. Sign convention for electrode potentials and Electrochemical series
10. Standard electrode potentials,
11. Types of concentration cells: Concentration cells without and with transference Concentration cells with liquid junction potential
12. Liquid junction potential and salt bridge
13. Applications of emf measurements: 1. Determination of pH of a solution by using hydrogen electrode, quinhydrone electrode and glass electrodes 2. Potentiometric titrations: i) Acid-base titrations, (ii) Redox titrations and (iii) Precipitation
14. Primary Batteries: Dry Cells, alkaline batteries with respect to construction, diagram and working
15. Secondary Batteries: Nickel-cadmium, Lithium-ion batteries, the lead acid battery with respect to construction, diagram and working
16. Applications for Secondary Batteries
17. Fuel Cells: Types of fuel cells, advantages, disadvantages of these fuels cells, comparison of battery Vs fuel cell
18. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)., (Page No: 1154-1178)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 835-880)
3. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000, (Page No: 320-412)
4) Modern Electrochemistry Second Edition by John O'M Bockris, Molecular Green Technology College Station, Texas and Amulya K. N. Reddy, President International Energy Initiative Bangalore, India, (Page No: 1789-1888)

2. Crystal structure

Types of Solids: Isotropy and Anisotropy, Laws of crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of crystal symmetry, Weiss indices and Miller indices, Crystal Structure: Parameters of the Unit Cells, Cubic Unit Cells: Three Types of Cubic Unit Cells, Calculation of Mass of the Unit Cell, Methods of Crystal structure analysis: The Laue method and Braggs method: Derivation of Bragg's equation, Determination of crystal structure of NaCl by Bragg's method, X ray analysis of NaCl crystal system, Calculation of d and λ for a crystal system, Numerical. **[10 L]**

Expected learning Outcomes:

After studying this topic students are expected to know and understand:

1. Distinguish between crystalline and amorphous solids / anisotropic and isotropic solids.
2. Explain the term crystallography and laws of crystallography.
3. Weiss and Millers Indices, determination of Miller Indices
4. Bravais lattices, space groups, seven crystal systems and fourteen Bravais lattices;
5. Cubic lattice and types of cubic lattice
6. Distance between the planes for 100, 110 and 111 for cubic lattice
7. Methods of Crystal structure analysis: The Laue method and Braggs method: Derivation of Bragg's equation,
8. Determination of crystal structure of NaCl by Bragg's method,
9. X ray analysis of NaCl crystal system and Calculation of d and λ for a crystal system,
10. Problems

Reference books:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).,(Pp: 491-507, 518-528)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 1165-1180)

[10L]

3. Nuclear Chemistry

Radioactivity, Types of Radiations, Properties of Radiations, Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter and Film Badges, Nuclear structure, Classification of nuclides, Types of Radioactive Decay, The Group Displacement Law, Kinetics of Radioactive Decay, Half-life, average life, Energy released in nuclear reaction, Mass Defect, Nuclear Binding Energy, Some applications of radio-isotopes as tracers: Chemical investigation – Esterification, Friedel -Craft reaction, Structural determination – Phosphorus pentachloride, Age determination – use of tritium and C^{14} dating, Problems

Expected learning Outcomes:

After studying this topic students are expected to know

1. Radioactivity
2. Types and properties of radiations: alpha, beta and gamma
3. Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter, Film Badges

4. Types of radioactive decay: α- Decay, β-Decay and γ-Decay
5. The Group Displacement Law, Radioactive Disintegration Series
6. Kinetics of Radioactive Decay, Half-life, average life and units of radioactivity
7. Energy released in nuclear reaction: Einstein's equation, Mass Defect, Nuclear Binding Energy,
8. Application of radioisotopes as a tracer: Chemical investigation- Esterification, Friedel - Craft reaction and structure determination w.r.t PCl_5, Age determination use of tritium and C^{14} dating.
9. Solve the problems based on this topic

Reference books:

1. Elements of Nuclear Chemistry by H.J. Arnikar
2. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)., (Page No: 117-145)

Additional Reference Books:

1) Physical Chemistry by G. M. Barrow, International student Edition, Mc Graw Hill.
2) University General Chemistry by C.N.R. Rao, Macmillan.
3) Physical Chemistry by, R. A. Alberty, Wiley Eastern Ltd.
4) The Elements of Physical Chemistry by P. W. Atkins, Oxford.
5) Principles of Physical Chemistry by S. H. Maron, C. H. Prutton, 4thE dition.
6) Principles of Physical Chemistry by Puri, Sharma, Pathania,
7) Chemical applications of radioisotopes by H.J.M. Brown
8) Source book of Atomic energy by S. Glasstone and D. Van .
9) Modern Electrochemistry Second Edition by John O'M Bockris Molecular Green Technology College Station, Texas and Amulya K. N. Reddy President International Energy Initiative Bangalore, India, Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow

DSEC-IV: CH-602 : Physical Chemistry-III [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Colligative properties of dilute solutions	09
2	Kinetics of Reactions in the Solid State	09
3	Electronic structure and macroscopic properties	08
4	Polymers	10
	Total	36

1) Colligative properties of dilute solutions (09L)

Introduction, Solution, electrolytes and nonelectrolytes, Meaning of term colligative property, relative lowering of vapour pressure of solvent in solution, elevation of B.P. of solvent in solution, Landsberger's method, freezing point depression, Beckmann's method, Osmosis and Osmotic pressure, Berkeley and Hartley method, application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight, Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property, Numerical.

Expected learning Outcomes:

After studying this topic students are expected to know

1. Meaning of the terms-Solution, electrolytes, nonelectrolytes and colligative properties,
2. Lowering of vapour pressure of solvent in solution,
3. Elevation of B.P. of solvent in solution, Landsberger's method,
4. freezing point depression, Beckmann's method Osmosis and Osmotic pressure, Berkeley and Hartley method,
5. Application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight,
6. Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property,
7. Problems.

Reference books:

3) Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 778 - 800)
4) Essential of Physical Chemistry, Bahl and Tuli (S. Chand). (Page No: 614 - 684)

2) Kinetics of Reactions in the Solid State: (09L)

Some General Considerations, Factors affecting reactions in Solids, Rate Laws for Reactions in Solids , The Parabolic Rate Law, The First-Order Rate Law, The Contracting Sphere Rate Law, The Contracting Area Rate Law, The Prout–Tompkins Equation, Rate Laws Based on Nucleation, Applying Rate Laws, Results of Some Kinetic Studies, The Deaquation-Anation of $[Co(NH_3)_5H_2O]Cl_3$, Two Reacting Solids

Expected learning Outcomes:

1. Factors affecting on solid state reactions,
2. Rate laws for reactions in solid state
3. Applying rate laws for solid state reactions
4. Results of kinetics studies

Reference books:

1) Principles of James E House, Second Edn, (Page nos: 229 to 262)
2) Principles of Physical Chemistry by Puri, Sharma, Pathania,
3)Essential of Physical Chemistry, Bahl and Tuli (S. Chand).

3) Electronic structure and macroscopic properties **(08L)**

Cohesive energy in ionic crystals, electronic structure of solids, conductors and insulators, Ionic crystals, semiconductors, cohesive energy in metals.

Reference books:

1. Castellan, G.W. Physical Chemistry Third edition (1993) , Addision –Wesley Publishing Co. (Page Numbers 709-719)

Expected learning Outcomes:

1. Cohesive Energy of ionic crystals based on coulomb's law and Born Haber Cycle
2. Correspondence between energy levels in the atom and energy bands in solid
3. Band structure in solids – Na , Ca and diamond
4. Conductors and insulators – Its correlation with Extent of energy in energy bands
5. phenomena of photoconductivity
6. Semiconductors – Role of impurity in transformation of insulator into semiconductor
7. Temperature dependant conductivity semiconductors
8. Cohesive Energy in metals
9. Numericals based on cohesive energy

4) Polymers

Introduction to Polymer Chemistry, Brief History, Polymer definition, Preparation, Classification, Structures, Chemical bonding & Molecular forces in Polymers. Ref. 1: Pages 1-14, Ref. 2: Pp. 1-16 **(10L)**

Molecular weights of polymers: Average Molecular weight, Number Average & Weight Average Molecular weight, Molecular weight & degree of polymerisation, Practical significance of polymer molecular weights, b) Molecular weight determination by End Group Analysis & Viscosity method and c) Problems based on Number Average & Weight Average Molecular weight Ref. 1: Pages 86-89, 92, 96-98, 402-409

References

Polymer Science by V.R. Gowarikar, N.V. Vishvanathan, Jaydev Shreedhar New Age International Ltd. Publisher 1996.(Reprint 2012)
Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiely-Interscience Publication John Wiely& Sons New York 1984. (Reprint 2008)

Expected learning Outcomes:

After studying this topic students are expected to know

1) History of polymers.
2) Classification of polymers
3) Chemical bonding & Molecular forces in Polymer
4) Molecular weight of polymers
5) Practical significance of polymer molecular weights
6) Molecular weight determination

Reference books:

1) Essential of Physical Chemistry, Bahl and Tuli (S. Chand). (Page No: 1 - 35)
2) Principles of Physical Chemistry by Puri, Sharma, Pathania, (Page No: 9-23)

Other Reference Books:

1. Atkins' Physical Chemistry by Peter Atkins Professor of Chemistry, University of Oxford, and Fellow of Lincoln College, Oxford Julio de Paula Professor and Dean of the College of Arts and Sciences Lewis and Clark College, Portland, Oregon
2. Barrow, G.M. Physical Chemistry Tata McGraw-Hill (2007).
3. Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry Cengage Learning India Pvt. Ltd., New Delhi (2009).
4. Mahan, B.H. University Chemistry 3rd Ed. Narosa (1998).

DSEC-IV: CH-603 : Physical Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed.

1. Potentiometry (any five)

1) To determine the PKa value of given monobasic weak acid by potentiometric titration.
2) To determine the formal redox potential of Fe_2+/ Fe_3+ system potentiometrically.
3) To determine the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
4) To determine the solubility product and solubility of AgCl potentiometrically using chemical cell.
5) Estimate the amount of Cl-, Br- and I- in given unknown halide mixture by titrating it against standard AgNO3 solution (mixture of any two ions).
6) To prepare standard 0.2 M Na2HPO4 and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pH value of these and unknown solution.

7) To determine the composition of Zinc ferrocyanide complex potentiometrically
8) To determine the standard electrode potentials of Cu and Ag electrodes and to determine the EMF of a concentration cell.

2. pH metry (any three)

1) To determine the degree of hydrolysis of aniline hydrochloride.
2) To determine the dissociation constant of oxalic acid by pH-metric titration with strong base.
3) Determination of Pka of given weak acid by pH metry titration with strong base
4) To determine the acid and base dissociation constant of an amino acid and hence the isoelectric point of an acid.
5) pH metric titration of strong acid against strong base by pH measurement and hence determine the concentration and strength of strong acid.

3. Radioactivity (any one)

1) To determine plateau voltage of the given G M counter.
2) To determine the resolving time of GM counter.
3) To determine Emax of beta particle

4. Colligative properties (any one)

1. To determine the molecular weight of solute by depression in freezing point method
2. To study the association of Benzoic acid in benzene by Beckmann Method
3. Determine the molecular weight of given electrolyte and non-electrolyte by Landsberger's method and to study the abnormal molecular weight of electrolyte

5. Turbidometry: (any one)

1. Determination of SO_4^{2-} and Cl^- by turbidimetric method (turbidimetric titration or calibration curve method)
2. To determine the molecular weight of a given polymer by turbidometry

6. Table work

1.Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

Reference Books:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co.,

DSEC-V: CH-604 : Inorganic Chemistry -II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Organometallic Chemistry	08
2	Homogeneous and Heterogeneous catalysis	10
3	Bioinorganic Chemistry	08
4	Inorganic Polymers	05
5	Inorganic solids/ionic liquids of technological importance	05
	Total	**36**

[8L]

1. Organometallic Chemistry

Definition of Organometallic compounds and Organometallic chemistry, CO as a π-acid donor ligand, binary metal carbonyls, classification of metal carbonyls, synthesis of metal carbonyls; (a) Direct reaction (b) Reductive carbonylation (c) Photolysis and thermolysis. Hepticity, Molecular and electronic structures of binary metal carbonyls, Electron count in complexes (18 electron rule). Applications of organometallic compounds in industrial catalysis (list of examples). Chemistry of ferrocene; Introduction, synthesis and physical properties of ferrocene. Reactions of ferrocene such as Friedel-Craft Acylation, Friedel-Craft Alkylation, Mannich reaction, Nitration and Halogenation.

[Further Reading: Student should also read about the interaction of different organic ligands with metals and their possible bonding.]

Aim and Objectives: Students should be able:

i. To understand M-C bond and to define organometallic compounds
ii. To define organometallic chemistry
iii. To understand the multiple bonding due to CO ligand.
iv. To know methods of synthesis of binary metal carbonyls.
v. To understand the structure and bonding using valence electron count (18 ele. rule)
vi. To understand the catalytic properties of binary metal carbonyls.
vii. To understand the uses of organometallic compounds in the homogenous catalysis.
viii. Chemistry of ferrocene

References:

1. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Langford – Oxoford, 5th Edn., 1994, pp 534-542,553-564.
2. Concise Inorganic Chemistry by J. D. Lee (Relevant pages)
3. General Chemistry by Raymond Chang(Relevant pages)

4. Basic Organometallic Chemistry: Concepts, Syntheses and Applications of Transition Metals (CRC), B. D. Gupta and Anil J. Elias, Universities Press; 2nd Edition, 2013.

2. Homogeneous and Heterogeneous catalysis **[10L]**

Introduction to Catalysis, basic principles, activity and selectivity in catalysis, Types of catalysis, homogeneous vs. heterogeneous catalysis, importance of catalysis in the synthesis of high value chemicals.

Homogeneous catalysis: catalytic cycles for following reactions: a) Hydrogenation of olefins using Wilkinson complex, b) Hydroformylation of olefins using Cobalt and Rhodium complexes, c) Carbonylation reaction: methanol to acetic acid process i.e. Monsanto processes and d) C-C coupling reactions: Heck reaction. **[References 1 to 3]**

Heterogeneous catalysis: History of the development of industrial heterogeneous catalysis, Classification of heterogeneous catalysts, supported metal catalyst, Role of support, Promoters and Poisons. Catalytic processes viz., a) Hydrogenation of olefins using Raney Nickel catalyst, b) Zeolites in catalysis: Catalytic cracking, c) Biodiesel synthesis using Heteropolyacids (HPAs) d) Automotive Exhaust catalysts: The catalytic converters. **[Reference 5 to 6]**

[Further reading: Student should also read about advanced development in the field of homogeneous and heterogeneous Catalysis.]

Aims and objectives: A student should be able to:

i. Understand the phenomenon of catalysis, its basic principles and terminologies.
ii. Define and differentiate homogeneous and heterogeneous catalysis.
iii. Give examples and brief account of homogeneous catalysts.
iv. Understand the essential properties of homogeneous catalysts-Give the catalytic reactions for Wilkinson's Catalysis, hydroformylation reaction, Monsanto acetic acid synthesis, Heck reaction
v. Understand the principle of heterogeneous catalyst and development in it.
vi. Give examples of heterogeneous catalysts.
vii. Understand the classification and essential properties of heterogeneous catalysts.
viii. Give the brief account of Hydrogenation of olefins , Zeolites in catalysis, biodiesel synthesis, Automotive Exhaust catalysts
ix. Understand the catalytic reactions used in industries around.

References:

1. Homogeneous Catalysis: The Applications and Chemistry of Catalysis by Soluble Transition Metal Complexes, G.W. Parshall and S.D. Ittel, Wiley, New York 1992.

2. Inorganic Chemistry D.F. Shriver and P.W. Atkins, 5th Edn, Oxford University Press, 2010, Chapter 26 pp690-721.
3. Homogeneous Catalysis: Mechanisms and Industrial Applications, S. Bhaduri and D. Mukesh, Wiley, New York, 2000.pp 13-23, 55-61,85-102, 161-163
4. Catalysis: Concepts and Green Applications: Gadi Rothenberg, Wiley-VCH; First edition, 2015 Relevant pages.
5. Heterogeneous catalysis in industrial practice, Chaerls N. Shatterfield, second edition, Krieger Publishing Company, Florida USA pp 1-16, 87-112, 203-205, 222-224.
6. Heterogeneous catalysis by B. Vishwanathan and D. K. Chakrabarty , New Age International Private Limited, 2007 (Relevant pages) **[8 L]**

3. Bioinorganic Chemistry

I. Introduction, Role of metals in bioinorganic chemistry, Classification as enzymatic and non-enzymatic metals, enzymatic redox metals such as Cu (SOD) and enzymatic non-redox metals such as Zn (Hydrolase). Role of metal ions in non-enzymatic processes-Na, K, Ca, Mg (one example of each and brief discussion). Role of metals in enzymatic processes-Transition metals-Catalase, peroxidase and nitrogenase (Redox active). II. Metalloproteins-Iron proteins-Introduction of Fe-S proteins, Electron transfer proteins (Fe-S, Fe_2S_2, Fe_3S_4, Fe_4S_4). Transport protein (transferrin) and Storage protein (ferritin) III. Bioinorganic Chemistry of Fe: Hemoglobin and myoglobin, its structure and functions and IV. Bioinorganic Chemistry of Co: Vitamin-B_{12}, its structure and function.

[Further Reading: Student should also read about the role of other metals and advanced development in the field of Bioinorganic Chemistry.]

Aims and objective- A student should:

i. Identify the biological role of inorganic ions & compounds.
ii. Know the abundance of elements in living system and earth crust.
iii. Give the classification of metals as enzymatic and non-enzymatic.
iv. Understand the role of metals in non-enzymatic processes.
v. Know the metalloproteins of iron.
vi. Explain the functions of hemoglobin and myoglobin in O_2 transport and storage.
vii. Understand the toxicity of CN- and CO binding to Hb.
viii. Draw the structure of Vit.B_{12} and give its metabolism.

References:

1. Concise Inorganic Chemistry by J.D. Lee - 5th edition, Pages 353, 775, 779, 796-797.
2. Inorganic Chemistry,-D.F. Shiver & P.W. Atkins- C.H. Longford ELBS- 2nd Ed,782-806.

3. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, Panima Publishing Corporation, 1st Edn., Pages 1-13, 24, 285-290.

4. Inorganic Polymers [5L]

Introduction, Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicates, silicones, siloxanes, borazines, and phosphazenes.

Aims and objective: A student should be able to:

i. know thy types of Inorganic polymers
ii. comparison with organic polymers
iii. synthesis, structural aspects of Inorganic polymers
iv. understand the polymers of Si, B, Si and P
v. Inorganic polymers and their use.

References:

1. Inorganic polymer chemistry, Pimpalpure , jain, soni, Sahai, Pragati edition 2012, pages 1-7, 110-129, 179-186, 207-217
2. N. H. Ray, Inorganic Polymers, Academic Press (1978).
3. Inorganic Polymers, Second Edition James E. Mark Harry R. Allcock Robert West Oxford University Press, 2nd Edition, 2005.

5. Inorganic solids/ionic liquids of technological importance [5L]

Inorganic solids, Preparation of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel method and Hydro-thermal method. Introduction to Solid electrolytes, inorganic liquid crystals and their examples. Ionic liquids, synthesis and application of imidazolium and phosphonium based ionic liquids.

Further reading: student should also read about the advanced smart materials and green aspects of ionic liquids.

Aims and objective: A student should know:

i. Understand Preparation of inorganic solids by various methods,
ii. Inorganic liquid crystals
iii. Ionic liquids, their preparations, and their significance w.r.t green chemistry.
iv. Technological importance of ionic liquids,

Reference

1. Rodger, G.E. *Inorganic and Solid State Chemistry*, Cengage Learning, 2002.
2. Ionic Liquids: Industrial Applications for Green Chemistry, Robin D. Rogers, Kenneth R. Seddon, American Chemical Society, Washington, DC, USA.pp1-13, 30-41

DSEC-V: CH-605: Inorganic Chemistry -III [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Acid–Base and Donor–Acceptor Chemistry	08
2	Ionic Solids	10
3	Chemistry of Zeolites	08
4	Introduction to Nanochemistry	05
5	Chemical Toxicology	05
	Total	**36**

1. Acid–Base and Donor–Acceptor Chemistry [8 L]

Acid–Base Models as Organizing Concepts, Arrhenius Concept, Brønsted–Lowry Concept, solvent system concept, Lux Flood concept, Lewis Concept, Frontier Orbitals and Acid–Base Reactions, Hard and soft acids and bases, theory of hard and soft acids bases, Acid and base strength (proton affinity, acidity and basicity of binary hydrogen compounds, inductive effects, steric effect, strength of oxy acids, acidity of cations in aqueous solutions, non-aqueous solvents and acid and base strengths, super acids).

Aims and objectives: A student should:

1. Student will learn the concept of acid base and their theories.
2. They will also come to know different properties of acids and bases.
3. Strength of various types acids.
4. How acid and base strengths get affected in non-aqueous solvents.

Reference: Inorganic chemistry, Gary L Messler and Donald A Tar, Third Ed, Pearson publisher, pages: 67-178, 183 – 208. [10L]

2. Ionic Solids

Crystalline and amorphous solids, crystal structures simple cubic, body centered cubic and face centered cubic, Properties of ionic solids, packing arrangements of anions in an ionic solids, Voids in crystal structure- tetrahedral and octahedral, Ionic radius, Palings univalent and crystal radii, Conversion of univalent radii to crystal radii, problems based on conversion of radii, Radius ratio effect, Lattice energy, Born-Lande equation, Born Haber cycle and its applications, Schottky and Frenkel defect.

A student should:

1. Know the nature of solids.
2. Know the crystal structures of solids.

3. Draw the simple cubic, BCC and FCC structures.
4. Identify the C.N. of an ion in ionic solid.
5. Identify the type of void.
6. Know the effect of radius ratio in determining the crystal structure.
7. Be able to define Pauling's univalent radius and crystal radius.
8. Be able to solve simple problems based on Pauling's univalent radii and crystal radii.
9. Know how to draw Born-Haber cycle.
10. Be able to solve simple problems based on Born- Haber cycle.
11. Know the defects in Ionic solids.
12. Be able to differentiate between the defects.

Reference Books:

Ref. 1- Concise Inorganic Chemistry by J.D. Lee - 5th edition. Pages 32-61

Ref .2- Concept and Model of Inorganic Chemistry by Douglas–Mc Daniels - 3rd edition Pp 102-127.

Ref. 3 -New Guide to Modern Valence Theory by G.I. Brown - 3rd edition Pages 55-62

3. Chemistry of Zeolites

1. Historical Background, Natural and artificial Zeolites, **[8L]**

2. Zeolite Framework Types: Classification, Nomenclature, Database of Zeolite Structures, Channels, Building Units, Natural Tiles, Framework Density, Coordination Sequences

3. Zeolite Structures: Framework Composition, Extra-framework Species, Stacking Faults and Disorder

4. Synthesis of Zeolites: Introduction, Basic Zeolite Synthesis, Mineralizing Agents, Effects of water concentration, Gel preparation and crystallization, Structure Directing Agents (SDA)

5. Applications 1.Zeolites as Heterogeneous Catalysts: Critical Properties for Catalysis, Catalytic Applications, Zeolites for Fine Chemistry: Acylation and Alkylation Aromatic Hydrocarbons, 2. Zeolites for Adsorption and Separations

A student should:

1. Different Zeolite Framework Types and their classification
2. Zeolite synthesis and their structure
3. Application of zeolites

Reference:

1. Zeolites in Catalysis Properties and Applications Edited by Jiri Cejka, Russell E. Morris, Petr Nachtigall, The Royal Society of Chemistry 2017 pp 1-5, 19-25, 37-50, 73-79, 87, 412-414, 418

2. Chemistry of Zeolites and Related Porous Materials: Synthesis and Structure, Ruren Xu, Wenqin Pang, Jihong Yu, Qisheng Huo, Jiesheng Chen, John Wiley & Sons (Asia) Pvt. Ltd, 2007 **[5L]**

4. Introduction to Nanochemistry

Synthesis and Stabilization of Nanoparticles by Chemical Reduction, Reactions in Micelles, Emulsions, and Dendrimers. Photochemical and Radiation Chemical Reduction, Cryochemical Synthesis, Physical Methods. Particles of Various Shapes and Films, Properties and Application of Nanoparticles in Science and Technology (in bief), Applications of CNTs

Reference:

1. Nanochemistry, G.B.Sergeev, Elsevier, 2006, pp 7-36, 175-83,199-201

2. The Chemistry of Nanomaterials C. N. R. Rao, A. Muller, A. K. Cheetham (Eds.) WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2004. (Relevant pages)

A student should:

1. Various methods of nanoparticle synthesis
2. Stabilization of Nanoparticles in solution
3. Properties and Application of Nanoparticles
4. Know about carbon nanotube and its application **[5L]**

5. Chemical Toxicology

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes. Biochemical effect of Arsenic, Cadmium, Lead and Mercury. Biological methylation.

A student should be able -

i) To know toxic chemical in the environment.
ii) To know the impact of toxic chemicals on enzyme.
iii) To know the biochemical effect of Arsenic, Cd, Pb, Hg.
iv) To explain biological methylation.

Reference:

i) Fundamental Chemistry by A. K. De (3rd Ed.)

ii) Environmental chemistry by A.K.De Publisher- Wiley Eastern Limited New Age International Limited Page No. 75-100.

DSEC-V: CH-606: Inorganic Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed.

A. Volumetric Estimations (Any 3)

1. Analysis of Phosphate (PO_4^{3-}) from Fertilizer. (Ref-1)
2. Analysis of Iodine from Iodized salt.(Ref-2)

3. Strength of medicinal H_2O_2. (Ref-1)
4. Analysis of Calcium from milk powder. (Ref-1)
5. Analysis of Cu from Cu-Fungicide. (Ref-1)

B. Flame Photometry (Any 3) (Ref-1)

1. Estimation of Na by flame photometry by calibration curve method.
2. Estimation of Na by flame photometry by regression method.
3. Estimation of K by flame photometry by calibration curve method.
4. Estimation of K by flame photometry by regression method.

C. Column Chromatography (any 1) (Ref-1)

1. Purification of water using cation/anion exchange resin and analysis by qualitative analysis /conductometry.

D. Nanomaterial synthesis (Any 1) (Ref-3, 4)

1. Synthesis of Silver nanoparticles.
2. Synthesis of ZnO nanoparticles.

E. Verification of periodic trends using solubility of alkaline earth metal hydroxides $Ca(OH)_2$, $Mg(OH)_2$, $Cr(OH)_2$, $Ba(OH)_2$. (Ref-1)

F. Synthesis of amine complexes of Ni(II) and its ligand exchange reaction (bidentate ligands like acac, DMG, Glycine) by substitution method.

OR

Determination of the Metal to ligand ratio (M : L) in complexes. (Ref-5)

G. Solvent free microwave assisted one pot synthesis of pthalocynin copper (II) complex.

OR

Fenton reaction: Degradation of H_2O_2 using Fe catalyst. (Ref-6)

H. Table work: Band gap calculation for the nanomaterial TiO_2/ SnO_2/ ZnO from its electronic spectra (UV-Visible). (Ref-3, 4)

References:

1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)
2: General Chemistry Experiment – Anil J Elias (University press).
3: Nanotechnology: Principles and Practices by Dr.Sulbha Kulkarni. Third Edition,Springer
4: A laboratory course in nanoscience and nanotechnology, Dr. Gerrad Eddy Jai Poinem, CRC press
5: Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horword Publishing, Chichester) 1999.

DSEC-VI: CH-607: Organic Chemistry-II [Credit -2, 36 L]

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Introduction to Spectroscopy	03
2	Ultra Violet and Visible Spectroscopy	06
3	Infra-Red Spectroscopy	08
4	Nuclear Magnetic Resonance Spectroscopy (PMR)	10
5	Combined problems based on U.V., I.R. and PMR spectroscopy	05
6	Stereochemistry of Disubstituted Cyclohexane and Decalin	04
	Total	**36**

1: Introduction to Spectroscopy **[03 L]**

Introduction, meaning of spectroscopy, Types of spectroscopy, nature of electromagnetic radiation and regions of electromagnetic spectrum, Terms used in spectroscopy; wavelength, amplitude, frequency, wavenumber, energy and their relations and conversions Ref 2: Page Nos. 43-55 Chapter

2: Ultra Violet and Visible Spectroscopy **[06 L]**

Introduction, Electromagnetic radiations, electronic transitions, λmax & εmax, chromophore, auxochrome, bathochromic and hypsochromic shifts, Application of visible, ultraviolet spectroscopy in organic molecules. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α, β – unsaturated compounds. Ref 1: Page Nos.367-398

3: Infra-Red Spectroscopy **[08 L]**

Introduction, Infrared radiation and types of molecular vibrations, functional group and fingerprint region. Infra-red spectroscopy in organic molecules, IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions). Ref 1: Page Nos 26-93

4: Nuclear Magnetic Resonance Spectroscopy (PMR) **[10 L]**

Introduction, Principles, Magnetic and nonmagnetic nuclei, nuclear resonance, chemical shift, shielding, & deshielding effect. Measurement of chemical shift, TMS as reference and its advantages, peak area, integration, spin-spin coupling, coupling constants, J-value , problems

based on NMR. Ref 1: Page Nos.108-175 and 225-366 Chapter 5: Combined Problems Based on U.V., I.R. and PMR Spectroscopy. [05 L] Ref 1: Page Nos. 501 to 567

5:Combined problems based on U.V., I.R. and PMR spectroscopy. **[05 L]**

Ref 1: Page Nos. 501 to 567

6: Stereochemistry of Disubstituted Cyclohexane and Decalin **[04 L]**

Recapitulation, Geometrical and optical isomerism of 1,3- dimethyl and 1,4-dimethyl cyclohexane with their stability and energy calculations. Conformations of decalin and their stability.

Ref.19: Pages 94, 213 - 216, 250. Ref.20: Pages 243 – 250, 289-292.

References:

1. Pavia D.L.; Lampman G.M. Kriz G. S.; Vyvyan J.R. Spectroscopy, First Indian Reprint 2008 : Brooks/Cole CENGAGE Learning.
2. Silverstein and Basallar: Spectroscopic Identification of Organic Compounds.
3. M. Parikh :Absorption Spectroscopy Organic Compounds (John Wiley)
4. P. S. Kalsi : Spectroscopy of organic compounds (New Age)
5. J. R. Dyer: Application of absorption spectroscopy of organic compounds.
6. V. M. Parikh:Application spectroscopy of Organic molecules. (Mehata)
7. D.W. Williams and Flemming: Spectroscopic methods of Organic compound.
8. Jackman and Sternineil: Application of NMR spectroscopy
9. J. D. Roberts:Nuclear magnetic resonance (J. Wiley)
10. Jaffe and Orchin: Theory and application of U. V.
11. K. Benjamin: Mass spectroscopy
12. Budsikiewicy et al.: Mass spectroscopy.
13. Beynon J H et al: The mass spectra of organic molecules.
14. W. Kemp: Organic spectroscopy ELBS
15. Atherben; Electron spin resonance
16. Das and Jame: Mass Spectroscopy.
17. Eliel: Stereochemistry of Organic Compounds, Tata Mc Graw Hill, 1989
18. D. Nasipuri: Stereochemistry of Organic Compounds- Principles and Applications, New Age International Publishers, 3rd edition.

Learning Outcomes

Chapter 1 to 5: Organic Spectroscopic Methods in Structure Determination. (Chapter 1-5)

Students will learn the interaction of radiations with matter. They will understand different regions of electromagnetic radiations. They will know different wave parameters.

1. Students will learn the principle of mass spectroscopy, its instrumentation and nature of mass spectrum.
2. Students will understand the principle of UV spectroscopy and the nature of UV spectrum. They will learn types of electronic excitations.
3. Students will be able to calculate maximum wavelength for any conjugated system. And from the value of λ-max they will be able to find out the extent of conjugation in the compound.
4. Students will understand the principle of IR spectroscopy, types of vibrations and the nature of IR spectrum.
5. From the IR spectrum, they will be able to find out IR frequencies of different functional groups. And thus, they will be able to find functional groups present in the compound.
6. Students will understand the principle of NMR spectroscopy and will understand various terms used in NMR spectroscopy. They will learn measurement of chemical shift and coupling constants.
7. Students will be able to interpret the NMR data and they will be able to use it for determination of structure of organic compounds.
8. Students will be able to determine the structure of simple organic compounds on the basis of spectral data such as λ max values, IR frequencies, chemical shift (δ values).

Chapter 6: Students should be able to learn

1. The use of models to draw different types of disubstituted cyclohexanes in chair form
2. The geometrical isomerism in disubstituted cyclohexanes
3. The stability, energy calculations and optical activity of these conformers
4. The use models and to draw different types of conformational isomers of decalin in chair form
5. To know the stability of geometrical isomers of decalin

DSEC-VI: CH-608: Organic Chemistry-III [Credit -2, 36 L]

Synthetic Organic Chemistry

Chapter No	Chapter	No of Lectures
1	Retrosynthetic Analysis and Applications	06
2	Organic Reaction Mechanism and Synthetic Applications	12
3	Reagents in Organic Synthesis	10
4	Natural Products	08

1. Retrosynthetic Analysis and Applications **[06 L]**

Introduction, Different terms used – Disconnection, Synthons, Synthetic equivalence, FGI, TM. One group disconnection, Retrosynthesis and Synthesis of target molecules: Acetophenone, Crotonaldehyde, Cyclohexene, Benzylbenzoate, and Benzyl diethyl malonate.

Ref 1: Page Nos. 1-34 Ref. 2: Page Nos. 694-722

2. Organic Reaction Mechanism and Synthetic Applications **[12 L]**

1. Chemistry of reactive intermediates (carbocations, carbanions, free radicals, carbenes, nitrenes, benzynes etc…);
2. Wolff rearrangement (Step up),
3. Hofmann rearrangement (Step down),
4. Simmons-Smith reaction,
5. Michael reaction,
6. Wittig reaction and McMurry reaction,
7. Diels-Alder reaction,
8. Functional group interconversions and structural problems using chemical reactions.

Ref 2 Page Nos. 1021-1022, 1009-1018, 500, 237-238, 982-983, 877-893

3. Reagents in Organic Synthesis

Reagents- Preparation and Applications of following reagents. **[10 L]**

Reducing Reagents: *Ref 2 Pages Nos. 226, 828, 131-132, 26, 39, 537*

Lithium aluminium hydride $LiAlH_4$, $NaBH_4$, DIBAL-H, $Li(tBuO)_3AlH$ & Raney Nickel.

Oxidizing Reagents: *Ref. 2 Page Nos. 545, 1123-1126, 919, 764*

1. DMSO either with DCC or Ac_2O, Dess Martin reagent, Osmium tetroxide, Selenium dioxide-(SeO_2), DDQ.

4. Natural Products

Ref 2: Page Nos. 1413-1447

[08 L]

Terpenoids: Introduction, Isolation, Classification. Citral- structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis.

Alkaloids: Introduction, extraction, Purification, Some examples of alkaloids and their natural resources. Ephedrine- structure determination using chemical methods.Synthesis of Ephedrine by Nagai.

Reference:

1.Designing Organic Synthesis by Stuart Warren 1983.
2.Organic Chemistry by Clayden, Greeves, Warren and Wothers.Second edition.
3.Organic Chemistry by I. L. Finar Vol. II Edn.V.
4.Organic Chemistry by Morrison and Boyd. VI Edn.
A Guidebook to Reaction Mechanism by Peter Sykes VI Edn.

DSEC-VI: CH-609: Organic Chemistry Practical-II [Credit -2, 73 L]

Total 12 Experiments to be performed

A) Interpretation of IR and NMR spectra (2 Experiments of each type)

1. Determination of functional group of organic compound from given IR spectra.
2. Determination of structure of organic compound from given NMR spectra.

(Ethyl alcohol, Cis-2-butene, Trans-2-butene, Benzoic acid, Propanaldehyde, Ethyl methyl ether, 1 Butyne, Ethyl acetate, Propyl Cyanide, Salicylic Acid, Nitro phenols, Isopropyl benzene, Propanamine, Benzamide, n-Pentane, 2-chloro butane, Acetophenone)

B) Organic Estimations (Any Three)

1. Estimation of glucose
2. Estimation of glycine
3. Saponification value of oil
4. Estimation of Alkali content in Antacid using HCl.

C) Organic Extractions (Any Three)

1. Caffeine from tea leaves
2. Eugenol from cloves
3. Lycopene from tomato peels
4. Cinnamic acid from cinnamon
5. Trimyristin from nutmeg

D) Column chromatography

1. Separation of mixture of aldehyde and carboxylic acid by column chromatography
2. Separation of mixture of *O*-nitrophenol and P-nitrophenol by column chromatography

Learning Outcomes:

A) Interpretations of IR and PMR Spectra The students will be able to

1. Explain "fingerprint region" of an infrared spectrum can used in the identification of an unknown compound.
2. Identify the functional group or groups present in a compound.
3. Identify the broad regions of the infrared spectrum in which occur absorptions caused by N–H, C–H, and O–H, C≡C and C≡N, C=O, C=N, and C=C.
4. Understand use NMR spectra to determine the structures of compounds.
5. Interpret integration of NMR spectra
6. Calculate coupling constants from 1 H NMR spectra.
7. Interpret elemental analysis technique

B) Organic Estimations The students will be able to

1. Practical knowledge of handling chemicals.
2. Achieve the practical skills required to estimations of glucose and glycine.
3. Achieve the practical skills required to Saponification value of oil.
4. Determine the molecular weight of given tribasic acids.

C) Organic Extractions The students will be able to

1. Apply the principles of extraction
2. Understand the equipment for extraction.
3. Gain practical hands-on experience of modern Extraction.
4. Develop basic design of extractor
5. Describe the extraction separation process.

D) Column chromatography The students will be able to

1. Defines the basic parameters in chromatography
2. Explain the processes of a chromatography analysis
3. Describes the types and materials of column.
4. Explains the types of mobile phase and elution.
5. Realize the selection of appropriate mobile phase, column and detector

SEC-III: CH-610: Skill Enhancing Course-III

Choose one out of the two options, A and B. **[Credit -2, 36 L]**

CH-610 (A) : Chemistry of Soil and Agrochemicals

Chapter No	Name of the Topic	Number of lectures
1	Soil Chemistry	6
2	Problematic Soil and Soil testing	6
3	Laboratory Methods of Soil Analysis	12
4	Fertilizers and Manures	6
5	Protection of Plants	6
	Total Lectures	**36**

1. Soil Chemistry **(6 L)**

1.1 Role of agricultural chemistry

1.2 Introduction to soil chemistry, definitions of soil, Soil components- Mineral component, organic matter or humus, soil atmosphere, soil water, soil microorganism.

1.3 Physical properties of soil- Soil texture, soil structure, soil colour, soil temperature, soil density, porosity of soil.

1.4 Surface soil and sub-soil, Functions of soil.

1.5 Chemical properties of soil - Soil reactions, importance of soil reaction, factors controlling soil reactions,

1.6 Buffer action, buffering capacity, importance of buffer reaction in agriculture, ion exchange and importance of ion exchange.

Ref 1- Pages 8-12, 92-94, 98-113, 116-146

Ref 3 - Pages 28-50

Ref 12 - Pages 211-224, 228-234

Ref 17 - Pages 49-56, 295-308, 357-370 **(06 L)**

2. Problematic Soil and Soil testing

2.1 Introduction to problematic soils.

2.2 Acid soils- formation of acid soil, effect of soil acidity on plant, reclamation of acidic soil, application of lime in improving the acidity of soil, lime requirements.

2.3 Alkali Soil- formation of alkali soil, reclamation of alkali soil.

2.4 Classification of alkali soil- saline soil, alkali soil, saline alkali soil, non-saline alkali soil.

2.5 Soil testing - Introduction, different methods of soil fertility evaluation.

2.6 Objectives of soil testing.

Ref 1- Pages 345-370

Ref 3 - 301-312

Ref 4 – Pages 135-147, 150-159 **(12 L)**

Ref 12 - Pages 237-246, 337-353

3. Laboratory Methods of Soil Analysis

3.1 Collection of soil Samples from field.

3.2 Soil sample preparation for analysis of various parameters.

3.3 Digestion and Extraction Procedures for soil.

3.4 Project/ Hands on training of Analysis of various parameters of soil and writing project on it.

(Note: Students can perform minimum six experiments out of eight in the laboratory with the help of teacher and write report on it and submit to subject teacher. It is considered for internal marks of this course).

1. Determination of pH of soil
2. Determination of EC and TDS of soil
3. Determination of soil organic matter of soil.
4. Determination of available nitrogen in soil.
5. Determination of available phosphorus from soil.

6. Determination of calcium and magnesium from soil by EDTA method.
7. Determination of sodium and potassium by flame photometry method.
8. Determination of carbonate and bicarbonates from soil.
9. Calculate the RSC, SAR, SSP, Salinity of soil. Interpretation of soil data and recommendations for soil use.

Ref 23 pages 11-160

Ref 25 pages 17-104

4. Fertilizers and Manures **(06 L)**

Fertilizers

4.1 Introduction, Classification of nitrogenous fertilizers, reaction of ammonium sulphate, urea as a fertilizer in soil.

4.2 Nano fertilizers- Nano-Fertilizers for Sustainable Crop Production, Nano urea- preparation, forms and application of nano urea.

4.3 Phosphatic fertilizers- Classification of phosphatic fertilizers, reactions of superphosphate as a fertilizer in soil.

4.4 Potassic fertilizers - Classification of potassic fertilizers, reactions of potash fertilizer in soil.

4.5 Complex fertilizers- Characteristics, advantages and disadvantages,

4.6 Mixed fertilizers - Characteristics, advantages and disadvantages.

4.7 Time and mode of applications of fertilizers in the solid and liquid form to plants.

4.8 Factors affecting efficiency of fertilizers.

Manures

4.9 Introduction, Definition and classification of manures.

4.10 Effect of bulky organic manures on soil.

4.11 Farm yard manures (FYM), improved methods of handling FYM- Trench method for FYM, Factors affecting the composition of FYM, losses during the handling and storage of FYM, Gober gas-compost plant - construction and advantages.

4.12 Biofertilizers - Definition, classification, role & advantages.

4.13 Vermicompost - Preparation, effect of vermicompost on soil fertility.

Ref 2- Pages 205-213,

Ref 3- Pages 90-112, 137-149

Ref 5 Pages Relevant pages

Ref 12 – Pages 263- 275, 280-290,

Ref 18 – URL: Attached in reference.

Ref 19 - URL: Attached in reference.

Ref 20 URL: Attached in reference.

5. Protection of Plants **(06 L)**

5.1 Classification of pesticides.

5.2 Insecticide- Definition, Classification on the basis of mode of action and chemical properties.

5.2.1 Inorganic insecticides - plants or animal origin insecticides- nicotine, pyrethrum, rotenone.

5.2.2 Synthetic organic insecticides – a) Organochlorine insecticides - DDT, BHC, Aldrin and dieldrin. b) Organophosphorus insecticides – Parathion, Malathion, c) Carbamate insecticides – Carbaryl, Baygon.

5.3 Fungicide – Definition and Classification of fungicides.

5.3.1 Inorganic fungicide- Copper fungicides a) Bordeaux mixture, b) Copper oxychloride.

5.3.2 Organic fungicides- Dithiocarbamate, Quinone fungicides, Heterocyclic fungicides.

5.3.3 Synthetic fungicides.

5.4 Herbicides- Definition, Classification on the basis of mode of action- Selective and non-selective herbicides, classification based on their effect on weeds- contact, systemic herbicides. Classification on the basis of their chemical structures.

5.5 Nano pesticides: Its Scope and Utility in Pest Management

Ref 6 - Relevant Pages

Ref 13 – Pages 80-177,

Ref 14 – Pages 73-110,

Ref 15 – Chapter 3 Pages 1-45

Ref 16 Pages 2-16,

Ref 19 URL: Attached in reference.

Ref 21 URL: Attached in reference.

Learning Objectives:

1) Know the different components and properties of soil.
2) Know classification of soil on the basis of pH.
3) Identify the problematic soil and recommend method for their reclamation.
4) Know the different plant nutrients required for plants and their functions.
5) Know the role of various fertilizers and manures required for plant growth.
6) Know the various methods and their techniques in analysis of soil.
7) Know importance of manures as compared to chemical fertilizers.

3. A. Poklis, Forensic toxicology in, *Introduction to Forensic Sciences*, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).Page No : 116-141

4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, *Techniques of Crime Scene Investigation*, CRC Press, Boca Raton (2013). Page No 323-337

5. THE NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES, ACT, 1985 https://legislative.gov.in/sites/default/files/A1985-61.pdf

6. THE NARCOTIC DRUGS SUBSTANCES AND PSYCHOTROPIC RULES, 1985 https://dor.gov.in/sites/default/files/Narcotic-Drugs-and-Psychotropic-Substances-Rules-1985_0.pdf

6. National Policy on NDPS Govt. of India https://dor.gov.in/narcoticdrugspsychotropic/national-policy-ndps

7.National Policy on NDPS & Punishment for Offences https://dor.gov.in/narcoticdrugspsychotropic/punishment-offences

8. J.W. Robinson, *Undergraduate Instrumental Analysis*, 5th Edition, Marcel Dekker, Inc., New York (1995). Page No : 721-797

9. Analytical Techniques in Forensic Science Rosalind Wolstenholme, Sue Jickells, Shari Forbes, edition first edition 2021 John Wiley & Sons Ltd Page No; 51-68

10. FORENSIC ANALYTICAL TECHNIQUES Barbara Stuart University of Technology, Sydney, Australia, first edition 2013 John Wiley & Sons, Ltd. 143-166

SEC-IV: CH-610: Skill Enhancing Course-IV [Credit -2, 36 L]

Choose one out of the two options, A and B.

CH-611(A): Analytical Chemistry-II

Chapter No.	Title of Topic/Chapter	No. of lecture
1	Solvent extraction	08
2	Instrumental Methods of Chromatographic Analysis	04
3	High Performance Liquid Chromatography	06
4	Gas Chromatography	06
5	Atomic Absorption Spectroscopy	08
6	Flame Emission Spectroscopy	04
	Total	**36**

1. Solvent extraction **(8 L)**

Introduction to solvent extraction, organic phase, Partition the theory of extraction (distribution coefficient, Distribution ratio, solute remaining unextracted, Separation coefficient), Factors favoring solvent extraction, Quantitative treatment to solvent extraction equilibrium, Ion association complexes, synergic extraction, some extraction reagent specifically used for inorganic ions (Acetylacetone, 8-Hydroxyquinoline, Diphenylthiocarbazone, Sodium diethyldithiocarbamate, Ammonium pyrrolidine dithiocarbamate), some practical aspects, Applications: determination of copper as the diethyldithiocarbamate complex, Determination of Fe(III) with 8-hydroxyquinoline, determination of nickel by synergistic extraction. Solid phase extraction (Ref-3) Numericals; **Key Reference-2**: 242- 253, [Supplementary Ref-3: 579-593] **(4 L)**

2. Instrumental Methods of Chromatographic Analysis

Principles of Chromatographic Separations, classification, Theory of Column Efficiency in Chromatography, (theoretical plate, rate theory of chromatography - the Van Deemter equation, efficiency and particle size in HPLC, retention factor efficiency and resolution, **Key Reference -4:** 603-617, Supplementary reference-3: 547-556. **(6 L)**

3. High Performance Liquid Chromatography

Introduction, Types of liquid chromatography (liquid-solid, liquid-liquid, bonded phases), Choice of mode of separation, Equipment for HPLC: mobile phase, sample injection and column design (mobile phase, optimization of mobile phase, gradient elution, solvent delivery and sample injection, sample injection system, the column (effect of column length and column diameter), Choosing the Detector, Ultraviolet detector, Luminescence detector, RI detector, electrochemical detector, Column efficiency, HPLC chromatogram and its characteristics (retention time, peak height, peak area), method of quantitative analysis by HPLC, Example: determination of aspirin, phenacetin and caffeine in a mixture, numerical, **Key Reference -2:** 289-315, [Supplementary reference - Ref-3: 649 – 724, Ref-6: 1-325 -relevant part **(6 L)**

4. Gas Chromatography

Introduction, Apparatus: A supply of carrier gas from a high-pressure cylinder, Sample injection system and derivatization, the column (Packed columns, Open tubular columns), the detector (properties, hot wire detector or TCD, FID, ECD), Quantitative analysis by GC (Area normalization method and internal standard addition method), Elemental analysis, numerical **Key Reference-2: 317- 337, [Supplementary reference - 7: 1-209 (relevant part)]** **(8 L)**

5. Atomic Absorption Spectroscopy

Introduction, Elementary theory, Instrumentation, flames, the nebulizer-burner system, non-flame techniques, (graphite furnace, cold vapour technique), resonance line sources, monochromator, detectors, interferences, chemical interferences, background correction

methods, Atomic absorption spectrophotometers, Experimental preliminaries (calibration curve methods, standard addition method) Preparation of sample (wet ashing, fusion, Dry ashing, microwave dissolution, concentration procedures), Detection limits, Estimation of Ca and Mg in water.

Key Ref-2: 612 – 643

6. Flame Emission Spectroscopy **(4 L)**

Introduction, emission spectra, flame emission spectroscopy, flame photometers. Evaluation methods, calibration curve procedure, the standard addition technique, Applications: determination of alkali metals by flame photometry, determination of tracc elements in contaminated soil by AAS. Numerical,

Key Reference-2: 645-649, 655-656

References:

Ref-1: Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (copublished with John Wiley Sons)

Ref-2: Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6th Ed, Pearson education

Ref-3: Analytical Chemistry by G. D. Christian, et al , Wiley, 6th Ed.

Ref-4: Principles of Instrumental Analysis: Holler, Skoog, Crouch 6th Ed. Thomson Publication

Ref-5: Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education

Ref-6: High performance Liquid Chromatography, (Analytical Chemistry through open learning series) Second Ed, Sandie Lindsay, Wiley

Ref-7: Gas Chromatography, (Analytical Chemistry through open learning series) 2nd Ed, Ian A. Fowlis, Wiley

Course outcome: After completion of the course student should able to

1. Define basic terms in solvent extraction, basics of chromatography, HPLC, GC, and AAS and AES. Some important terms are: solvent extraction, aqueous and organic phase, distribution ratio and coefficient, solute remain unextracted, percent extraction, ion association complex, theoretical plate, HETP, retention time, selectivity, resolution, stationary phase, normal and reverse phase, ion exchange, column efficiency, carrier gas, split and spitless injection, packed column, tubular column, atomic absorption and emission spectroscopy, electronic excitation in atoms, nebulization, atomization, reduction of metal ions in flame, absorbance by atoms in flame, flame atomizers, furnace atomizers, interference in AES and FES, HCL, hydride generator, etc.

M. Sc. [I]

Detailed Syllabus:

Semester-I

CCTP-1: CHP-110, Physical Chemistry-I, Semester - I

(Fundamentals of Physical Chemistry) (4 Credits)

SECTION - I (2 Credits, 24 L, 6T)

1.Thermodynamics **(05 L)**

State function, path function, exact differential and inexact differential, internal energy and enthalpy, temperature dependent internal energy and enthalpy, reversible and irreversible adiabatic expansion. The entropy of irreversible changes, the Helmholtz and Gibbs function, Entropy and entropy change in an ideal gas with temperature and pressure, Clausius inequality, chemical potential, chemical potential of a substance in a mixture.

2. Change of State **(04 L)**

Partial molar quantities, methods for determination of molar quantities, ideal solutions, Raoult's and Henery's law, Thermodynamics of Gibbs function of mixing, colligative properties: Elevation in boiling point, depression in freezing point and osmosis.

3. Quantum Chemistry **(08 L)**

Applications of quantum chemistry- blackbody radiation, photoelectric effect, de Broglie hypothesis and uncertainty principle and its experimental evidence. Schrödinger wave equation, particle in one dimensional box, Normalization and orthogonality of wave function, particle in three dimensional box, hydrogen like atoms (no derivation).Operators: algebra of operators, commutative property, linear operators, commutator operator, the operator ∇ and ∇^2. **(07 L)**

4. Chemical Bonding

Valence bond theory, hybrid orbitals, geometry and hybridization, molecular orbital theory for di and tri atomic molecule, linear variation method, approximations underlying Huckel theory, applications to simple π-systems.

SECTION – II (2 Credits, 24 L, 6 T)

Chemical Kinetics and Reaction Dynamics

1.Rate Laws **(06 L)**

Recapitulations of basic concept, the temperature dependent reaction rates, reaction moving towards equilibrium, consecutive reaction, parallel reactions, pre-equilibria, unimolecular reactions. 2.

2. Kinetics of Complex Reactions **(03 L)**

Fast reactions: flash photolysis, flow technique, stopped flow technique, relaxation method, the steady state approximation, chain reactions - free radical polymerization reaction between H_2 and Br_2, explosive reaction.

3. Molecular Reaction Dynamics **(05 L)**

Collision theory of bimolecular gas phase reactions, diffusion controlled and activation controlled reaction in solution, activated complex theory of reaction rate, Eyrings equation.

4. Enzyme Catalysis **(04 L)**

Michaelis mechanism, effect of pH and temperature on enzyme catalyzed reactions, limiting rate, Lineweaverburk and Eadie equation and plots, inhibition of enzyme action, competitive inhibition and non- competitive inhibition.

5. Molecular Thermodynamics **(06 L)**

Molecular energy levels, Boltzmann distribution law, partition functions and ensembles, translational, rotational and vibrational partition function of diatomic molecule, obtaining energy, heat capacity, entropy and equilibrium constants from partition functions, Maxwell- Boltzmann, Fermi-Dirac and Bose-Einstein statistics.

References:

1. Physical Chemistry by P.W.Atkin and De Paul
2. Physical Chemistry by T.Engel and P. Reid
3. Physical Chemistry and molecular approach by D. Mequarie and J. Siman
4. Physical Chemistry for biological sciences by Raymond Chang (Universal books, 2000)
5. Physical Chemistry by Merron and C.F. Prouton
6. Physical Chemistry by G.M. Barrow
7. Quantum Chemistry by I. Levine 8. Quantum Chemistry by R.K. Prasad

Semester-I

CCTP-4: CHP-210, Physical Chemistry-II, Semester - II (Molecular Spectroscopy and Nuclear Chemistry) (4 Credits)

SECTION - I Molecular Spectroscopy (2 Credits, 24 L, 6T)

1) Microwave Spectroscopy **(03 L)**

Types of molecule on the basis of moment of inertia and rotational spectra of di- and poly-atomic molecules.

2) Infra-red Spectroscopy **(05 L)**

The vibrating diatomic molecule, harmonic and Anharmonic oscillator, The diatomic vibrating rotator, breakdown of the Born-Oppenheimer approximation, The vibrations of polyatomic molecule, Fourier transform spectroscopy and its advantages, The carbon dioxide laser, Applications.

3) Raman Spectroscopy **(05 L)**

Quantum and classical theory of Raman effect, pure rotational Raman spectra, vibrational Raman spectra, polarization of light and Raman effect, structure determination from Raman and Infra-red spectroscopy, applications.

4) Electronic Spectroscopy of molecules **(07 L)**

Electronic spectra of diatomic molecules - The Born- Oppenheimer approximation, Vibrational coarse structure, Frank- Condon principle, dissociation energy and dissociation product, Rotational fine structure of electronic-vibration transition, The fortrat diagram, Pre-dissociation, molecular photoelectron spectroscopy.

5) Mossbauer Spectroscopy **(04 L)**

Principle, Instrumentation and Applications of Mossbauer Spectroscopy.

SECTION – II Nuclear and Radiation Chemistry (2 Credits, 24 L, 6T)

1) Radioactivity **(04 L)**

Types of radioactive decay, general characteristics of radioactive decay, decay kinetics, general expression for the activity of a daughter nuclide, Geiger- Nuttalis law, α-decay: A problem in classical physics, Internal conversion and the Auger effect.

2) Elements of Radiation **(06 L)**

Chemistry: Interaction of radiation with matter, interaction of γ radiation with matter, units for measuring radiation absorption, Radiation dosimetry, Radiolysis of water, free radicals in water radiolysis, Radiolysis of some aqueous solutions.

3) Nuclear Fission: **(06 L)**

The discovery of nuclear fission, the process of nuclear fission, fission fragments and their mass distribution, charge distribution, Ionic charge of fission fragments, fission energy, fission cross-section and threshold, fission neutrons, theory of nuclear fission, Neutron evaporation and spallation.

4) Applications of Radioactivity **(08 L)**

Typical reaction involved in the preparation of radioisotopes, The Szillard- Chalmers reaction, Radiochemical principles in the use of tracers, Isotopes in elucidating reaction mechanism and structure determination, physic-chemical research - The solubility of a sparingly soluble substances, surface area of a powder or precipitate rates of diffusion, Analytical applications- Isotope dilution analysis, Neutron activation analysis, Radiometric titrations, Medical applications-Thyroiditis, Assessing the volume of blood in a patient, Industrial applications thickness measurements and control, friction and wear out, gamma radiography.

References:

1) Elements of Nuclear Chemistry by H.J.Arnikar
2) Source book of Atomic energy by S. Glasstone and D. Van
3) Chemical applications of radioisotopes by H.J.M. Brown
4)Fundamentals of molecular spectroscopy by C.N.Banwell and E.M.McCash

Semester-I

CCTP-2: CHI-130, Inorganic Chemistry-I, Semester - I

(Molecular Symmetry and Chemistry of Main Group Elements) (4 credits)

SECTION-I (2Credits, 24 L, 6 T)

Molecular Symmetry and its Applications

1) Molecular Symmetry and Symmetry Groups **(10L)**

Symmetry elements and operations, Symmetry planes and reflections, the inversion centre, proper axes and proper rotations, improper axes and improper rotation, products of symmetry operations, equivalent symmetry elements and equivalent atoms, general relations among symmetry elements and symmetry operations, classes of symmetry operations, symmetry elements and optical isomerism, symmetry point groups, classification of molecular point groups. Defining properties of a group, group multiplication table, some examples of group, subgroups andclasses.

2) Representations of Groups **(06 L)**

Matrix representation and matrix notation for geometric transformation, The Great Orthogonality Theorem and its consequence, character tables (No mathematical part),wave function as basis for irreducible representations.

3)Symmetry Adapted Linear Combinations **(04L)**

Projection operators and their use of construct SALC (Construction of SALC for sigma bonding for molecules belonging point groups: D_{2h}, D_{3h} D_{4h}, C_{4v}, Td., Oh., normalization of SALC, transformation properties of atomic orbital, MO's for sigma bonding,ABn molecules, tetrahedral AB_4 and Oh AB_6 cases.

4) Application of Group theory to Infrared Spectroscopy **(04L)**

Introduction, selection rules, polyatomic molecules, possible vibrations in a linear molecule, bending modes, symmetry of vibrations and their IR activity, Group vibration concept and its limitations, IR spectra related to symmetry of some compounds, IR spectra of complex compounds.

References:

1) Chemical Applications of Group Theoryby F. A. Cotton
2) Symmetry and spectroscopy of molecules by K. VeeraReddy
3) Group Theory and its Chemical Application, P.K. Bhattarchrya
4) Inorganic Chemistry by Shriver and Atkins
5) Concise Inorganic Chemistry by J. D. Lee
6) Inorganic chemistry: principle of structures and reactivity by Huheey, Keiter, Medhi

Learning outcomes:

1. Student should visualize/ imagine molecules in 3 dimensions.
2. To understand the concept of symmetry and able to pass various symmetry elements through the molecule.
3. Understand the concept and point group and apply it to molecules.
4. To understand product of symmetry operations.

5. To apply the concept of point group for determining optical activity and dipole moment.
6. Student should understand the importance of Orthogonality Theorem.
7. They should able to learn the rules for constructing character table.
8. Using reduction formulae should be able to find out the possible type of hybridization.
9. Student should know the concept of SALC.
10. Student able to find out character for reducible representation.
11. To know about projection operator.
12. Apply projection operator to find out the normalized wave function for atomic orbital.
13. Student should correlate the application of symmetry to spectroscopy.
14. Students able to find out the possible modes of vibration.
15. From the previous knowledge of symmetry student must able to find out which mode are IR active.

Section-II (2 Credits, 24 L, 6 T)

Chemistry of Main Group Elements

1. Hydrogen and its compounds: **(02L)**

Classification of Hydrides, electron deficient, electron precise and electron rich hydrides.; PH_3, SbH_3 , AsH_3 , Selenides, Tellurides.

2. Alkali and Alkaline Earth Metals **(02L)**

Solutions innon - aqueous media, application of crown ether in extraction of alkali and alkaline earth metal **(04L)**

3. Boron Group

Boron Hydrides, preparation, structure and Bonding with reference to LUMO, HOMO, interconversion of lower and higher boranes, metalloboranes, carboranes, reactions of organoboranes, STYX rules and structure of higher boranes. **(03L)**

4. Carbon Group

Allotropes of carbon, Diamond, Graphite, Graphene, fullerenes ,carbon nanotube with synthesis, properties , Structure- single walled and multi walled and its application ,Intercalation compounds of graphite, Silicates, including Zeolites.

5. Nitrogen Group

(03L) Nitrogen activation, Boron nitride, Oxidation states of nitrogen and their interconversion, PN and SN Compounds, Applications of PN and SN compounds. **(03L)**

6. Oxygen Group

Metal Selenides and Tellurides, oxyacid's, and oxoanions of Sulphurand nitrogen. Ring, Cage and Cluster compounds of p-block elements. **(02L)**

7. Halogen Group:

Interhalogens, pseudohalagen, Synthesis, Properties and Applications, Structure, Oxyacid's andOxyanions of Halogens. **(02L)**

8.Noble gases:

Occurrence, Compounds ofXenon-with fluorine andOxygen and its uses

9.Organometallic Compounds **(03L)**

Organometallic Compounds of Li, Mg, Si, Pb, As, with Classification, Nomenclature, Synthesis, Structure Properties and Usesof Li, Mg, Si, Pb, As, with Classification, Synthesis, Structure Properties and Uses

References:

1) Inorganic Chemistry by Shriver and Atkins
2) Concise Inorganic Chemistry by J. D. Lee
3) Inorganic chemistry byPrinciple of Structures and Reactivity by Huheey, Keiter, Medhi
4) Inorganic Chemistry by Catherine Housecraft
5) Inorganic Chemistry by MeisslerandTarr
6) Organometallics by Christoph Elschenbroich
7) Organometallics by A Concise Introduction by Christoph Elschenbroich and Albrecht Salzer
8) Basic Organometallic Chemistry by B. D. Gupta and A. J. Elias

Learning outcomes:

1.Student should understand the detail chemistry of S and P block elements w.r.t. their compounds, their reactions and applications.
2. To learn the advance chemistry of boranes, fullerene, zeolites, polymers etc.
3. Organometallic chemistry of some important elements from the main groups and their applications

Semester-I

CCTP-5: CHI-230,Inorganic Chemistry, Semester – II (Coordination and Bioinorganic Chemistry) (4 Credits)

(2 Credits, 24 L, 6T)

SECTION-I

Coordination Chemistry

1)Concept and Scope of Ligand Fields: **(05 L)**

Quantum numbers, Free ion Configuration, Terms and States, Energy levels of transition metal ions, free ion terms, microstates, term wave functions, spin-orbits coupling.

2)Ligand Field Theory of Coordination Complexes **(07L)**

Effect of ligand field on energy levels of transition metal ions, weak cubic ligand field effect on Russell- Saunders terms, Orgel diagrams, strong field effect, correlation diagrams, Tanabe-Sugano Diagrams, Spin-Pairing energies.

3)Electronic spectra of Transition Metal Complexes **(06 L)**

Introduction, band intensities, band energies, band width and shapes, transition metalspectra of 1st, 2nd and 3rd row ions and complexes, electronic spectra of Lanthanide and Actinide, spectrochemical andnephelauxetic series, charge transfer and luminescence spectra, calculations of Dq, B, β parameters, percentage of covalent character for metal complexes.

4)Magnetic Properties of Coordination Complexes **(06 L)**

Origin magnetism, types of magnetism, Curie law, Curie-Weiss Law, Magnetic properties of complexes-Para magnetism, 1stand 2nd Ordered Zeeman effect ,quenching of orbital angular momentum by Ligand fields, Magnetic properties of A, E and T ground terms in complexes, spin freeand spin paired equilibria, temperature dependence of magnetism.

References:

1. Ligand field theory and its applications by B.N. Figgis and M.A. Hitachman
2. Symmetry and spectroscopy of moleculesby K. Veera Reddy
3. Elements of Magnetochemistry by R. L. Datta and A. Syamal

Learning outcomes:

1. Student should able to find out the no of microstates and meaningful term symbols, construction of microstate table for various configuration
2. Hund's rules for arranging the terms according to energy.
3. Student should understand interelectronic repulsion.
4. Student should know the concept of weak and strong ligand field.
5. Student able to find out splitting of the free ion terms in weak ligand field and strong ligand field.
6. To draw correlations diagram for various configurations in Td an Oh ligand field.
7. Student should know basic instrumentation and selection rules and relaxation in rules.
8. Student should know basic d-d transition, d-p mixing, charge transfer spectra.

9. Interpretation of electronic spectra for spin allowed oh and td complexes using Orgel diagram.
10. Understand the concept of spectro chemical series and Nephelauxetic series.
11. Should able to solve numerical based on crystal field parameters.
12. Understand the various terms involved in magnetochemistry.
13. Various phenomenons of magnetism and their temperature dependence.
14. Various experimental methods to find out magnetic moment.
15. Understand the various Quenching of orbital angular momentum.

Section-II:
Bioinorganic Chemistry (2Credits, 24 L, 6 T)

1) Overview of Bioinorganic Chemistry (04 L)
Historical Background and current relevance, role of Cu, Fe, Mn and Mo in metalloprotein, and metalloenzymes.

2) Concepts of Inorganic Chemistry in Bioinorganic Chemistry (08L)
Thermodynamic aspects - HSAB concept, chelate effect and Irving-William series, pK_a values of coordinated ligands, Tuning of redox potential, Biopolymer effects. Kinetic aspects- Electron transfer reaction, Electronic substitution reaction. reactions of coordinated ligands and Template effect, concept of spontaneous self-assembly model compounds.

3) Functions and Transport of Alkali and Alkaline Earth Metal Ions (04L)
Importance of alkali and alkaline earth metals, Distribution of cationic and anionic electrolytes in blood plasma and intracellular fluid, Ionophores: Natural and Synthetic, Application of ionophores, Different mechanism involved in exchange of ions across cell wall,Na+/K+-ATPase ion pump for active transport of Na^+ and K^+.

4) Biochemistry of following Elements: (08L)
(a) Ca in Blood coagulation.
(b) Magnesium in Photosystem I
(c) Manganese in Photosystem II
(d) Iron in Ferritin, Transferrin, Fe-S clusters, Porphyrin based system.

References:
1. Principle of Bioinorganic Chemistry by S.J. Lippard and J. M. Berg
2.Bioinorganic Chemistry: Inorganic Elements in Chemistry of Life by W.Kaim and B. Schwederski

Learning outcomes:
1) Importance of bioinorganic chemistry.
2) Role of metals in Metalloprotein and metalloenzymes.
3) Similarities in coordination theory for metal complexes and metal ions complexed with biological ligands.
4) Importance and transport of metal ions.
5) Passive transport metal ions by ionophores and gramicidin.
6) Mechanism for active transport of $Na^+$and K^+
7) Nerve impulse generation in rod cell of retina.
8) Importance and function of Ca, Fe and Mg in metalloprotein
9) Catalytic role of Mn in photosynthesis.

Semester-I

CCTP-3:CHO-150, Organic Chemistry-I, Semester – I (4 Credits)
(2 Credits, 24 L, 6T)
SECTION-I
Basic Organic Chemistry

1. Structure and Reactivity: (04 L)
Aromaticity: Benzenoid and non-benzenoid compounds, Huckel's rule, antiaromaticity, Application to carbocyclic and heterocyclic systems, annulenes, azulenes, current concepts of aromaticity.

2. Heterocyclic Chemistry (08 L)
Five and six membered heterocycles with one and two hetero atoms: Synthesis, reactivity, aromatic character and importance of following heterocyclic compounds, Furan, Pyrrole, Thiophene, Pyrazole, Imidazole, Pyridine, Pyrimidine

3. Stereochemistry: (12 L)
a) Sterochemical principles, enantiomeric relationship, distereomeric relationship, R and S, E and Z nomenclature in C, N, S, P containing compounds, Prochiral relationship, stereospecific andstereoselective reactions, optical activity in biphenyls, spiranes, allenes, Topicity.
b) Conformational analysis of di, tri, tetra-substituted 5 -6 membered rings and decalins.

(2 Credits, 24 L, 6T)
SECTION-II

1. Structure, Stability and Reactions of Reactive Intermediates (06 L)
a) Carbocation, Carbanion, Free Radical, Carbenes and nitrenes
b) NGP : Neighbouring group participation

2. Rearrangements: (06 L)
Beckmann, Hofmann, Curtius, Schmidt, Wolff, Lossen, Bayer-villiger, Sommelet, Favorskii, Pinacol-pinacolone, Benzil-benzilic acid, Fries, Tiffeneau Demjanov.

3. Ylides: (04 L)
Phosphorus, Nitrogen and Sulphur ylides

4. Oxidation and Reduction Reactions: (08 L)
Oxidisingagents: CrO_3, PDC, PCC, $KMnO_4$, MnO_2, Swern, SeO_2, $Pb(OAc)_4$, Pd-C, RuO_4, OsO_4, m-CPBA, O_3,$NaIO_4$, HIO_4, TEMPO, IBX, CAN, Dess-Martin, DDQ, Ag_2O
Reducing agents: Boranes and hydroboration reactions,MPV reduction and reduction with H_2/Pd-C, Raney-Ni, $NaBH_3CN$, Willkinsons catalyst, DIBAL and Wolff-Kishner reduction, Birch, Clemenson, Dissolving metal

References:
1. Organic Chemistry–by J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford)
2. Advanced Organic Chemistry –by J. March 6th Edition
3. Advanced Organic Chemistry (Part A) –by A. Carey and R.J. Sundberg
4. A guidebook to mechanism in organic chemistry – Peter Sykes 6th Ed.
5. Stereochemistry of carbon compound-by E.L. Eliel
6. Stereochemistry of organic compound-by Nasipuri
7. Stereochemistry conformations and mechanism by P.S. Kalsi

Semester-I

CCTP-6:CHO – 250, Organic Chemistry-II, Semester–II

(4 Credits)

SECTION-I

(2 Credits, 24 L, 6T)

Photochemistry and Pericyclic Reactions

1) Photochemistry [12 L]

Principles of Photochemistry, photochemistry of carbonyl compounds, alkenes,dienes, and aromatic compounds, photo rearrangements, Barton reaction

2) Pericyclic Reactions [12 L]

Cycloaddition reactions, Analysis by correlation diagrams, FMO approach, Electrocyclic, sigmatropic and ene reactions. 1,3-dipolar additions,

References:

1. Advanced Organic Chemistry, Part A by F. A. Carey and R. J. Sundberg
2. Excited states in Organic Chemistry by J.A. Barltrop and J.D.Coyle
3. Organic photochemistry: A visual approach by Jan Kopecky
4. Conservation of orbital symmetry by R. B. Woodward and R. Hoffmann
5. Orbital Symmetry : A problem solving approach- R. E. Lehr and A. P. Marchand
6. Pericyclic Reactions By A. P. Marchand, Roland E. Lehr
7. Organic reactions and orbital symmetry, 2nd Ed. T. L. Gilchrist and R. C. Storr
8. Molecular Orbitals and Organic Chemical Reactions by Ian Fleming
9. Pericyclic Reactions by Ian Fleming
10. Pericyclic Reactions by A Mechanistic and Problem-Solving Approachby Sunil Kumar Vinod Kumar S.P. Singh
11. Essentials of Pericyclic and Photochemical Reactions by Dinda and Biswanath Sankararaman, Roald Hoffmann (Foreword by)
12. Pericyclic Reactions - A Textbook: Reactions, Applications and Theory by S.

SECTION-II

(2 Credits, 24 L, 6T)

Spectroscopic Methods in Structure Determination of Organic Compounds

1. UV and IR Spectroscopy [04L]

UV: Recapitulation of UV spectroscopy, calculations of ∃max of aromatic compounds IR spectra of important functional groups 1. With and without conjugation, 2. Ring size effect 3. Effect of H-bonding, 4. Resonance effect,5. Inductive effect.

2. ^{1}H-NMR [12L]

Understanding of basic principle, chemical and magnetic nonequivalence, Homotopism, Enantiotopism, diastereotopism, chemical shifts and factors influencing chemical shift: electronegativity, NMR solvent polarity, temperature, anisotropic effect, chemical shifts of acidic protons. D_2O exchange, Multiplicity patterns and Coupling Constants: Pascal's triangle, understanding of tree diagram, complex splitting patterns in aromatic, vinylic, saturated monocyclic compounds, bicyclic compounds (fused and bridged rings), Integration: NMR of racemic mixture, relationship between integration and ee% in diasterotomers.

Problems: complex problems based on multiple coupling constants should be discussed and drawing of expected ^{1}H-NMR spectrum along with complex multiplicity patterns and coupling constants. Drawing of multiplicity patterns and determination of coupling constants of complex multiplets should be discussed.

3. ^{13}C-NMR [04L]

Basic of ^{13}C-NMR: Chemical shift and factors affecting chemical shifts in ^{13}C NMR, off resoanance and proton decoupled spectra. Simpleproblems on ^{13}C-NMR.

4. Mass spectrometry (MS) [04L]

Basic principle of MS, significance of M^+ (m/z) in determination of molecular formula, Rule of 13. Genesis of m/z fragments: alkanes (cyclic and acyclic), alcohols, amines

Problems: Based on 2-3 fragments of above mentioned functional groups should be discussed.

Combined problems: Problems based on UV, IR, MS, ^{1}H-NMR, ^{13}C-NMR should be solved.

Learning outcomes:

1. Students should able to understand free radicals' formation, stability and reactivity and should also be able to use the basic understanding in writing probable reaction mechanisms.
2. Students should able to write MO diagram for various olefinic compounds and should able to predict the products, the stereochemistry as well as should able to understand the preferred reaction pathways.
3. Students should able to calculate λmax of organic compounds containing more than one and less than four conjugated systems. Students should able to correlate IR bands with functional groups using numerical data as well as spectral data.
4. Students should able to solve 1H-NMR problems and should also able to draw the 1H-NMR spectrum for simple organic compounds mentioning multiplicity pattern and coupling constant with the help of "Tree Diagram" Should able to predict and analyze the multiplicity patterns with more than one coupling constants.
5. Students should able to use ^{13}C-NMR data to interpret the structure NMR problems and should also able to draw the ^{1}H-NMR spectrum for simple organic compounds mentioning multiplicity pattern and coupling constant with the help of "Tree Diagram" Should be able to predict and analyze the multiplicity patterns with more than one coupling constants.
6. Students should know various key factors responsible for the spectroscopic data acquisition and should able to solve Problems based on UV, IR, MS, ^{1}H-NMR,^{13}C-NMR. .

Course outcomes:

Students will be able to understand -

1. MOT and will be able to extend this in predicting reaction mechanism and stereochemistry of electrocyclic reactions.
2. The concepts in free radical reactions, mechanism and the stereo chemical outcomes.
3. The basic principle of spectroscopic methods and their applications in structure elucidation of organic compounds using given spectroscopic data or spectra.

Semester-I

CBOP-1: CHG – 190, General Chemistry-I, Semester-I (4 Credits)

SECTION-I: Theory Course (2 Credits, 24 L, 6T)
(Any one option is to be selected by candidate)

Elective Option-A : Introduction to Solid State of Matter

1. Bonding in Solids and Electronic Properties (Ref-1, 4) **(05 L)**

Recollect the concepts: Crystalline solids, unit cell, and types of unit cells

Introduction, Bondingin Solids—Free Electron Theory, Electronic Conductivity, Bonding In Solids—Molecular Orbital Theory, Simple Metals, Semiconductors—Si And Ge, Photoconductivity, The *P-N* Junction—Field-Effect Transistors, Bands In Compounds—Gallium Arsenide, Bands In D-Block Compounds—Transition Metal Monoxides.

2. Defects and Non-Stoichiometry (Ref-1, 4) **(07 L)**

Introduction, point defects—an introduction, defects and their concentration, intrinsic defects, extrinsic defects the concentration of defects, ionic conductivity in solids, solid electrolytes, fast-ion conductors: oxygen ion conductors, fast-ion conductors: sodium ion conductors, Applications: 1) fuel cells, 2) sensors, 3) electrochromic devices, non-stoichiometric compounds, introduction, non-stoichiometry in wustite, the titanium monoxide structure.

3. Superconductivity (Ref-1, 4) **(04 L)**

Introduction, Discovery, The Magnetic Properties Of Superconductors, Josephson Effects, The Bcs Theory Of Superconductivity, High Temperature Superconductors, Theory Of High Tc Superconductors, Uses Of High Temperature Superconductors

4. Synthesis of Solids (Ref-2 and 3) **(08L)**

Introduction, Common Reactions Employed in Synthesis, Soft-Chemistry Routes, Ceramic Methods, Decomposition of Precursor Compounds, Combustion Synthesis, Mechano-chemical and Sono-chemical methods, Soft Chemistry Routes(Ion Exchange Reactions, Use of Fluxes, Sol–Gel Synthesis, Electrochemical Methods, Hydrothermal, Solvothermal and Ionothermal Synthesis), Chemical Vapour Deposition and Atomic Layer Deposition, Procedures of synthesis of some nano-materials- Gold and Silver nanoparticles, CdS nanoparticles, ZnO, TiO2 and Fe_2O_3 nanoparticles and Porous Silica

References

Ref.-1: Elaine A. Moore, Lesley E. Smart - Solid State Chemistry - an Introduction. Third Ed. / Fourth Ed. CRC Press (2012)
Ref-2: C. N. R. Rao, Kanishka Biswas, Essentials of inorganic materials synthesis, Wiley, 2015
Ref-3: Nanotechnology: Principles and Practices, S. K. Kulkarni, Third Ed. Springer
Ref-4: Anthony R. West, Solid State Chemistry and its Applications Second Edition (Student Edition), Wiley.

Learning outcomes

At the end of course student will understand
1. Bonding in solids – band theory
2. Electronic conductivity
3. Semiconductors, photoconductivity
4. Non-stoichiometry, defects and types of defects in solids

2. Harper's Biochemistry by R.K. Murray, D. I. Granner, P. A. Mayes, (Prentice Hall International Inc.)
3. Biochemistry by U. Satynarayana
4. Biochemistry by J. L. Jain
5. Biophysical Techniques by Upadhyaya Nath

Course Outcomes:

The goal of this course is to introduce students to fundamental concepts in Chemical Biology and methods of chemistry used to solve problems in molecular and cell biology. After completion of this course, successful students will:

1) Students will be able to explore new areas of research in both chemistry and allied fields of science and technology.
2) Students will be able to function as a member of an interdisciplinary problem solving team.
3) To impart the students thorough idea in the chemistry of carbohydrates, amino acids, proteins and nucleic acids etc.
4) Be able to describe the chemical basis for replication, transcription, translation and how each of these central processes can be expanded to include new chemical matter.
5) Develop skills to critically read the literature and effectively communicate research in a peer setting.

Semester-I

SECTION-II: Practical Course (2 Credits,48 L 12T)
(Any one option to be selected by candidate)

Elective Option-A: Inorganic Material Analysis, Synthesis and Applications

Time allotted: One practical session of 4 hours per week for one semester

Part-I: Analysis (at least two of the following) (Ref. -1)

1. Determination of Silica and Manganese from pyrolusite ore.
2. Determination of Aluminum and Silica from Bauxite ore.
3. Determination of silica and iron from hematite ore.
4. Determination of copper and Sulphide from Chalcopyrite ore.

Part-II: Alloy Analysis (at least two of the following) (Ref. -1)

5. Determination of tin and lead from solder alloy.
6. Determination of iron and chromium from stainless steel alloy.
7. Determination of copper and nickel from cupranickel alloy.

Part-III: Synthesis of solid state materials / nano-materials (any three) (Ref- 2 and 3)

8. Synthesis of ZnO from zinc oxalate - precursor method and determine band gap by absorption spectroscopy
9. Synthesis of TiO_2 $TiCl_4$ or Ti-Isopropoxide by Sol-gel method and determine band gap by absorption spectroscopy
10. Synthesis of Colloidal silver nanoparticles and determine band gap by absorption spectroscopy
11. Synthesis of Fe_2O_3 nanoparticles sol-gel/coprecipitation/hydrothermal (any one method)

12. ZnO, TiO_2, Fe_2O_3 nanoparticles powder XRD, SEM, TEM (at least one spectral analysis should be done)

Part-IV: Applications of Solid State Materials

12. Removal and kinetics of photocatalytic dyes, degradation (methylene blue) by ZnO TiO_2 photocatalysis (Ref-2)
13. Study of adsorption of phosphate ion on alfa-Fe_2O_3 (Ref-2)

References:

1. Text book of Quantitative Analysis by A.I. Vogel 3rded^{n} (1963).
2. Experimental Inorganic Chemistry by Mounir A. Malati, Horwood
3. Nanotechnology by S. K.Kulkarni

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **50% students will be assigned experiment on part-I or II while remaining – (analysis of any one component) 50% students will assigned experiment on part-III and IV.**
3. **Use of only university supplied procedure will be allowed at the time of examination.**

Elective Option - B: Chemical Biology-I Practical

Time allotted: One practical Session of 4 hours per week for one semester

1. Statistical treatment of experimental data (calculation of mean and standard deviation for given data and least square method for calibration curve method) - Compulsory

Perform at least 10 Practical from the following

1. Preparation of biological buffers.
2. Qualitative analysis of carbohydrates
3. Qualitative analysis of Lipids
4. Qualitative analysis of amino acids
5. Paper chromatographic / TLC separation of mixture of amino acids and their detection
6. Paper chromatographic separation of mixture carbohydrates and their detection
7. Quantitative estimation of Glucose by dinitro salicylic acid by using calorimetric method
8. Quantitative estimation of proteins by Loawry's method
9. Kjeldahl method of Protein Determination
10. Saponification number of fats
11. Iodine value of oil
12. Isolation Quantitative estimation of DNA by Diphenyl amine method
13. Determination of Inorganic Phosphate in Biological Samples

References:

1. A reference book of biochemistry practicals by Sadashivam
2. Practical approach to biochemistry by Plummer
3. Martin Holtzhauer, Basic Methods for the Biochemical Lab, First Edition, Springer

Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**

Semester-II

CBOP-2: CHG – 290, General Chemistry -II, (4 Credits)

SECTION-I: Theory Course (2 Credits, 24 L, 6T)

(Any one option is to be selected by candidate)

Elective Option-A: Material Characterization Technique

1. X-Ray Diffraction Methods (Ref-1) (6 L)

Miller and Weiss indices, X-Ray Radiation, Generation of X-Rays, X-Ray Absorption, Theoretical Background of Diffraction, Diffraction Geometry, Bragg's Law, Reciprocal Lattice, Diffraction Intensity, Structure Extinction, X-Ray Diffractometry, Instrumentation, System Aberrations, Samples and Data Acquisition, Sample Preparation, Acquisition and Treatment of Diffraction Data, Distortions of Diffraction Spectra, Crystallite Size, Applications, Crystal-Phase Identification, Quantitative Measurement , Wide-Angle X-Ray Diffraction and Scattering, Wide-Angle Diffraction, Wide-Angle Scattering. Problem on XRD (Calculation of d values, assigning planes, calculation of crystal parameters)

2. Transmission Electron Microscopy (Ref-1) (4 L)

Instrumentation, Electron Sources, Thermionic Emission Gun, Field Emission Gun, Electromagnetic Lenses , Specimen Stage, Specimen Preparation, Prethinning, Final Thinning, Electrolytic Thinning, Ultramicrotomy, Image Modes (Mass–Density Contrast, Diffraction Contrast, Phase Contrast), Selected-Area Diffraction (SAD), Selected-Area Diffraction Characteristics.

3. Scanning Electron Microscopy (Ref-1) **(4 L)**

Instrumentation, Optical Arrangement , Signal Detection, Detector, Probe Size and Current Contrast Formation, Electron–Specimen Interactions, Topographic Contrast, Compositional Contrast, Operational Variables, Working Distance and Aperture Size, Acceleration Voltage and Probe Current, Astigmatism, Specimen Preparation, Preparation for Topographic examination.

4. X-Ray Spectroscopy for Elemental Analysis (Ref-1) **(10 L)**

Features of Characteristic X-Rays, Types of Characteristic X-Rays, Selection Rules, Comparison of K, L, and M Series, X-Ray Fluorescence Spectrometry, Wavelength Dispersive Spectroscopy, Analyzing Crystal, Wavelength Dispersive Spectra, Energy Dispersive Spectroscopy, Detector, Energy Dispersive Spectra, Advances in Energy, Dispersive Spectroscopy, XRF Working Atmosphere and Sample Preparation, Energy Dispersive Spectroscopy in Electron Microscopes, Special Features, Scanning Modes, Qualitative and Quantitative Analysis, Qualitative Analysis, Quantitative Analysis, Quantitative Analysis by X-Ray Fluorescence, Fundamental Parameter Method, Quantitative Analysis in Electron Microscopy, Numerical.

References:

1:Yang Leng, Materials Characterization -Introduction to Microscopic and Spectroscopic Methods, Second Ed. Wiley-VCH,
2:R. D. Braun, Introduction to Instrumental Analysis, Second Ed.
3:Elaine A. Moore, Lesley E. Smart - Solid State Chemistry - an Introduction. Fourth Ed. CRC Press (2012)

SECTION-II: Practical Course **(2 Credits, 48 L, 12T)**
(Any one option to be selected by candidate)

Elective Option-A: Electrochemical Methods of Analysis

Time allotted: One practical Session of 4 hours per week for one semester
Total 11 practical to be conducted

Part-I: Conductometry: (Any three)
1. Hydrolysis of NH_4Cl or CH_3COONa or aniline hydrochloride.
2. Determination of λ_0 or $\lambda\alpha$ and dissociation constant of acetic acid.
3. Hydrolysis of ethyl acetate by NaOH.
4. Determination of ΔG, ΔH, and ΔS of silver benzoate by conductometry.
5. Determination of critical micellar concentration (CMC) and ΔG of micellization of sodium Lauryl Sulphate / Detergent

Part-II: Polarography (any one)
6. Determination of half wave potential E 1/2 and unknown concentration of Cu or Pb or Zn ion.
7. Amperometric titration of $Pb(NO_3)_2$ with $K_2Cr_2O_7$.

Part-III: Potentiomerty: (Any three)
8. Stability Constant of a complex ion.
9. Solubility of a sparingly soluble salt.
10. To determine the ionic product of H_2O
11. Estimation of halide in mixture.

Part-IV: pH metry (any two)
12. Determination of the acid and base dissociation constant of an amino acid and hence the isoelectric point of the acid.
13. Determination of dissociation constants of tribasic acid (phospheric acid)
14. Construct pH curve for titration of strong base – strong acid, strong base - weak acid and predict the best indicator in these titrations (methyl orange, methyl orange, brocresol green, phenolphthalein, etc.)

Part-V: Table Work (any two)
15. Analysis of powder XRD of $SrTiO_3$ and Ag metal or any two compounds (Calculation d, lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)
16. Cyclic voltamogram of $K_3Fe(CN)_6$ in KCl/H_2O / Ferrocene in TEAP//MeCN
17. Detailed interpretation of Raman spectra of diatomic molecules

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett(Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.).
4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Physical chemistry by Wien (2001)

Semester-II

CCPP-1: CHP-107: Practical Course – I: Semester -I

Basic Practical Chemistry (Compulsory) **(4 Credits, 96 L, 24T)**

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for Section-I and one practical session for Section-II per week is compulsory)

Sec-I: Physical Chemistry Practical (11 Experiments)

1. Statistical treatment of experimental data (calculation of mean and standard deviation for given data and least square method for calibration curve method) (compulsory)

Part-I: Chemical Kinetics: (Any three)
2. Kinetic decomposition of diacetone alcohol by dilatometry.
3. Determination of an order of a reaction.
4. Brönsted primary salt effect.
5. Kinetics of oxidation of ethanol by $K_2Cr_2O_7$

Part-II: Non-Instrumental: (Any Three)
6. Determination of surface excess of amyl alcohol or TX-100 surfactant by Capillary rise method.
7. Determination of molecular weight by steam distillation.
8. Glycerol radius by viscosity.
9. Partial Molar Volume (Polynometry) Determination of the densities of a series of solutions and to calculate the molar volumes of the components.

Part-III: Colorimetry and spectrophotometry (Any four experiments)
10. Simultaneous determination of Ni and Co by spectrophotometry (Ref-1)
11. Simulations determination of $KMnO_4$ and $K_2Cr_2O_7$ by spectrophotometry.(Ref-7)
12. To study the adsorption of certain dyes such as methyl violet, picric acid or malachite green on charcoal. (Ref-2)
13. To determine the indicator constant of bromocresolpuple by half height method (Ref-8)
14. Estimation of Cu(II) by titration with Na_2 EDTA by colorimetry
15. a. Determination of energy of n to Π^* transition in acetone and study of effect of solvent on energy of this transition by recording absorbance spectra in n-hexane and water. b. To study the effect of the extended conjugation on the λ_{max} of p-nitro phenol by recording spectrum in acidic and alkaline medium (Ref-8).

Part -IV: Radioactivity: (Any one)
10. Estimation of Mn in tea leaves by NAA.
11. Half-life of a radioactive nuclide and counting errors.
12. Determination of E-max of β radiation and absorption coefficients in Al.

References:

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett(Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co., Delhi.).

4. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Physical chemistry by Wien (2001)
6. Advance Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut),
7. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
8. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books

Sec-II: Organic Chemistry (11 Experiments)

Introduction to Laboratory Safety: Meaning of safety signs on container of chemicals, safety handling of chemicals, MSDS sheets: Detailed explanation at least for 4 different types of substances (e.g. nitric acid, benzene, potassium dichromate, bromine, etc.), Handling of glassware's and care to be taken, handling of organic flammable as well as toxic solvents in laboratory, use of safety goggles, shoes and gloves, fire extinguisher and its use, action to be taken in accidental cases e.g. cleaning of acid spill over, use eye wash station and bath station in emergency, etc. (compulsory)

Part-I: Purification Techniques (Compulsory) (8 Experiments)

a) Purification of **two** organic solids by recrystallization using solvents other than water
b) Purification of **two** organic liquids by upward/downward/traditional distillation technique
c) Column Chromatography technique should be performed for any one of the following preparation
d) Sublimation by Cold Thumb Method
e) Thin Layer Chromatography technique **two mixtures**

Part-II: Introduction to Green Chemistry (Compulsory 1 Practical)

Concept of green chemistry, twelve principals of green chemistry, applications of green chemistry for sustainable development, Atom economy, Monitoring of reaction using TLC.

Green Chemistry Experiments (any two)

1. Preparation of Schiff's bases in aqueous medium.
2. Preparation of dihydropyrimidinone under solvent free conditions
3. Preparation of acetanilide from aniline and acetic acid using Zn dust

1. Examination Scheme:

1. **The examination structure will be given before the commencement of examination.**
2. **Use of only university supplied procedure will be allowed at the time of examination.**
3. **One experiment from Physical chemistry and any one experiment from organic section will be assigned.**

Semester-II

CCPP-2: CHP-227: Practical Course-II: Semester -II

Basic Practical Chemistry (Compulsory) **(4 Credits, 96 L, 24T)**

Time allotted: Two practical sessions of 4 hours per week for one semester (one practical session for Section-I and one practical session for Section-II per week is compulsory)

Section-I: Inorganic Chemistry (11 Experiments)

Part-I: Synthesis of coordination complexes (any three) (Ref. 2)

1. Synthesis and Purity of $[Mn(acac)_3]$
2. Synthesis and Purity Chloropentaamminecobalt(III) chloride.
3. Synthesis and Purity Nitro pentaamminecobalt(III) chloride.
4. Synthesis and Purity Bis[TrisCu(I)thiourea]

Part-II: Inorganic Conductometry (any two)

4. Structural determination of metal complexes by conductometric measurement. (Ref-3)
5. To study complex formation between Fe(III) with sulfosalicylic acid by conductometry (Ref-3).
6. To verify the Debye Huckel theory of ionic conductance for strong electrolytes KCl, $BaCl_2$, K_2SO_4 and $[K_3Fe(CN)_6]$ (Ref-3)
7. Determination of Pb(II) in solution with Na_2SO_4 solution and determination of solubility product of $PbSO_4$ (Ref-4)

Part-III: Inorganic characterization techniques (any two of the following)

8. Determination of equilibrium constant of M – L systems Fe(III)–Sulphosalicylic acid or Fe(III)–β–resorcilic acid by Job's continuous variation method. (Ref.-3, 5)
9. Solution state preparation of $[Ni(en)_3]S_2O_3$, $[Ni(H_2O)_6]Cl_2$, $[Ni(NH_3)_6]Cl_2$. Record absorption spectra in solution of all three complexes and calculate 10 Dq. Arrange three ligands according to their increasing strength depending on your observations. (Ref. -5)
10. Determination of magnetic susceptibility (χg and χm) of mercury tetracyanato cobalt or $Fe(acac)_3$ or Ferrous ammonium sulfate by Faraday or Gouy method. (Ref. -3, 5)

Part-IV: Inorganic Kinetics Experiment (any two)

11. Synthesis and photochemistry of $K_3[Fe(C_2O_4)_3].3H_2O$. (Ref-4)
12. Kinetics of substitution reaction of $[Fe(Phen)_3]^{2+}$ (Ref-3)
13. Kinetics of formation of Cr(III)-EDTA complex (Ref-3)

Part-V: Ion – Exchange Chromatography (Ref. -1 and 3)

1. Separation of mixture of Zn(II) and Mg(II) using Amberlite IRA 400 anion exchanger and quantitative estimation of separated ions Zn(II) and Mg(II)

Part-VI: Solvent Extraction and colorimetric (any one experiment) (Ref. -1 and 3)

2. Determination of Cu(II) by solvent extraction as Dithiocarbamate complex (Ref-1)
3. Determination of iron by solvent extraction techniques in a mixture of Fe(III) +Al(III) or Fe(III) + Ni(III) using 8–hydroxyquinoline reagent. (Ref. -1)

References:

1. Vogel's Textbook of Inorganic quantitative analysis

2. Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horwood publishing, Chichester) 1999.
3. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
4. General Chemistry Experiments, Anil. J Elias, University Press (2002)
5. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books

Section -II: Organic Chemistry (11 Experiments)

1. Base catalyzed aldol condensation using $LiOH.H_2O$ as a Catalyst.
2. Bromination of *trans*-stilbene using sodium bromide and sodium bromate
3. [4+2] cycloaddition reaction in aqueous medium at room temperature
4. BenzilBenzilic acid rearrangement under solvent free condition
5. Clay catalyzed solid state synthesis of 7-hydroxy-4-methylcoumarin
6. Ecofriendly nitration of phenols and its derivatives using Calcium nitrate
7. Bromination of acetanilide using ceric ammonium nitrate in aqueous medium
8. Green approach for preparation of benzopinacolone from bezopinacol using iodine catalyst,
9. Preparation of 1, 1-bis-2-naphthol under grinding at room temperature.
10. Solvent free aldol condensation between 3,4-dimethoxybenzaldehyde and 1-indanone
11. Preparation of azlactone from hippuric acid
12. Preparation of thioamide from benzaldehyde in water.

Note: Students should perform a) Relevant chemical analysis. b) Column chromatography. c) Elemental analysis. d) Spectroscopic interpretation. e) How to draw schemes and mechanism using Chem Draw / ISIS Draw etc.

N B. :

1. **Use molar concentrations for volumetric /estimations/synthesis experiments.**
2. **Use optimum concentrations and volumes**
3. **Two burette method should be used for volumetric analysis (Homogeneous mixtures)**
4. **Use of microscale technique is recommended wherever possible**

References:

1. Comprehensive Practical Organic Chemistry by V.K. Ahluwalia and Renu Aggarwal
2. Monograph on Green Chemistry Laboratory Experiments by Green Chemistry TaskForce Committee, DST

Learning Outcomes:

1. This course is designed to make students aware of how to perform organic compounds in laboratory.
2. The course includes synthesis of some derivatives and organic compounds, which will help them while working in research laboratory in future.
3. Making derivatives of organic compounds will help them in industry or while doing research in medicinal chemistry for Drug development.
4. This practical course is also designed to make student aware of green chemistry and role of green chemistry in pollution reduction.
5. The students learn how to avoid solvents and do solvent free reaction.
6. Also the work-up procedure in many experiments is made more eco-friendly to environment.

Course Outcomes:

The detailed course wise syllabus of M. Sc-II Organic Chemistry is as follows:

Semester-III

CCTP-7, CHO-350: Organic Reaction Mechanism and Biogenesis [48L+12T]

Section I: Organic Reaction Mechanism, [24 L + 6 T]

1. **Methods for determining Reaction Mechanisms** [4 L]
(Kinetic and nonkinetic methods), Ref -1,
2. **Free Radicals:** Generation, stability, reactivity, Free radical substitution, addition to multiple bonds. radicals in synthesis, Inter- and intra-molecular bond formation via mercury hydride, tin hydride, thiol donors, cleavage of C-X , C-Sn, C-S, O-O bonds, Oxidative coupling, C-C bond formation in aromatics, SNAr reactions, Free Radicals in Organic Synthesis. *(Ref-2, 3, 6, 7).* [8 L]
3. **Linear Free Energy Relationships**, *Ref. 3, 4.* [6 L]
4. Hammet plots, Hammet equation, substituent constants, reaction constants, use of Hammet plots, calculation of k and K, Deviations from straight line plots, Taft equation, solvent effects. *Ref. 3, 4, 5* [6 L]

Section II: Biogenesis: The Bbuilding Blocks and Cconstruction Mmechanism, [24 L + 6 T]

1. **Terpenoids:** Mono-, Sesqui-, Di-, tri-terpenoids and cholesterol, *Ref.- 8, 9, 10* [6 L]
2. **Alkaloids:** Derived from ornithine, lysine, nicotinic acid, tyrosine and tryptophan. *Ref.- 8, 9, 10* [6 L]
3. **The Shikimate pathway:** Cinnamic acids, lignans and lignin, coumarins, flavonoids and stilbens, isoflavanoids and terpenoid quinones. *Ref.- 8, 9, 10* [6 L]
3. **A case study:** Alkaloids isolated from the Roots of ***Piper nigrum,*** *Ref. -11, 12* [6 L]

References:

1. Mechanism and structure in Organic Chemistry E. S. Gould (Holt, Rinehart and Winston)
2. Advanced Organic Chemistry –J. March, 4th edition
3. Advanced Organic Chemistry- Part A: Structure and Mechanism- F. A. Carey and R. J. Sundberg, 5th Edition, Springer 2007)
4. A guidebook to mechanism in Organic Chemistry- Peter Sykes
5. The Hammett Equation by C. D. Johnson
6. Organic Chemistry-J. Clayden, N. Greeves, S. Warren, P. Wothers, Oxford University Press
7. Radical in Organic Synthesis- B. Giese, Pergamon Press (1986)
8. Natural Product Biosynthesis: Chemical Logic and Enzymatic Machinery by Christopher T Walsh, Yi Tang
9. From Biosynthesis to Total Synthesis: Strategies and Tactics for Natural Products- Editor Alexandros L. Zografo
10. Medicinal Natural Products: A Biosynthetic Approach, 3rd Edition By Paul M. Dewick
11. J. Nat. Prod. 2004, 67, 1005-1009.
12. J. Org. Chem. 2005, 70, 4, 1164–1176

Additional Study Material: Organic Reaction Mechanism

https://nptel.ac.in/courses/104/101/104101005/
https://nptel.ac.in/courses/104/101/104101115/

CCTP-8, CHO-351: Structure Determination of Organic Compounds by Spectroscopic Methods [48L +12L]

Section-I: NMR Spectroscopy [24 L + 6 T]

1. NMR in Stereochemistry Determination: Homotopic, enatiotopic and distereotopic protons, Chemical and Magnetic equivalence; First and second order splitting, Complex multiplicity patterns and coupling constants in asymmetric compounds; Simplification of complex spectra, NOE, Diastereomerism, Atrop or axial chirality, % Enantiomeric excess, chiral NMR solvents etc in structure elucidation.

2. ^{13}C NMR spectroscopy - APT, DEPT and INEPT **[10 L]**

3. ^{15}N, ^{19}F and ^{31}P NMR spectroscopy **[6 L]**

Fundamentals and applications in structure elucidation of organic compounds, catalysts and biomolecules. ***(Self learning and for internal assessment only).** **[*0 L]**

4. 2D NMR spectroscopy in structure elucidation: (a)Homonuclear: COSY, TOCSY, 2D-INADEQUATE, 2D- ADEQUATE, NOESY, ROESY (b) Heteronuclear: HSQC, HMQC, HMBC **[8 L]**

Section-II: Mass Spectrometry [24 L + 6 T]

1. Mass Spectrometry: Principle, ionization methods like EI, CI, ES, MALDI and FAB-Fragmentation of typical organic compounds, stability of fragments, Rearrangements, factors affecting fragmentation, ion analysis, ion abundance, High-Resolution mass spectrometry in determination of molecular formula.

2. Applications of Mass Spectrometry: Determination of the elemental composition, Isotopic Abundance in structure establishment; Analysis of Biomolecules: Proteins and Peptides, Oligonucleotides and Oligosaccharides **[6 L]**

3. Problems solving: Structure elucidation using UV, IR, 1D (1H and13C) NMR and 2D NMR (1H-1H, 13C- 1H COSY /HETCOR only), APT, DEPT and MS data as well as spectra. **[12 L]**

References:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley.
2. One and Two dimensional NMR Spectroscopy by Atta-Ur-Rehman, Elsevier (1989).
3. Organic Structure Analysis-Phillip Crews, Rodriguez, Jaspars by Oxford University Press (1998).
4. Organic Structural Spectroscopy by Joseph B. Lambert, Shurvell, Lightner, Cooks, Prentice-Hall (1998).
5. Organic Structures from Spectra by Field L.D. Kalman J.R. and Sternhell S. 4th Ed. John Wiley and Sons Ltd.
6. Mass Spectrometry Basics by Christopher G. Herbert Robert A.W. Johnstone
7. Mass Spectrometry Principles and Applications by Edmond de Hoffmann and Vincent Stroobant.

CCTP-9, CHO-352: Stereochemistry and Asymmetric Synthesis of Organic Compounds [48L + 12T]

Section I- Stereochemistry [24L + 6T]

1. Conformations of polysubstituted cyclohexane, six membered rings with SP^2 carbon, heterocycles with N and O, anomeric effect, stereochemical principles involved in reactions of six membered rings and other than six membered rings, concept of I- Strain. *(Ref. 1, 2, 3, 4, 5, 6)*

2. A) Stereochemistry of fused and bridged ring systems: Nomenclature, synthesis; stereochemical aspects of Perhydrophenanthrene, Perhydroanthracene, hydrindane, Steroids; Bridged system (bi, tri and polycyclo system) including heteroatoms, Bredt's Rule. ***(Ref.-1, 2, 3, 4, 5, 6).*** **2. B) Conformations of following compounds with justification of each:** cis and trans -1,3- and 1,4-di-t-butyl-cyclohexanes; Cis-4-di-t-butyl-cis-2,5-dihydroxycyclohexane; Twistane; bicyclo- [2.2.2]octane; Trans-anti-trans-Perhydro-anthracene and the lactone; cyclohexane-1,4-dione; 1,2,2,6,6-penta-methyl-4-hydroxy-4-phenylpiperidine; ψ-tropine; 2-hydroxy-2-phenyl quinolizidine; 4-t-butyl-4-methyl-1,3-dioxane: cis- and trans-2,5-di-t-butyl-1,3-dithianes;cis-2,5-di-t-butyl-1,3,2-dioxaphosphorinan-2-one *(Ref. 1, 7, 8)* **[8 L]**

3. Determination of configuration, Cram's rule, Cram's cycle model, Cram's dipolar model, Felkin-Anh Model: Resolution and analysis of stereomers - formation of racemization and methods of resolution. (*Ref.* 1, 2, 4), Stereochemistry of a polymer chain – Types and examples of Tacticity (Ref. 7), **[8 L]**

4. Decalols, Decalones, Octahydronaphthalenes, decahydroquinolines **[*0 L]**

***(Self learning and for internal assessment only)**

1.

References:

1. Stereochemistry of Carbon compounds - E. L. Eliel
2. Stereochemistry of carbon compounds - E. L. Eliel and S. H. Wilen
3. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 1st. Ed.
4. Stereochemistry of organic compounds –Nasipuri
5. Stereochemistry of organic compounds-P. S. Kalsi
6. Organic stereochemistry – Jagdamba Singh
7. Topics in Stereochemistry (Volume 2) By Norman L. Allinger and Ernest L. Eliel.
8. Topics in Stereochemistry (Volume 8) By Ernest L. Eliel and Norman L. Allinger.

Additional Study Material: Stereochemistry

https://nptel.ac.in/content/syllabus_pdf/104105086.pdf

https://nptel.ac.in/courses/104/105/104105086/

Section II- Asymmetric Synthesis [24L + 6T]

1. Introduction of Asymmetric Synthesis, Chirol pool and Chiral auxillaries.
2. Asymmetric Organocatalysis
3. Asymmetric Aldol Reaction, Enantioselective, diastereoselective and double diastereoselective Aldol reactions.
4. Transition Metal-Catalyzed Homogeneous Asymmetric Hydrogenation
5. Transition Metal-Catalyzed Homogeneous Asymmetric Hydroxylation and Epoxidation
6. Asymmetric Phase-Transfer and Ion Pair Catalysis **(*Self learning)**

References:

1. Catalytic Asymmetric Synthesis, 3rd ed,Ed: I. Ojima, John Wiley & Sons, New Jersey, 2010
2. Catalysis in Asymmetric Synthesis by Vittorio Caprio and Jonathan M. J. Williams
3. Angew. Chem. Int. Edn. 2008, 47, 4638–4660.
4. Principles and Applications of Asymmetric Synthesis by Guo-Qiang Lin, Yue-Ming Li, Albert S. C. Chan, A John Wiley & Sons, Inc., Publication.
15. Organic Chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers 2nd. Ed.

Additional Study material: Catalytic Asymmetric Synthesis

https://nptel.ac.in/courses/104/103/104103067/

https://nptel.ac.in/content/syllabus_pdf/104103067.pdf

CBOP-3, CHO-353(A): Protection - De-protection, Chiron approach and Carbohydrate Chemistry OR CHO-353(B): Designing Organic Syntheses and Heterocyclic Chemistr [48L + 12T]

CBOP-3, CHO-353(B): Designing Organic Syntheses and Heterocyclic Chemistry

[48 L + 12 T]

Section I: Designing Organic Syntheses [24 L + 6 T]

1. **Concepts of Retrosynthesis:** Retrosynthetic analysis, disconnection approach, Synthons, multiple step synthesis, functional group intercoversion, Illogical two group intercoversion, C-C disconnection, Donor and acceptor Synthons, two group disconnection, 1,5 related functional group disconnection, Umpolung, convergent synthesis, special methods for small rings, Heteroatom and Heterocyclic compounds, problems, (*Ref*-1, 2, 4). [12 L]
2. **Application of Retrosynthetic Approach:** Retrosynthesis and synthesis of following Molecules: Strychnine, Reserpine, Thienamycin, Asteltoxin, Indolizomycin, Erythronolide B. Ref-3 [12 L]

References:

1. Designing Organic Syntheses by Stuart Warren
2. Organic Chemistry from Retrosynthesis to Asymmetric Synthesis, by Vitomir Sunjic, Springer; 1st ed. 2016 edition
3. Classics in Total Synthesis by K.C. Nicolaou and E.J.Sorensen

Additional Study material: NPTEL Lecture:
A Study Guide in Organic Retrosynthesis: Problem Solving Approach (https://nptel.ac.in/content/syllabus_pdf/104105087.pdf)

Section II: Advanced Heterocyclic Chemistry [24 L + 6 T]

1. Systematic nomenclature (Hantzsch-Widman System) for monocyclic, fused and bridged heterocycles. Tautomerism in aromatic heterocycles. Strain-bond angle, torsional strains and their consequences in small ring heterocycles. [4 L]
2. General chemical behaviour of heterocyclic compounds and their applications in: Biological systems (Anthocyanins, Flavones, Neurotransmitters), Natural Products (Alkaloids: Nicotin, Quinine). Drugs and Medicines (Omeprazole, Amlodipine, Cilostazol) [4 L]
3. **Synthesis, reactions and structural effects of heterocyclic rings** [16 L]

a) Common Methods in Ring Synthesis of Aromatic Heterocyclic Systems: Typical ring synthesis involving C – Heteroatom, C – C bond formations, Electrocyclic processes in heterocyclic Synthesis: 1,3 -dipolar cycloadditions producing five - membered heterocycles, Nitrenes in heterocyclic synthesis, Palladium catalysis in the synthesis of Benzo - Fused heterocycles, Fischer synthesis, Epoxidation, Use of Sulphur Ylides, Azides for small rings

b) Three and four membered heterocylces: Aziridines, Oxiranes, Thirienes, Azetidines, Oxitanes and Thietanes

c) Five-membered and benzo-fused five memberedheterocycles:Oxazole, Isoxazole, Thiazole, Pyrazole, Imidazole, Benzothiazole and Benzimidazole

d) Six membered and benzo-fused six membered heterocycles:Pyrazine, Pyridazine, Pyrimidine, Quinazoline, Quinoxaline, Aziridines, Quinoline

Self Learning: Isoquinoline, Indoles

References

1. Heterocyclic Chemistry by T. Gilchrist.
2. An Introduction to the Chemistry of Heterocyclic Compounds by RM Acheson.
3. Heterocyclic Chemistry by J A Joule and K. Mills.
4. Principles of Modern Heterocyclic Chemistry by A Paquette.

5. Heterocyclic Chemistry by J A Joule and Smith.
6. Handbook of Heterocyclic Chemistry by A R Katritzky

Additional Study Material: Heterocyclic Chemistry
https://nptel.ac.in/content/syllabus_pdf/104105034.pdf
https://nptel.ac.in/courses/104/105/104105034/

CCPP-3, CHO-354: Practical-I Solvent Free Organic Synthesis

[96L +24T]

Note:
The students should perform any 24 Syntheses from the following list. Students should acquire **pre-experiment** (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and **post-experiment** skills (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

A) Solvent Free Carbon–Carbon Bond Formation

1. Pinacol coupling reaction (Page 36)
2. Reformatsky reaction/Luche reaction (Page 36)
3. Knoevenagel condensation (Page 40)
4. Dieckmann condensation (Page 42)
5. Corrole Synthesis (Page 42)
6. Knoevenagel condensation. 3-carboxycoumarin (Page 45)
7. 3-(ethoxycarbonyl)-4-hydroxy-5-(1-hydroxyalkyl)-2-isoxazoline-2-oxide (Page 46)
8. Biginelli reaction (Page 46)
9. Claisen reaction(Page 47)
10. Pechmann reaction (Page 50)
11. calix[4]resorcinarene (Page 50)

B) Solvent-Free C–N Bond Formation

1. terephthalic acid dihydrazide (Page 205)
2. azomethine synthesis (Page 213)
3. diazepinone synthesis (Page 218)
4. dibenzyl sulfone Synthesis (Page 297)

C) Solvent-Free C–S Bond Formation

1. 1,3-dithiolane synthesis (Page 299/300)

D) Solvent-Free C–X Bond Formation

1. Cinnamic acid/ stilbene halogenations (Page 319)
2. Phenol bromination using *N*-bromosuccinimide (Page 320)

E) Solvent-Free N–N Bond Formation

1. Triazenes Synthesis (Page 335)
2. Beckmann rearrangement (Page 346)

F) Other Solvent-Free Reactions

1. D-mannitol protection using phenylboronic acid (Page 388)
2. Baeyer-Villiger reaction
3. 2-Hydroxybenzaldehyde oxidation using urea-hydrogen peroxideComplex (Page 13)
4. Alumina-supported permanganate oxidation (Page 15)
5. Sulfide oxidation using MnO_2 (Page 21)
6. Oxidative coupling of thiol using MnO_2 (Page 22)
7. Iodine catalysed S-S bond formation of Cystine (Page 28)

G) Solvent free supramolecular assembly formation

1. Caffeine and oxalic acid (Page 420)
2. *rac-Bis*-beta-naphthol and benzoquinone
3. Isovaleraldehyde and pyrogallol

Reference:

Solvent-free Organic Synthesis by Koichi Tanaka (Copyright © 2009 WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim. ISBN: 978-3-527-32264-)

Additional Study Material: https://nptel.ac.in/courses/104/106/104106108/

Semester IV

CCTP- 10, CHO-450: Chemistry of Natural Products [48L +12T]

Section I: [24 L + 6 T]

1. Understanding and planning of total synthesis while maintaining the stereochemistry. A case study: **Longifolene** – (All Nine syntheses from Advanced Organic Chemistry Carey, Sundberg; Part B).
2. **Total Synthesis of** **[12 L]**
   - **i. Hirsutellone B** (Angew. Chem. Int. Ed. 2009, 48, 6870 –6874.)
   - **ii. Ribisins A and B** : (J. Org. Chem. 2019, 84, 15165–15172)
   - **iii. Subincanadine E** : (*For Self-Learning) (J. Org. Chem. 2017, 82, 11126-11133)

Section II : [24 L + 6 T] **[12 L]**

A) **Vannusals**

References:

1. J. Am. Chem. Soc. 2010, 132, 20, 7138-7152.
2. J. Am. Chem. Soc. 2010, 132, 20, 7153-7176.
3. Angew. Chem. Int. Ed. 2009, 48, 5642 –5647.
4. Angew. Chem. Int. Ed. 2009, 48, 5648–5652

B) **Pinnaic acid**

References:

1. Angew. Chem. Int. Ed. 2001, 40 (23), 4450-4452.
2. Angew. Chem. Int. Ed. 2001, 40, (23), 4453-4456.
3. Angew. Chem. Int. Ed. 2007, 46, 5746–5749

CCTP- 11, CHO-451: Organometallic Reagents in Organic Synthesis [48 L + 12T]

1. Transition metal complexes in organic synthesis; Pd, Ni, Ru, Fe, Ir and Cu only (C-C, C-N, C-O bond formation reactions with catalytic cycle, ligand and % mole concepts)**[18 L]**
2. C=C formation reactions: Wittig, Horner-Wordworth-Emmons, Shapiro, Bamford-Stevens, McMurry, Julia-Lythgoe and Peterson olefination reactions. **[6 L]**
3. Multi-component reactions: Ugi, Passerini, Biginelli and Mannich reaction **[3 L]**
4. Ring formation reactions: Pausan-Khand, Bergman and Nazerov cyclization **[3 L]**
5. Click chemistry: criterion for click reaction, Sharpless azides cycloadditions. Click reactions in synthesis of bioconjugates **(sugars and proteins)** **[4 L]**
6. Metathesis: Schrock and Grubbs catalyst, Olefin cross coupling (OCM), ring closing (RCM) and ring opening (ROM) metathesis, application in polymerization and synthesis of small organic molecules. **[6 L]**
7. Use of Boron and Silicon reagents in organic synthesis. **[8 L]**
8. Other important reactions: Baylis Hilman, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction. [*Self Learning]

References:

1. C–N bond forming cross-coupling reactions: an overview: by Jitender Bariwalab and Erik Van der Eycken *Chem. Soc. Rev.*, 2013, **42**, 9283
2. Iron Catalysis in Organic Synthesis Chem. Rev. 2015, 115, 3170–3387.

3. Recent advances in homogeneous nickel catalysis Nature 2014, Vol 509, Page 299-309.
4. Ruthenium-Catalyzed Reactions for Organic Synthesis *Chem. Rev.* **1998**, *98*, 2599-2660.
5. Organic Synthesis Involving Iridium-Catalyzed Oxidation Chem. Rev. 2011, 111, 1825–1845.
6. Aerobic Copper-Catalyzed Organic Reactions Chem. Rev. 2013, 113, 6234–6458.
7. Transition Metals for Organic Synthesis Volume 1 *Edited by M. Beller and C. Bolm* WILEY-VCH Verlag GmbH & Co. KGaA ISBN: 3-527-30613-7
8. Multicomponent Reactions Edited by Jieping Zhu, Hugues Bienayme WILEY-VCH Verlag GmbH & Co. KGaA
9. Organic chemistry – J. Clayden, N. Greeves, S. Warren and P. Wothers (Oxford Press),
10. Some modern methods of organic synthesis – W. Carruthers (Cambridge)
11. Organic synthesis – Michael B. Smith
12. Advanced organic chemistry, Part B – F. A Carey and R. J. Sundberg, 5th edition (2007).
13. Strategic Applications of named reactions in organic synthesis-Laszlo Kurti and Barbara Czako
14. Name Reactions Jie Jack Li (Fourth Expanded Edition), Page No: 1-582.
15. Organic Synthesis Using Transition Metals, by Roderick Bates, Second Edition, A John Wiley & Sons, Ltd., Publication.

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry

OR

CHO-452(B): Applied Organic Chemistry [48L + 12T]

CBOP-4, CHO-452(A): Concepts and Applications of Medicinal Chemistry [48L + 12T]

Section-I: [24 L + 6 T]

1. Introduction to Peptides and proteins, Proteins as biological catalyst Nucleic acids, Metabolism, Chemistry of cofactors/coenzymes, Chemistry of TPP, PLP, Folic Acid and other vitamins, Principle of drug design, Chemistry of diseases and Drug development, Proton pump inhibitors and Problem solving. **[8 L]**
   Additional study material: NPTEL lecture: Organic Chemistry in Biology and Drug Development (full course) https://nptel.ac.in/content/syllabus_pdf/104105120.pdf) https://nptel.ac.in/courses/104/105/104105120/
2. Peptides, sequencing and applications in therapeutics, Solution phase and solid phase peptide synthesis and Modern techniques for biomolecules and disease diagnosis. **[6 L]**
   Additional study material: NPTEL lecture (only 3 topics): Essentials of Biomolecules: Nucleic Acids and Peptides https://nptel.ac.in/content/syllabus_pdf/104103121.pdf https://nptel.ac.in/courses/104/103/104103121/
3. Introduction to medicinal Chemistry. History, drug targets. Drug discovery, design and development, Case Study: Design of Oxamniquine. **[4 L]**
4. Pharmacokinetics and Pharmacodynamics of drug: Drug absorption, distribution, metabolism, elimination and toxicity, drug metabolism, biotransformation, Drug receptor interactions, Hansch Equation and significance of terms involved in it. **[6 L]**

Section II: [24 L + 6 T]

1. Structure and activity Relationship: QSAR, Applications of SAR and QSAR in drug design, physio-chemical parameters lipophilicity, partition coefficient, electronic ionization constant. Case Study: Statins **[10 L]**
2. Introduction, Developments, SAR, Mode of action, limitations and adverse effect of Anti-infective Agents. Beta lactam antibacterial agents (Penicillins, Cephalosporins), Tetracyclins, Macrolides, Chloramphenicol, Polyenes, Amphotrecin-B, Azoles, Amantadine,Acyclovir. Quinine, Quinolines, Quinolones, Refamycine, Sulphonamides **[14 L]**

References:

1. Medicinal Chemistry and Drug Discovery by Burger
2. Introduction to Medicinal Chemistry by Grham and Patrick
3. Introduction to Drug Design by J. R. Dimmock and S.S. Pandeya
4. The Organic Chemistry of Drug Design and Drug Action, 3rd Edition, R. B. Silverman, Academic Press. 2014
5. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F Dorge, 12th Edition, 2010
6. Chemistry of Heterocycles by T. Eicher and S. Hauptmann, Thieme

CBOP-4, CHO-452(B): Applied Organic Chemistry [48 L + 12T]

Section-I: [24 L + 6 T]

1. Covalent Organic Frameworks: Structures, Synthesis, and Applications. **[12 L]**
(Ref: Review article by Maria S. Lohse and Thomas Bein *Adv. Funct. Mater.* 2018, 28(33), 1705553.)

2. Organic Electroluminescent Materials, **[12 L]**
(Ref: Review article by L.S. Hunga and C. H. Chen *Materials Science and Engineering* 2002, R 39, 143–222)

Section –II : [24 L + 6 T]

1. Supramolecular Organic Compounds **[8 L]**

(Ref: Review by Matthew C. T. Fyfe and J. Fraser Stoddart *Accounts of Chemical Research* 1997, 30 (10), 393-401.)

(Ref: Review article by Wei Chen and et al. *Chem. Soc. Rev.*, **2015**, *44*, 2998-3022)

2. Single Molecule Switches **[8 L]**

(Refs: Review article by Wei Chen and et al. *Chem. Soc. Rev.*, **2015**, *44*, 2998-3022.)

2. Molecular Machines **[8 L]**

(References:

1. Review article by David A. Leigh and et al. *Chem. Rev.* 2015, *115*, 10081−10206.
2. Redox-Gated Tristable Molecular Brakes of Geared Rotation. *J. Org. Chem.*, 2017, 82(10), 5354-5366.
3. Massimo Baroncini, Serena Silvi, Alberto Credi. *Chem. Rev.* 2020, *120* (1), 200-268).

References:

1. The Chemistry of Metal–Organic Frameworks- Wiley Online. Print ISBN: 9783527338740, Online ISBN:9783527693078, DOI:10.1002/9783527693078
2. Covalent Organic Frameworks - 1st Edition - Atsushi Nagai, ISBN 9789814800877, Published January 24, 2020 by Jenny Stanford Publishing.

CBOP-5, CHO-453: Practical-III: Select ANY TWO Section I, II and III [96 L + 24 T]

Section-I: Ternary Mixture Separation [48 L + 12 T]

Separation of minimum 12 mixtures containing three components. The mixtures should also involve separation of nitrophenols, amino acids, low boiling and water soluble and insoluble compounds solids and liquids with **multifunctional groups**. The mixture separation should be carried out on micro-scale using ether or water.

The students should be able to

1. Understand and employ concept of type determination and separation
2. Meticulously record physical constants
3. Perform micro scale chemical elemental analysis
4. Perform qualitative estimation of functional groups
5. Recrystallize /distill the separated compounds
6. Extend these skills to organic synthesis

Section-II: Carbohydrates Synthesis and Isolation Natural Products [48 L + 12 T]

Unit I: Carbohydrate Synthesis (Any 3)

1) Synthesis and structural determination of α- and β-D-glucose penta- acetate.
2) Selective deacylation of α- and β-D-glucose penta-acetate.
3) Benzoylation of D-glucose.to D-glucose penta-benzoate.
4) Selective debenzoylation of D-glucose penta-benzoate
5) Synthesis 1.2:5,6-di-O-isopropylene-D-glucofuranose.
6) Synthesis of 1,2: 5.6 – di-O-isopropylene-3-O-benzyl –D-glucofuranose.

Note:

Carbohydrate (sugar molecules) are highly soluble in water, to derivatives the sugar molecules require special practical skill in order to get product in hand.

i) To understand the meaning of dry condition in reaction.
ii) How to prepare dry solvents.
iii) Workup of reaction in minimum quantity of water.
iv) To acquire skill in handling of carbohydrates reaction.

Unit II: Isolation of pigments from the natural products (Any 3)

1. Orange Marigold
2. Rose
3. Sunflower
4. Hibiscus
5. Any colored flowers/fruits available in the local area **(only one is allowed).**

Note: Students should be able to collect reasonable quantities of color pigments to do the characterization (Physical Constant, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to use these pigments for developing food grade natural colors from lesser known plant sources.

Unit III: Isolation of essential oils from the natural products (Any 3)

1. Ginger
2. Lemongrass
3. Garlic
4. Ajwain/ajowan/Trachyspermum ammi
5. Vekhand (achourus calamus) root

6. Any natural products available in the local area **(only one is allowed)**

Note: Students should be able to collect a reasonable quantities of essential oils to do the characterization(Physical Constant, Density, Elemental analysis functional group test) Should form the appropriate derivative. They are encouraged to use these essential oils for the development of the products like soap, perfumes etc.

Unit IV: Isolation of medicinally important component from the natural products (Any 3)

1. Nimbin from Neem leave
2. Amyrin from Apati/Apta bark
3. Eujenol from Tulsi leaves
4. D-Galacturonic Acid from Jeshtamadh
5. Piper from Betel leaf
6. Any medicinally important plants available in the local area **(only one is allowed)**

At least one natural product should be isolated by using column chromatographic techniques (Use micro columns to avoid excess use of solvents)

Note: Students should be able to collect a reasonable quantities natural products to do the characterization (Physical Constant, solubility, Elemental analysis functional group test etc) and should also form the appropriate derivative. They are encouraged to study novel medicinal plants from their local area.

References for Carbohydrates:

1. Essentials of Carbohydrate and Chemistry and Biology: Thisbe K. Lindhorst, WILEY-VCH, 2000.
2. Kawanata , K. P. R. Tretrahedron Lett. 1986, 27, 3415.
3. Bessodes, M., Shamszar, J. Antonakies, K., Synthesis, 1988, 560.

Section-III: Project [48 L + 12 T]

Project/ Industrial Training/Summer Training/ Internships

1. Students should carry out a small research project.
2. This should make them familiar with
   i. Literature survey, research methodologies
   ii. Data Analysis
   iii. Column and TLC chromatographic techniques
   iv. Characterization of the products by analytical and spectral methods.
3. **Project report must be written and submitted in a proper format as follows;**
   i) Certificate (Signed by Project guide and Head of the Department)
   ii) Certificates for Poster/Paper presented in conferences (if any)
   iii) Self declaration certificate for plagiarism
   iv) Introduction (not more than 6 pages)
   v) Results and Discussions
   vi) Experimental Section
   vii) Conclusion
   viii) References (Use ACS format)
   ix) Spectroscopic or other relevant supporting data
   x) Acknowledgement
4. Interdisciplinary projects shall be encouraged; however there **must be some organic chemistry component.**
5. Students should spend enough time for the project works (**at least** 4 hours per week for **15 weeks**)
6. At least 30% students should undertake projects/summer training/Internships etc.
7. If student is performing project in another institute, for such a student, internal mentor must be allotted and he will be responsible for internal assessment of a student. In this

case student has to obtain certificate from both external and internal mentor. ***Systematic record of attendance of project students must be maintained by a mentor.*** Project will be evaluated jointly by three examiners and there will not be any practical performance during the examination. Typically, student has to present his practical work, discuss results and conclusions in details (20-30 min.) which will be followed by question-answer session (10 min). It is open type of examination.

CCPP-04, CHO-454: Practical-II: Convergent and Divergent Organic Syntheses [96 L + 24T]

Note: Any **3 sets** should be conducted from the following convergent and divergent synthesis sets.

Students should acquire **pre-experiment** (Reading MSDS, purification of reactants and reagents, mechanism, stoichiometry etc) and **post-experiment skills** (work-up, isolation and purification of products, physical constants characterization using any spectroscopic methods etc.)

SET-I

A) Convergent Synthesis 1 (Three Stage Synthesis)

1. Stage I: Anisole to 4-nitro anisole to 4-amino anisole (2 steps)
2. Stage II: Toluene to 4-nitro toluene to 3-acyl nitro toluene (2 steps)
3. Stage III: Synthesis of N-(1-(2-methyl-5-nitrophenyl) ethyl) aniline from 4-amino anisole, 3-acyl nitro toluene and SBH (One pot synthesis: MCR)

B) Divergent Synthesis 1 (5 Single Stage Synthesis from Acetyl acetone):

1. Acetyl acetone to Pyrimidine
2. Acetyl acetone to 2,4-dimethyl-1H-benzo[b][1,4]diazepine
3. Acetyl acetone to Pyrazole
4. Acetyl acetone with 1mmol benzaldehyde to 3-benzylidenepentane-2,4-dione
5. Acetyl acetone with 3 mmol benzaldehyde into 3-benzylidene-6-phenylhex-5-ene-2,4-dione

SET-II

A). Convergent Synthesis 2(Three Stage Synthesis)

1. Stage I: 4-Nitro toluene to 4-amino toluene (Reduction by using Sn/HCl)
2. Stage II: Phenol into 2-hydroxy benzaldehyde (Reimer-Tiemann reaction)
3. Stage III: Synthesis of amidoalkyl-2-naphthols from β-Naphthol,4-amino toluene and of 2-hydroxy benzaldehyde (One pot synthesis: MCR)

B). Divergent Synthesis (5 Single Stage Synthesis from β-Naphthol)

1. β-Naphthol to Synthetic dye (By diazonium coupling)
2. β-Naphthol to 6-Bromo-2-naphthol (Bromination reaction)
3. β-Naphthol to β-Naphthyl methyl ether (Methylation reaction)
4. β-Naphthol to temperature dependent sulfonation (Sulfonation reaction)
5. β-Naphthol to (±) Binol then Resolution of Binol (Resolution technique)

SET-III

A). Convergent Synthesis-3 (Three Stage Synthesis)

1. Stage I: Salicylic acid to 5-Chloro-2-hydroxybenzoic acid
2. Stage II: o- Anisidine to 2-methoxy-4-nitroaniline
3. Stage III: Synthesis of 5-chloro-2-hydroxy-N-(2-methoxy-4-nitrophenyl) benzamide from 5-Chloro-2-hydroxybenzoic acid, -methoxy-4-nitroaniline (One pot synthesis: MCR)

B). Divergent Synthesis-3 (5 Single Stage Synthesis from Salysaldehyde)

1. Salicylaldehyde to Salicylaldehyde phenylhydrazone
2. Salicylaldehyde with melanonitrile to 2-iminochromene by intramolecular cyclization.
3. Salicylaldehyde to 2-hydroxy-3,5-dinitrobenzaldehyde

4. Salicylaldehyde to o-Formylphenoxy acetic acid
5. Salicylaldehyde to catechol

SET-IV

A) Convergent Synthesis- 4 (Three Stage Synthesis)

1. Stage I: Benzene to actophenone (F.C acylation)
2. Stage II: 4-Nitrochlorobenzene into 4-amino chlorobenzene (Reduction by using hydrazine)
3. Stage III: Quinoline synthesis by using acetophenone, 4-amino chloro benzene and styrene (One pot synthesis: [3 + 2 + 1] cycloaddition reaction)

B). Divergent Synthesis-4 (5 Single Stage Synthesis from Acetophenone)

1. Acetophenone to Ethyl benzene by Wolf Kishner reduction
2. Acetophenone to m-Nitro acetophenone by nitration
3. Acetophenone to Chalcone using aromatic aldehyde
4. Acetophenone into Schiff base using aromatic amine
5. Acetophenone to Benzoic acid and Iodoform

References

1. Practical organic chemistry by Mann and Saunders
2. Text book of practical organic chemistry –by Vogel
3. The synthesis, identification of organic compounds –Ralph L. Shriner, Christine K.F. Hermann, Terence C. Morrill and David Y. Curtin

Important Notes for Practical Courses

- All experiments should be carried out on micro-scale and by considering stoichiometric quantities of reactants and reagents with the proper understanding of the mechanism.
- Post graduate departments should arrange at least **one study visit to relevant industry/national research laboratory/premier academic institute.**
- Students must read MSDS and should handle chemicals and reactions accordingly.
- The necessary reactions should be carried out in fume hood and appropriate safety measures should be taken during the laboratory experiments and projects.
- All reactions should be **monitored using alumina coated TLC plates.**
- Certified journals should be presented at the time of final examination.
- Students opting for the projects are encouraged to participate in AVISHKAR, national and international conferences and other project competitions.
- Teachers are encouraged to give the project ideas based on the societal needs.

List of Courses addresses crosscutting issues as per new syllabus (CBCS- 2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	B. Sc. Mathematics	MT-113	Mathematics Practical	Professional Ethics
2	B. Sc. Mathematics	MT-123	Mathematics Practical	Professional Ethics
3	B. Sc. Mathematics	MT232(A)	Numerical Methods and Its Applications	Professional Ethics
4	B. Sc. Mathematics	MT-232(B)	Graph Theory	Professional Ethics
5	B. Sc. Mathematics	MT-233	Mathematics Practical based	Professional Ethics
6			on MT - 231 and MT - 232	
7	B. Sc. Mathematics	MT-242(B)	Dynamical Systems	Professional Ethics
8	B. Sc. Mathematics	MT-243	Mathematics Practical based	Professional Ethics
9			on MT - 241 and MT-242	
10	B. Sc. Mathematics	MT 355(A)	Operations Research	Professional Ethics
11	B. Sc. Mathematics	MT 355(C)	C- Programming	Professional Ethics
12	B. Sc. Mathematics	MT356(A)	Machine Learning-I	Professional Ethics
13	B. Sc. Mathematics	MT 356(B)	Number Theory	Professional Ethics
14	B. Sc. Mathematics	MT 356(C)	Laplace Transform and Fourier Series	Professional Ethics
15	B. Sc. Mathematics	MT 357	Practical Course Lab-1(on Metric Space and Real Analysis-I)	Professional Ethics
16	B. Sc. Mathematics	MT 358	Practical Course Lab-II(on Differential equations)	Professional Ethics
17	B. Sc. Mathematics	MT 359	Practical Course Lab-III (on DSE-3A and DSE-3B)	Professional Ethics

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18	B. Sc. Mathematics	MT -3510	Programming in Python-I	Professional Ethics
19	B. Sc. Mathematics	MT-3511	LaTeX for Scientific Writing	Professional Ethics
20	B. Sc. Mathematics	MT 365(A)	Optimization Techniques	Professional Ethics
21	B. Sc. Mathematics	MT 365(B)	Calculus of Variation and Classical Mechanics	Professional Ethics
22	B. Sc. Mathematics	MT 365(C)	Financial Mathematics	Professional Ethics
23	B. Sc. Mathematics	MT366(A)	Machine Learning-II	Professional Ethics
24	B. Sc. Mathematics	MT 366(B)	Computational Geometry	Professional Ethics
25	B. Sc. Mathematics	MT366(C)	Lebesgue Integration	Professional Ethics
26	B. Sc. Mathematics	DSE-4MT367	Practical Course Lab-1(on Complex Analysis and Real Analysis-II)	Professional Ethics
27	B. Sc. Mathematics	MT 368	Practical Course Lab-II(on Ring Theory and Partial Differential Equations)	Professional Ethics
28	B. Sc. Mathematics	MT 369	Practical Course Lab-III (on DSE-6A and DSE-6B)	Professional Ethics
29	B. Sc. Mathematics	SEC-III MT 3610	Programming in Python-II	Professional Ethics
30	B. Sc. Mathematics	SEC-IVMT3611	Mathematics into LaTeX	Professional Ethics
31	M.Sc. Mathematics	MTUT 114	Advance Calculus	Professional Ethics
32	M.Sc. Mathematics	MTUT 124	Advance Numerical Analysis	Professional Ethics
33	M.Sc. Mathematics	MTUT 133	Programming with Python	Professional Ethics
34	M.Sc. Mathematics	MTUTO134	Discrete Mathematics	Professional Ethics

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35	M.Sc. Mathematics	MTUTO 135	Mechanics	Professional Ethics
36	M.Sc. Mathematics	MTUTO136	Advanced Complex Analysis	Professional Ethics
37	M.Sc. Mathematics	MTUTO137	Integral Equations	Professional Ethics
38	M.Sc. Mathematics	MTUTO 138	Differential Manifolds	Professional Ethics
39	M.Sc. Mathematics	MTUT 141	Fourier Series and Boundary Value Problems	Professional Ethics
40	M.Sc. Mathematics	MTUT 142	Differential Geometry	Professional Ethics
41	M.Sc. Mathematics	MTUT 143	Introduction to Data Science	Professional Ethics
42	M.Sc. Mathematics	MTUTO144	Number Theory	Professional Ethics
43	M.Sc. Mathematics	MTUTO147	Coding Theory	Professional Ethics
44	M.Sc. Mathematics	MTUTO148	Probability and Statistics	Professional Ethics

List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Mathematics	Principles of Programming Language	CC.004	2019-20	Professional Ethics

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List Showing Curricular and Extra Curricular activities to address Crosscutting Issues (Similar/repeated activities are not listed).

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1	Guest lecture on the topic 'History of Mathematics' on 20th December 2019	Professional Ethics, Human Values	
2	Covid -19 Vaccination camp 28/10/2021	Human Values, Environment and Sustainability	 

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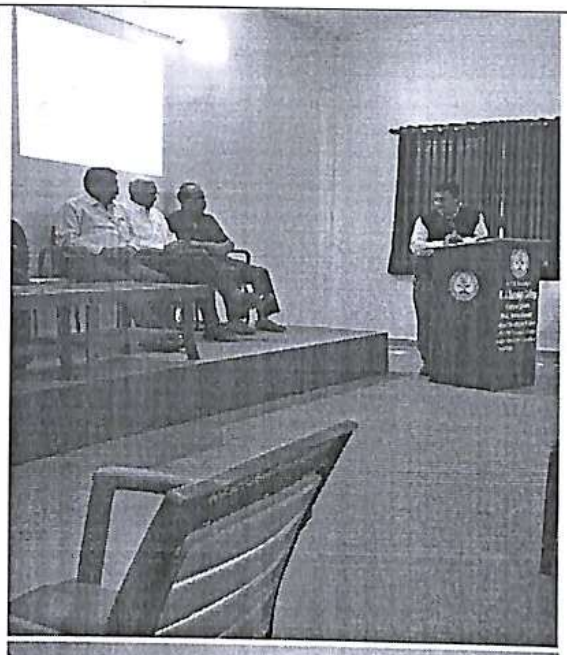
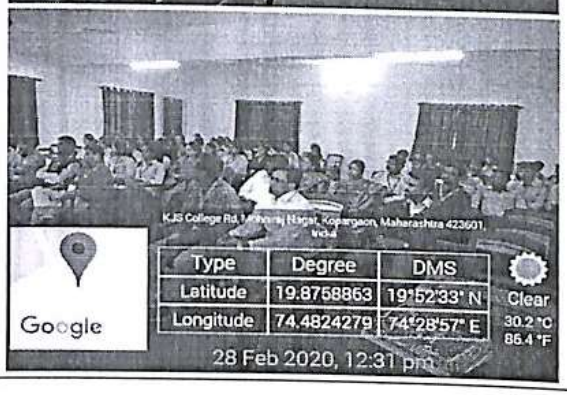
3	Department of Mathematics celebrated the 'National Science Day' on 28th February 2020. On this occasion Dr. B. D. Gavhane delivered a lecture for science stream students on the topic 'Current innovations in science and technology'	Professional Ethics, Human Values	 
4	Dr.B.D.Gavhane worked as a examiner in a state level science exhibition held on 24-27th Feb. 2020 organized by National education research and training organization, Government of Maharashtra	Professional Ethics, Gender, Human Values, Environment and Sustainability	

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5	guest lecture of Dr. K. C. Takale, Department of Mathematics, Bytco College, Nashik on 15th Sep.2019 on the topic 'Maxima Software'	Professional Ethics	
6	guest lecture of Dr. K. C. Takale, Department of Mathematics, Bytco College, Nashik on 29th Jan. 2020 on the topic 'Computational Mathematics using Maxima software'	Professional Ethics	

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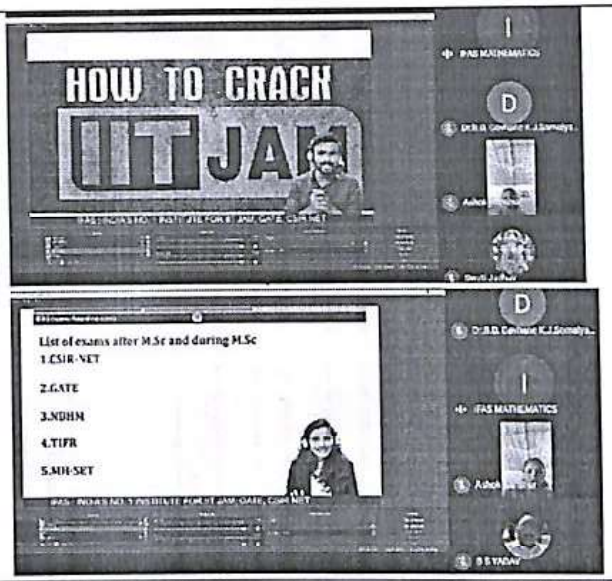
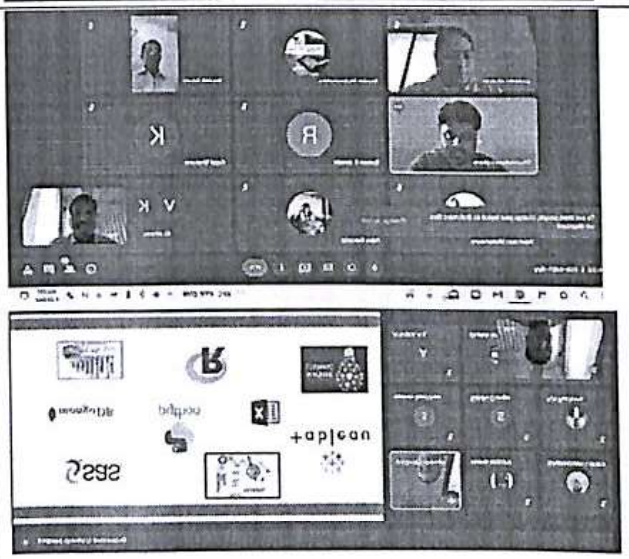
7	department of Mathematics organized one day National webinar on 'Strategies to Crack Competitive Exams in Mathematics' on 3rd February 2021. To	Professional Ethics	
8	Department of Mathematics, IQAC and EduBridge Learning organized one day National Seminar on 'Data Science with R and Python' on 28th April 2022.	Professional Ethics	

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9	poster presentation competition was organized for students and 35 students participated in this competition on 22nd Dec. 2021	Professional Ethics, Human Values, Environment and Sustainability	 
10	guest lecture of Dr. Professor Lahu Gaikwad (Narayangaon College) on the topic 'History of Indian Mathematicians' on 22nd Dec.2021	Professional Ethics, Gender, Human Values, Environment and Sustainability	

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11	guest lecture of Dr. K. C. Takale, Department of Mathematics, Bytco College, Nashik on 1st October 2022 for all students of department of Mathematics on the topic 'Latex: Scientific Writing Language'	Professional Ethics	 
12	online guest lectures of Prof. Suresh Ghule, Department of Mathematics, Ahmednagar College, Ahmednagar on 3rd January 2022 for all students of department of Mathematics about the topic 'Preparation of Madhava Mathematics competition Exam'	Professional Ethics	

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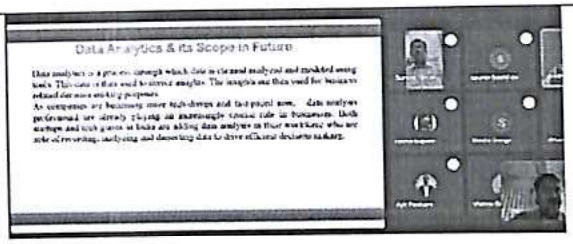
13	online guest lectures of Prof. Suresh Ghule, Department of Mathematics, Ahmednagar College, Ahmednagar on 4th January 2022 for all students of department of Mathematics about the topic 'Data Science'	Professional Ethics	
14	Department of Mathematics organized two days educational tour at Konkan Darshan: Aakvira Devi-Karle-Leni-Diveaagar-Janjira Fort on 5-6th May 2022. Thirty two students of department participated in this tour.	Professional Ethics, Gender, Human Values, Environment and Sustainability	 

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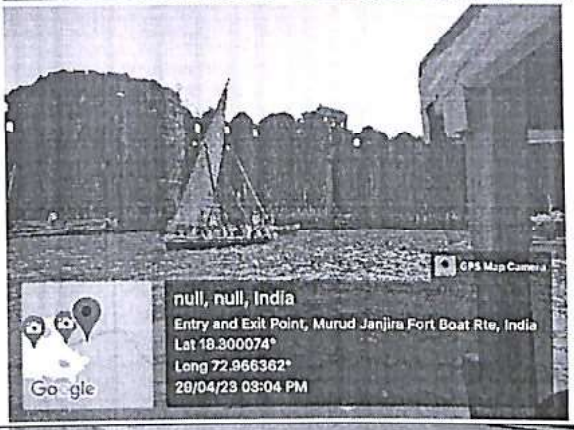
15	Department of Mathematics along with department of Botany and B.C.A. organized two days educational tour at Konkan Darshan: Ganpatipule-Diveaagar-Janjira Fort on 28-29th May 2023. Fifteen students of the department participated in this tour	Professional Ethics, Gender, Human Values, Environment and Sustainability	 
16	Department of Mathematics organized two days educational tour at Panchgani-Mahabaleshwar on 27-28th Jan. 2020. Thirty nine students of department participated in this tour.	Professional Ethics, Gender, Human Values, Environment and Sustainability	

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Sr.No.	Title of the Activity	Period		Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
		From	To	
1	students appeared for the Madhva Mathematics competition which was organized by TIFR and Homi Bhaba Centre for Science Education, Mumbai	Every Academic year		Professional Ethics
2	National Mathematics day	Every Academic year		Human values
3	department of mathematics organized a certificate course 'Principles of programming language' (computer based Practicals)	Every Academic year (from 2019-20		Professional Ethics
4	Department of Mathematics organized online guest lecture of Dr. K. C. Takale, Department of Mathematics, Bytco College, Nashik on the topic 'Maxima Software'	17th February 2021		Professional Ethics
5	Department of Mathematics organized online guest lecture of Dr. K. C. Takale, Department of Mathematics, Bytco College, Nashik on the topic 'Python Software'	29th January 2022		Professional Ethics

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6	guest lecture of Prof. T. K. Kumkar, Arts, Commerce and Science College, Rahata on the topic 'Time Management'	16th March 2022	Professional Ethics, Gender, Human Values
7	guest lecture of Prof. M.B. Labade M.J.S. College, Shrigonda on the topic 'Gender Equality'	26th March 2022	Gender, Human Values
8	Dr. Giramkar K.L. delivered a lecture on the topic 'Ramanujan: Great Indian Mathematician'.	22nd December 2022	Professional Ethics,Human Values

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Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Mathematics

(Faculty of Science & Technology)

F.Y.B.Sc. (Mathematics)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Title of the Course: B. Sc (Mathematics)

Preamble:

SavitribaiPhule Pune University has decided to change the syllabi of various faculties from June,2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects board of studies in mathematics with concern of teachers of mathematics from different colleges affiliated to SavitribaiPhule Pune University has prepared the syllabus of F. Y. B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

(i) Give the students a sufficient knowledge of fundamental principles,methods and a clearperception of innumerous power of mathematical ideas and tools and know how to usethem by modeling ,solving and interpreting.
(ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science and technology.
(iii) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skills , creative talent and power of communication necessary for various kinds of employment .
(iv) Enabling students to develop a positive attitude towards mathematics as an interestingand valuable subject of study.

Objectives:

(i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays , state important facts resulting from their studies.
(ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
(iii) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
(iv) A student be able to apply their skills and knowledge ,that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
(v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Course Outcome:

Upon successful completion of this course, the student will be able to:
i) The mathematical maturity of students in their current and future courses shall develop.
ii) The student develops theoretical, applied and computational skills.
iii) The student gains confidence in proving theorems and solving problems.

Structure of the course:

	Semester - I		Semester -II		Credit
Paper I	MT-111	Algebra	MT-121	Analytical Geometry	2
Paper II	MT-112	Calculus - I	MT-122	Calculus - II	2
Paper III	MT-113	Mathematics Practical	MT-123	Mathematics Practical	1.5

Proposed Structure of S. Y. B. Sc. Mathematics Courses:

	Semester - III		Semester -IV		
Paper I	MT-231	Calculus of Several Variables	MT-241	Linear Algebra-I	2
Paper II	MT-232 (A)	Laplace Transform and Fourier Series	MT-242(A)	Vector Calculus	2
	MT-232 (B)	Computational Geometry	MT-242(B)	Numerical Analysis	2
Paper III	MT-233	Mathematics Practical	MT-243	Mathematics Practical	2

Proposed Structure of T. Y. B. Sc. Mathematics Courses:

Semester- V		Semester- VI		Credit
MT 351	Matric Spaces	MT 361	Complex Analysis	2
MT 352	Real Analysis-I	MT 362	Real Analysis-II	2
MT 353	Problem Course on MT 351 and MT 352	MT 363	Problem Course on MT 361 and MT 362	2
MT 354	Group Theory-I	MT 364	Ring Theory-I	2
MT 355	OrdinaryDifferential Equations–I	MT 365	Partial Differential Equations-I	2
MT 356	Problem Course on MT 354 and MT 355	MT 366	Problem Course on MT 364 and MT 365	2

Select Any Two out of six courses				
MT357:A	Operations Research	MT367: A	Optimization Techniques	2
MT357:B	Number Theory	MT367: B	Graph theory	2
MT357:C	C- Programming	MT367: C	Lebesgue Integration	2
MT357:D	Lattice Theory	MT367: D	Financial Mathematics	2
MT357:E	Python Course -I	MT367: E	Python Course-II	2
MT357:F	Machine Learning Course- I	MT367: F	Machine Learning Course- II	2
MT 338	Practical based on papers selected from 357 A to 357 F	MT 348	Practical based on papers selected from 367 A to 367 F	2
MT-3510	Skill Enhancement course in maths	MT-3511	Skill Enhancement course in maths	2
MT-3610	Skill Enhancement course in maths	MT-3611	Skill Enhancement course in maths	2

All three above courses are compulsory.

1. Equivalence of Previous syllabus along with new syllabus:

	Old course	New Course
Paper I	MT-101 : Algebra and Geometry	MT-111: Algebra and MT-121 : Analytical Geometry
Paper II	MT-102 : Calculus and Differential Equations	MT-112 : Calculus - I and MT-122 : Calculus – II
Paper III	MT-103 : Mathematics Practical	MT – 113 : Mathematics Practical and MT – 113 : Mathematics Practical

Details of Syllabus:

Semester – I

MT 111- Algebra

Unit 1: Sets Relations and Functions (8 Lectures)

1.1 Sets, Relations, Equivalence relations, Equivalence classes and partitions of a set

1.2 Functions, Basic terminology, Types of Functions, Inverse of a Function, Composition of Functions (Excluding theorems only examples).

Unit2: Divisibility Theory in the Integers(10 Lectures)

2.1 Mathematical Induction:Well-Ordering Principle.

2.2 The Division Algorithm, The Greatest Common Divisor, Euclid's Lemma, The Least Common Multiple, The Euclidean Algorithm.

Unit 3: Primes and the theory of Congruence (8 Lectures)

3.1 The Fundamental Number of Arithmetic: Prime Numbers, Euclid's Lemma.

3.2 The theory of Congruence: Basic Properties of congruence.

3.3 Fermat's Theorem

Unit 4: Complex Numbers (10 Lectures)

4.1 Sums and Products, Basic Algebraic Properties, Moduli, Complex Conjugates, Exponential form, Products and Quotients, De-Moivre's theorem.

4.2 Roots of Complex Numbers: The nth roots of unity.

4.3 Regions in Complex Plane.

Text Books:

1. **A Foundation Course in Mathematics, Ajit Kumar, S. Kumeresan and Bhaba Kumar Sarma, Narosa Publication House.**
Unit 1: Chapter 2: Sec. 2.1 to 2.5, Chapter 3: Sec. 3.1 to 3.6, Chapter 4: Sec. 4.1 to 4.4.
2. **Elementary Number Theory, David M. Burton, Tata McGraw Hill, Sixth Edition.**
Unit 2: Textbook 2: Chapter 1: Sec. 1.1, Chapter 2: Sec. 2.2 to 2.4
Unit 3: Textbook 2: Chapter 3: Sec. 3.1, Chapter 4: Sec. 4.1, 4.2, Chapter 5: Sec. 5.2.
3. **Complex Variables and Applications, James Ward Brown and Ruel V. Churchill, Mc-Graw Hill, Seventh Edition.**

Unit 4: Textbook 3: Chapter 1: Sec 1 to 10.

Reference Books:

1. Textbook of Algebra, S. K. Shah and S. C. Garg, Vikas Publishing House Pvt. Ltd. Edition 2017.
2. Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert,John Wiley and Sons Inc, Fourth Edition.

MT 112: CALCULUS - I

Unit 1: Real Numbers (06 Lectures)

1.1 The Algebriac and Order Properties of R:
Algebraic properties of R, Order properties of R, Well-Ordering Property of N. Arithmetic mean-Geometric mean inequality, Bernoulli's inequality.
(Revision: essential properties should be revised with illustrative examples)

1.2 Absolute Value and the Real Line:
Absolute value function and its properties, triangle inequality and its consequences, neighborhood of a point on real line.

1.3 The Completeness Property of R:
Definitions of Upper bound, Lower bound, supremum, infimum of subsets of R, completeness property of R.

1.4 Applications of the Supremum Property:
Archimedean property and its consequences, The density theorem (without proof).

Unit 2. Sequences (10 Lectures)

2.1 Sequences and Their Limits:
Definition and examples of sequences of real numbers, Definition of limit of sequence and uniqueness of limit, Examples on limit of sequence.

2.2 Limits Theorems:
Definition of bounded sequence, Every convergent sequence is bounded, Algebra of limits.

2.3 Monotone Sequences:
Definition and examples of monotone sequences, Monotone convergence theorem and examples.

2.4 Subsequences and Bolzano -Wierstrass Theorem:
Definition of subsequence and examples, Divergence criteria, Monotone Subsequence theorem (without proof), Bolzano -Wierstrass theorem (first proof).

Unit 3. Limits (08 lectures)

3.1 Functions and their Graphs:

Functions, domain and range, graphs of functions, representing a function numerically, Vertical line test, Piecewise defined functions, increasing and decreasing functions, even and odd functions symmetry, common functions

3.2 Limits of Functions:
Definition of cluster point and examples, definition of limit of a function, sequential criterion for limits, divergence criteria.

3.3 Limit Theorems:
Algebra of limits (proofs using sequential criterion) ,Squeeze theoerem.

3.4 Some extension of limit concepts:
one-sided limits, infinite limits (without proof) .

Unit 4: Continuity (12 lectures)

4.1 Continuous Functions:
Definition of continuous function at a point , sequential criterion for continuity, Divergence criterion, combination of continuous functions.

4.2 Continuous Functions on Intervals:
Properties of continuous functions on an interval, Boundedness theorem (without proof), The minimum -maximum theorem(without proof), Location of root theorem (Without proof), Bolzano's intermediate value theorem. Continuous function maps closed bounded interval to closed bounded interval, Preservation of interval theorem.

Textbook Books:

1. **Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons Inc, Fourth Edition.**
Unit 1: Chapter 2: Sec 2.1 (2.1.1 to 2.1.13), Sec. 2.2(2.2.1 to 2.2.9), 2.3, 2.4(2.4.1, 2.4.3 to 2.4.6, 2.4.8, 2.4.9).
Unit 2: Chapter 3: Sec. 3.1(3.1.1 to 3.1.7, 3.1.10, 3.1.11), Sec. 3.2(3.2.1 to 3.2.11), Sec. 3.3(3.3.1, 3.3.4), Sec. 3.4 (3.4.1 to 3.4.3, 3.4.5 to 3.4.8).
Unit 3: Chapter 4: Sec. 4.1(4.1.1, 4.1.3 to 4.1.9), Sec. 4.2(4.2.1 to 4.2.8), Sec. 4.3 (4.3.1 to 4.3.9).
Unit 4: Chapter 5: Sec. 5.1, Sec. 5.2, Sec 5.3 (5.3.1 to 5.3.5, 5.3.7 to 5.3.10).

2. **Thomas Calculus, Thirteenth edition, Pearson Publication.**
Unit 3: Text book-2: Chapter 1: Sec. 1.1.

Reference books:

1 Introduction to Real analysis, William F.Trench, Free edition, 2010.
2 Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3 Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4 Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.

MT 113: Mathematics Practical

(Practicals based on the applications of articles in MT 111 and MT 112)
In Semester-I, we should conduct 3 written practical and 3 practical on maxima software for each paper MT-111 and MT-112.

List of Practical

Practical 1 : Problems on Unit 1 and Unit 2(Written) from MT-111.
Practical 2 : Problems on Unit 3 (Written) from MT-111.
Practical 3 : Problems on Unit 4(Written) from MT-111.
Practical 4 :Introduction to *maxima software* forMT-111.
Practical 5 : Problems on unit 1 and unit 2 from MT-111using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MT-111using maxima software.
Practical 7: Problems on Unit 1 and Unit 2(Written) from MT-112.
Practical 8 : Problems on Unit 3 (Written) from MT-112.
Practical 9 : Problems on Unit 4(Written) from MT-112.
Practical 10 :Introduction to maxima software for MT-112.
Practical 11 : Problems on unit 1 and unit 2 from MT-112using maxima software.
Practical 12 : Problems on Unit 3 and Unit 4 from MT-112 using maxima software.

Note:

1 The soft copy of practicals on maxima software will be prepared and provided by the Board of Studies in mathematics.

2. Practicals on maxima software can be performed on computer and android mobiles.

3. Android mobiles are allowed for practical examination on maxima software .

4.Practical examination of 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Semester - II

MT 121-Analytical Geometry

Unit 1: Analytical Geometry of Two Dimension **(10 Lectures)**

1.1. Change of axes: translation and rotation.
1.2. Conic Sections: General equation of second degree in two variables
1.3. Reductionto standard form, center of conic, nature of conic.

Unit 2: Planes **(10 Lectures)**

2.1. Direction cosines and direction ratios,Equation of plane, Normal form, Transform to the normal form, Plane passing through three non-collinear points, Intercept form, Angle between two planes.
2.2. Distance of a point from a plane, Distance between parallel planes, Systems of planes, two sides of planes, Bisector planes.

Unit 3: Lines in three dimension **(8 lectures)**

3.1. Equations of a line in Symmetric and unsymmetrical forms, Line passing through two points, Angle between a line and a plane.
3.2. Perpendicular distance of a point from a plane, Condition for two lines to be coplanar (without proof).

Unit 4: Sphere **(8 Lectures)**

4.1. Equation of a sphere in different forms, plane section of a sphere.
4.2. Equation of a circle, sphere through a given circle
4.3. Intersection of a sphere and a line, Equation of tangent plane to sphere.

Text Books:

1. **Analytic Geometry in Two and Three Dimensions : Von Steuben**
Unit1: Sec, 8.4
2. **Analytical Solid Geometry: Shantinarayan; S. Chand and Company Ltd, New Delhi, 1998.**
Unit2: Sec. 1.6,1.7, Sec. 2.1 to 2.7
Unit3: Sec. 3.1 to 3.4, 3.7
Unit4: Sec. 6.1 to 6.6.

Reference Book:

1. P.K.Jain and Khalil Ahmad,A Text Book of Analytical Geometry of Three Dimensions, Wiley Estern Ltd. 1999.

MT 122: Calculus-II

Unit 1: Differentiation **(10 lectures)**

1.1. The Derivatives:
Definition of the derivative of a function at a point, every differentiable function is continuous, Rules of differentiation, Caratheodary'stheorem(without proof), The chain rule, Derivative of inverse function (without proof , only examples).

1.2 The Mean Value Theorems:
Interior extremum theorem, Mean Value theorems and their Consequences, Intervals of increasing and decreasing of a function,first derivative test for extrema.

Unit 2: L' Hospital Ruleand Successive Differentiation(10 lectures)

2.1 L'Hospital Rule:
Indeterminate forms, L'Hospital Rules(without proof)

2.2 Taylor's theorem: Taylor's theorem and Maclaurin'stheorem with Lagrange's form of remainder(Without proof).

2.3 Successive Differentiation: The nth derivative and Leibnitz theorem for successive differentiation.

Unit 3: Ordinary Differential Equations **(08 lectures)**

3.1 Linear first order equations.
3.2 Separable equations.
3.3 Existence and Uniqueness of solutions of nonlinear equations.

Unit 4: Exact Differential Equations **(08 lectures)**

4.1 Transformation of nonlinear equations to separable equations.
4.2 Exact differential equations.
4.3 Integrating factors.

Textbooks:

1. **Introduction to Real Analysis by R.G. Bartle and D.R. Sherbert, John Wiley and Sons, Inc., Fourth Edition.**
   Unit 1: Chapter 6: Sec. 6.1(6.1.1 to 6.1.8), Sec 6.2(6.2.1 to 6.2.8).
   Unit 2: Chapter 6: Sec 6.3(6.3.1 to 6.3.7), Sec 6.4(6.4.1 to 6.4.3).
2. **Differential Calculus by Shanti Narayan, Tenth Revised Edition.**
   Units 2: Chapter 5: Sec. 5.1 to 5.6.
3. **Elementary Differential equations, William F. Trench, E-book (Free download)**
   Unit 3: Chapter 2: Sec 2.1 to 2.3.
   Unit 4: Chapter 2: Sec 2.4 to 2.6.

Reference books:

1. Introduction to Real analysis, William F.Trench, Free edition, 2010.
2. Calculus of a single variable Ron Larson , Bruce Edwards, tenth edition.
3. Elementary Analysis, The Theory of Calculus, Kenneth A. Ross, Springer Publication, second edition.
4. Calculus and its Applications, Marvin L. Bittinger, David J. Ellenbogen and Scott A. Surgent, Addison Wesley, tenth edition.
5. Ordinary and partial Differential equations,M.D. Raisingania, S. Chand andCompany,2009.

MT 123: Mathematics Practical

(Practical based on the applications of articles in MT 121 and MT 122)

In Semester-II, we should conduct 4 written practical and 2 practical on maxima software for each paper MT-121 and MT-122.

List of Practical

Practical 1 : Problems on Unit 1 (Written) from MT-121.
Practical 2 : Problems on Unit 2 (Written) from MT-121.
Practical 3 : Problems on Unit 3(Written) from MT-121.
Practical 4 :Problems on Unit 4(Written) from MT-121.
Practical 5 : Problems on unit 1 and unit 2 from MT-121using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MT-121using maxima software.
Practical 7: Problems on Unit 1 (Written) from MT-122.
Practical 8 : Problems on Unit 2 (Written) from MT-122.
Practical 9 : Problems on Unit 3(Written) from MT-122.
Practical 10 :Problems on Unit 4(Written) from MT-122.
Practical 11 : Problems on unit 1 and Unit 2 from MT-122using maxima software.
Practical 12: Problems on Unit 3 and Unit 4from MT-122 using maxima software.

Note:

1 The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.
2. Practicals on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on maxima software .
4.Practical examination 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Modalities For Conducting The Practical and The Practical Examination:

1) There will be one 3 hour practical session for each batch of 15 students per week.

2) The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The practical examination will consist of written examination of 20 marks, 10 marks on maxima software and oral examination of 05 marks.

3) There will be no external examiner, the practical exam will be of the duration of 3 hours.

4) The subject teacher will set a question paper based on pattern as follows:

Q1. Any 2 out of 4 each question of 5 marks on paper - I.

Q2.Any 2 out of 4 each question of 5 marks on paper - II.

Q3. (a) Any 1 out of 2 each question of 5 marks on maxima software from paper – I.

(b) Any 1 out of 2 each question of 5 marks on maxima software from paper – II.

5) Each student will maintain a journal to be provided by the college.

7) The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical.

8) It is recommended that concept may be illustrated using computer software maxima andgraphing calculators wherever possible.

9) Study tours may be arranged at places having important mathematical institutes or historical places.

10) **Special Instruction:**

a) There should be well equipped mathematics practical laboratory of size 20 X 20 sq. fts containing at least 10 computers.

b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per rule.

c) Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed.

Savitribai Phule Pune University, Pune

(Formerly University of Pune)

Second Year B.Sc in Mathematics

(Faculty of Science & Technology)

Revised Syllabi for

S.Y.B.Sc. - Mathematics

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System Syllabus

To be implemented from the Academic Year 2020-2021

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE
Board of Studies in Mathematics Syllabus for S. Y. B. Sc
Subject: MATHEMATICS
(With effect from June 2020)

Introduction:

Savitribai Phule Pune University, Pune has decided to change the syllabi of various faculties from June 2020. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects Board of studies in Mathematics with concern of teachers of Mathematics from different colleges affiliated to Savitribai Phule Pune University, Pune has prepared the syllabus of S.Y.B.Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Aims:

- Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling ,solving and interpreting.
- Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
- Enhancing students overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment .
- Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

- A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such as notations, terminology and recognize basic geometrical figures and graphical displays ,state important facts resulting from their studies.
- A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.
- A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.
- A student be able to apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
- A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.

Eligibility: F. Y. B. Sc., as per University rules.

Structure of the course:

Semester - III			Semester -IV	
Paper I	**MT-231**	**Calculus of Several Variables**	**MT-241**	**Linear Algebra**
Paper II	**MT-232(A)**	**Numerical Methods and Its Applications**	**MT-242(A)**	**Vector Calculus**
	MT-232(B)	**Graph Theory**	**MT-242(B)**	**Dynamical Systems**
Paper III	**MT-233**	**Mathematics Practical based on MT - 231 and MT - 232**	**MT-243**	**Mathematics Practical based on MT - 241 and MT-242**

- All three above courses are compulsory.
- In Semester-III, select any one from **MT-232(A) and MT-232(B).**
- In Semester-IV, select any one from **MT-242(A) and MT-242(B).**

Medium of Instruction: English.

Examination:

A) Pattern of examination: Semester.
B) Standard of passing: 20 marks out of 50 marks for each papers.
But for MT- 231, MT -232(A), MT -232(B), MT -241, MT -242(A), MT -242(B), MT -233 and MT-243 for passing a student should obtain minimum 14 marks out of 35 in the theory examination and overall total marks for theory and internal should be minimum 20.
C) Pattern of question papers: For MT- 231, MT -232(A), MT -232(B), MT -241, MT -242(A), MT -242(B).

Q1. Attempt any 05 out of 07 questions each of 01 marks. [05 Marks]

Q2. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q.3. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q4. Attempt any 02 out of 04 questions each of 10 marks. [10 Marks].

D) External Students: Not allowed.

E) Verification /Revaluation: Allowed for MT- 231, MT -232(A), MT -232(B), MT - 241, MT -242(A), MT -242(B).

The pattern of question paper for MT -233, MT-243 is given in the detailed syllabus.

Equivalence of Previous syllabus along with new syllabus:

	Semester-III		Semester-IV	
	New Course	Old Course	New Course	Old Course
Paper I	MT-231: Calculus of Several Variables	MT-211 : Multivariable Calculus-I	MT-241:Linear Algebra	MT-221: Linear Algebra
Paper II	MT-232(A): Numerical Methods and Its Applications MT-232(B): Graph Theory	MT-212(A): Discrete Mathematics MT- 212(B): Laplace Transform and Fourier Series	MT-242(A): Vector Calculus MT-242(B): Dynamical Systems	MT-222(A): Multivariable Calculus - II MT-212(B): Numerical Analysis
Paper III	MT-233: Mathematics Practical based on MT-231 and MT-232	MT-213 : Mathematics Practical based on MT-211 and MT-212	MT-243: Mathematics Practical based on MT-241 and MT-242	MT–223: Mathematics Practical based on MT-221 and MT-222

Qualifications for Teacher: M.Sc. Mathematics (with NET /SET as per existing rules).

Semester – III

MT-231: Calculus of Several Variables

Unit-1 Limits and Continuity

1.1 Functions of Several Variables :- Functions of two variables, Domain and Range, Graphs, Level Curves, Functions of Three or More Variables **[06 lectures]**

1.2 Limits and Continuity.

Unit-2 Partial Derivatives and Differentiability

2.1 Definition and examples.

2.2 Higher Derivatives, Clairaut's Theorem (Statement Only) , Partial Differential Equations, Wave equation. **[10 lectures]**

2.3 Differentiable function, Differentials

2.4 Chain Rule, Homogeneous Functions, Euler's theorem **[08 lectures]**

Unit-3 Extreme Values

3.1 Extreme values of functions of two variables.

3.2 Necessary conditions for extreme values.

3.3 Second Derivative Test (without proof).

3.4 Lagrange Multipliers (with one constraints) **[12 lectures]**

Unit-4 Multiple Integrals

4.1 Iterated Integrals, Fubini's Theorem (Statement only)

4.2 Double integral over general regions, Change of order of integration for two variables.

4.3 Double integral in Polar coordinates.

4.4 Triple integrals , Evaluation of triple integrals. Triple integrals in spherical coordinates

4.5 Jacobians , Change of variables in multiple integrals .(Results without proofs)

Text book: Multivariable Calculus 7th Edition By James Stewart, Brooks/Cole, Cengage Learning, 2012, 2008.

Unit 1:- Chapter 14: Sec- 14.1, 14.2
Unit 2:- Chapter 14: Sec- 14.3(except the Cobb-Douglas production function), 4.4 (except Tangent Planes and Linear Approximations), Sec-14.5
Unit 3:- Chapter 14: Sec 14.7, 14.8 (except two constraints)
Unit 4:- Chapter 15: Sec 15.2, 15.3, 15.4, 15.7 (without Riemann sum and Application), 15.9, 15.10

Reference Books:

1. Basic Multivariable Calculus, J. E. Marsden, A. J. Tromba , A. Weinstein, Springer Verlag (Indian Edition).
2. Shanti Narayan, R.K. Mittal, A Text-book of Vector Calculus, S.Chand and Company.
3. D.V. Widder, Advanced Calculus (2nd Edition), Prentice Hall of India ,NewDelhi,(1944).
4. T.M. Apostol , Calculus Vol. II (2nd Edition), John Wiley, New York, (1967).

MT-232(A): Numerical Methods and It's Applications

Unit1: Solution of Algebraic and Transcendental Equations **[10 Lectures]**

1.1 Errors and their computations
1.2 Bisection method.
1.3 The method of False position
1.4 Newton- Raphson method **[12 Lectures]**

Unit 2: Interpolation

2.1 Finite Difference Operators and their relations (Forward, Backward difference and Shift operator).
2.2 Differences of a polynomial
2.3 Newton's Interpolation Formulae (Forward and Backward)
2.4 Lagrange's Interpolation Formula

Unit 3: Numerical Differentiation and Integration **[06 Lectures]**

3.1 Numerical Differentiation (Derivatives using Newton's forward difference formula)
3.2 Numerical Integration, General quadrature formula.
3.3 Trapezoidal rule.
3.4 Simpsons's 1/3rd rule.
3.5 Simpsons's 3/8th rule.

Unit 4: Numerical solution of first order ordinary differential equations [08 Lectures]

4.1 Taylor's Series method
4.2 Picard's method of successive approximations
4.3 Euler's method.
4.4 Modified Euler's methods.
4.5 Runge - Kutta Methods.

Text book:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, 5th edition, Prentice Hall of ndia.

Unit 1: Chapter 1: section 1.3, Chapter 2: section 2.2, 2.3, 2.5
Unit 2: Chapter 3: section 3.3, 3.5, 3.6, 3.9(3.9.1 only)
Unit 3: Chapter 4: section 6.2 (excluding 6.2.1 to 6.2.3), 6.4
Unit 4: Chapter 5: section 8.2, 8.3, 8.4 (excluding 8.4.1).

Reference Books:

1. C.F. Gerald and O.P. Wheatley, Applied Numerical Analysis, Addison Wesley; 7thedition (2003).
2. K.E. Atkinson; An Introduction to Numerical Analysis, Wiley Publications.
3. T. Sauer, Numerical analysis, 3rd edition, Pearson.
4. M. K. Jain, SRK Iyengar and R.K. Jain, Numerical Methods For Scientific & Engg 5e, New Age International (P) Ltd (2008).

MT-232(B) : Graph Theory

Unit 1. Introduction

1.1 What is a Graph?
1.2 Application of Graphs **[04 Lectures]**
1.3 Finite and Infinite Graphs
1.4 Incidence and Degree
1.5 Isolated Vertex, Pendant Vertex and Null Graph

Unit 2. Paths and Circuits **[12 Lectures]**

Semester - IV

MT-241: Linear Algebra

Unit-1: Matrices and System of Linear Equations **[06 lectures]**

1.1 Row echelon form of a matrix, reduced row echelon form of a matrix.
1.2 Definition of rank of a matrix using row echelon or row reduced echelon form.
1.3 System of linear equations- Introduction, matrix form of linear system, definition of row equivalent matrices.
1.4 Consistency of homogeneous and non-homogeneous system of linear equations using rank, condition for consistency.
1.5 Solution of System of Equations: Gauss elimination and Gauss-Jordan elimination method, examples.

Unit-2: Vector Spaces-I **[10 lectures]**

2.1 Definition and Examples.
2.2 Subspaces.
2.3 Linear Dependence and Independence.
2.4 Basis of Vector Space

Unit-3: Vector Spaces-II **[08 lectures]**

3.1 Dimension of a Vector Space.
3.2 Row, Column and Null Space of a matrix.
3.3 Rank and nullity.

Unit-4: Linear Transformations **[12 lectures]**

4.1 Definition and Examples, Properties, Equality.
4.2 Kernel and range of a linear Transformation
4.3 Rank-Nullity theorem.
4.4 Composite and Inverse Transformation.
4.5 Matrices and Linear Transformation.
4.6 Basic Matrix Transformations in R^2 and R^3
4.7 Linear Isomorphism.

Text Book::

Howard Anton, Chris Rorres, Elementary Linear Algebra, Application Version, Ninth Edition, Wiley, 11th edition.

Unit-1: Chapter-1: Sec. 1.1, 1.2.
Unit-2: Chapter- Sec. 4: 4.1 to 4.4.
Unit-3: Chapter- Sec. 4: 4.5, 4.7, 4.8

Unit- 4: Chapter- Sec.8: 8.1 to 8.4, 1.8, 4.9.

Reference Books:

(1) K. Hoffman and R. Kunze, Linear Algebra, 2nd edition(2014), Prentice Hall of India, New Delhi

(2) Steven J. Leon, Linear Algebra with Applications, 4th edition(1994), Prentice Hall of India. New Delhi

(3) Vivek Sahai, Vikas Bist, Linear Algebra, 4th Reprint 2017, Narosa Publishing House, New Delhi

(4) Promode Kumar Saikia, Linear Algebra, 2009, Pearson, Delhi

(5) S. Lang, Introduction to Linear Algebra, 2nd edition,1986, Springer-Verlag, New York, Inc.

MT 242(A): Vector Calculus

Unit 1: Vector-Valued Functions **[08 lectures]**

1.1 Curves in Space, Limits and Continuity, Derivatives and Motion, Differentiation Rules for Vector Function, Vector Functions of Constant Length.

1.2 Integrals of Vector Functions.

1.3 Arc Length along a Space Curve, Speed on a Smooth Curve, Unit Tangent Vector.

1.4 Curvature of a Plane Curve, Circle of Curvature for Plane Curves, Curvature and Normal Vectors for a Space Curve.

Unit 2: Integrals [12 Lectures]

2.1 Line Integral of Scalar Functions, Additivity, Line integral in the Plane.

2.2 Vector Fields, Gradient Fields, Line Integral of Vector Fields, Line Integrals with respect to dx, dy, dz .

2.3 Work done by a Force over a Curve in Space, Flow Integrals and Circulation for Velocity Fields, Flow across the Simple Closed Plane Curve.

2.4 Path Independence, Conservative and Potential Functions.

2.5 Divergence, Two forms for Green's Theorem, Green's Theorem in the Plane (Proof for special regions),

Unit 3: Surface Integrals

3.1 Parameterizations of Surfaces, Implicit surfaces.

3.2 Surface integrals, Orientation of Surfaces. **[08 Lectures]**

3.3 Surface Integrals of Vector Fields.

Unit 4: Applications of Integrals

4.1 The Curl Vector Field, Stokes' Theorem(without proof), Conservative Fields and Stokes' Theorem. **[08 Lectures]**

4.2 Divergence in three Dimensions, Divergence Theorem (without proof).

4.3 Unifying the Integral Theorems.

Text Book:

- Thomas' Calculus (14th Edition) by Hass, Heil, Weir, Pearson Indian Education Services Pvt. Ltd.
  Unit 1: Chapter 13: Sec- 13.1, 13.2, 13.3, 13.4
  Unit 2: Chapter 16: Sec-16.1, 16.2, 16.3, 16.4
  Unit 3: Chapter 16: Sec- 16.5, 16.6
  Unit 4: Chapter 16: Sec- 16.7, 16.8

Reference books:

(1) Basic Multivariable Calculus byJ.E.Mardson, A.J.Tromba, A. Weinstein, Sppriger Verlag (Indian Edition)

(2) Advanced Calculus by M.R. Spiegel, Schaum Series.

(3) Advanced Calculus (IInd Edition) byD.V. Widder, Prentice Hall of India, New Delhi(1944).

(4) Advanced Calculus by John M. H. Olmsted, Eurasia Publishing House, New Delhi(1970)

(5) Calculus Vol. II (IInd Edition) by T.M. Apostol, John Wiley, New York (1967).

MT-242(B): Dynamical Systems

Unit 1: Eigenvalues and Eigenvectors **[08 Lectures]**

1.1 Eigenvalues and Eigenvectors

1.2 Diagonalisation(matrices with real and distinct eigenvalues)

Unit 2: First-Order Equations and Planar Linear Systems **[12 Lectures]**

2.1 The Simplest Example
2.2 The Logistic Population Model
2.3 Second-Order Differential Equations
2.4 Planar Systems
2.5 Preliminaries from Algebra
2.6 Planar Linear Systems
2.7 Eigenvalues and Eigenvectors
2.8 Solving Linear Systems
2.9 The Linearity Principle.

Unit 3: Phase Portraits for Planar Systems **[08 Lectures]**

3.1 Real Distinct Eigenvalues
3.2 Complex Eigenvalues
3.3 Repeated Eigenvalues
3.4 Changing Coordinates

Unit 4: Classification of Planar Systems and Exponential of a matrix **[08 Lectures]**

4.1 The Trace-Determinant Plane
4.2 Exponential of a matrix.

Textbooks :

1) Elementary Linear Algebra by Howard Anton and Chris Rorres (9th edition), Applications Version.

Unit 1: Chapter 7 : Section 7.1 (Examples, Theorems with Statements only) , Section 7.2 (2 x 2 and 3 x 3 matrices with real and distinct eigenvalues, Theorems with Statements only)

2) Differential Equations, Dynamical Systems and An Introduction to Chaos (2nd edition) by Morris Hirsch, Stephen Smale and Robert Devaney, Academic Press.

Unit 2: Chapter 1 : Section - 1.1 to 1.2, Chapter 2 : Section - 2.1 to 2.7.
Unit 3: Chapter 3 : Section, 3.1 to 3.4,
Unit 4: Chapter 4 :Section 4.1, Chapter 6 : Section 6.4 (2 x 2 matrices with distinct real, repeated real and complex eigenvalues, 3 x 3 matrices with distinct real eigenvalues).

Reference Books :

1. K.B.Datta, Matrix and Linear Algebra, Prentice hall of India Pvt.Ltd, New Delhi 2000.

2. Differential Equations and Dynamical Systems (Third Edition) by Lawrence Perko, Texts in Applied Mathematics 7, Springer.

Outcomes of Course:

Upon completion of the course, the students will achive the following.

(i) The mathematical maturity of students in their current and future courses shall develop.

(ii) The student develops theoretical, applied and computational skills.

(iii) The student gains confidence in proving theorems and solving problems.

MT 243: Mathematics Practical

(Practical based on the applications of articles in MT- 241 and MT -242)

In Semester-IV, we should conduct 4 written practical and 2 practical on maxima software for each paper MT-241 and MT-242.

List of Practical

Practical 1 : Problems on Unit 1 (Written) from MT-241.

Practical 2 : Problems on Unit 2 (Written) from MT-241.

Practical 3 : Problems on Unit 3(Written) from MT-241

Practical 4 : Problems on Unit 4(Written) from MT-241.

Practical 5 : Problems on unit 1 and unit 2 from MT-241using maxima software.

Practical 6 : Problems on Unit 3 and Unit 4 from MT-241 using maxima software.

Practical 7 : Problems on Unit 1 (Written) from MT-242.

Practical 8 : Problems on Unit 2 (Written) from MT-242.

Practical 9 : Problems on Unit 3(Written) from MT-242.

Practical 10 : Problems on Unit 4(Written) from MT-242.

Practical 11 : Problems on unit 1 and Unit 2 from MT-242 using maxima software.

Practical 12 : Problems on Unit 3 and Unit 4 from MT-242 using maxima software.

Note:

1 The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.

2. Practicals on maxima software shall be performed on computer only..

3.Practical examination 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on computer only).

Modalities For Conducting The Practical and The Practical Examination:

1) There will be one 4 hour 10 minutes (250 minutes) practical session for each batch of 15 students per week.
2) The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The practical examination will consist of written examination of 20 marks, 10 marks on maxima software and oral examination of 05 marks.
3) There will be external examiner; the practical exam will be of the duration of 3hours.
4) The teacher will set a question paper at the time of paper setting meeting conducted by Savitribai Phule Pune University, Pune based on pattern as follows

Q1. Any 2 out of 4 each question of 5 marks on paper - I.
Q2. Any 2 out of 4 each question of 5 marks on paper - II.
Q3. (a) Any 1 out of 2 each question of 5 marks on maxima software from paper – I.
(b) Any 1 out of 2 each question of 5 marks on maxima software from paper – II.

5) Each student will maintain a journal to be provided by the college.

7) The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical.

8) It is recommended that concept may be illustrated using computer software maxima and graphing calculators wherever possible.

9) Study tours may be arranged at places having important mathematical institutes or historical places.

10) **Special Instruction:**

a) There should be well equipped mathematics practical laboratory of size 20x20 sq. fts containing at least 20 computers.

b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per rule.

c) Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Mathematics

(Faculty of Science and Technology)

T. Y. B. Sc. (Mathematics)

Choice Based Credit System Syllabus

(With effect from June 2021)

To be implemented from Academic Year 2021-2022

Title of the Course: B. Sc. (Mathematics)

Preamble:

University of Pune has decided to change the syllabi of various faculties from June, 2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of Studies in Mathematics with concern of the teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of T. Y. B. Sc. Mathematics. To develop the syllabus the U.G.C. Model curriculum is followed.

Programme Specific Outcome (PSO)

i) Give the students a sufficient knowledge of fundamental principles, methods and a clear perception of innumerous power of mathematical ideas and tools and know how to use them by modeling, solving and interpreting.

ii) To equip the students sufficiently in both analytical and computational skills in Mathematical Sciences.

iii) To develop a competitive attitude for building a strong academic - industrial collaboration, with focus on continuous learning skills.

iv) Enhancing students overall development and to equip them with mathematical modeling abilities, problem solving skills, creative talent and power of communication necessary for various kinds of employment.

v) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

vi) Enabling students to Gauge the hypothesis, theories, techniques and proofs provisionally.

Programme Outcome: (PO)

A graduate of this program are expected to:

i) Gain sound knowledge on fundamental principles and concepts of Mathematics and computing with their applications related to Industrial, Engineering, Biological and Ecological problems.

ii) Exhibit in depth the analytical and critical thinking to identify, formulate and solve real world problems of science and engineering.

iii) Get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved, mathematical reasoning.

iv) A student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical Sciences.

v) Apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.

vi) Be capable of undertaking suitable experiments/research methods while solving the real-life problem and would arrive at valid conclusions based on appropriate interpretations of data and experimental results.

vii) Develop written and oral communications skills in order to effectively communicate design, analysis and research results.

viii) Demonstrate appropriate inter-personal skills to function effectively as an individual, as a member or as a leader of a team and in a multi-disciplinary setting.

ix) Acquire competent positions in industry and academia as well.

Eligibility:

S. Y. B. Sc. (with Mathematics) or T. Y. B. Sc. Computer Science as per University rules.

Medium of Instruction: English

Structure of the Course:

Semester –V		Semester-VI	
DSE-1A	MT 351: Metric Spaces	DSE-4A	MT 361: Complex Analysis
DSE-1 B	MT 352: Real Analysis-I	DSE-4 B	MT 362: Real Analysis-II
DSE-2 A	MT 353: Group Theory	DSE-5 A	MT 363: Ring Theory
DSE-2 B	MT 354: Ordinary Differential Equations	DSE-5 B	MT 364: Partial Differential Equations
Select any one out of three		Select any one out of three	
DSE-3A	MT 355(A): Operations Research MT 355(B): Differential Geometry MT 355(C): C- Programming	DSE-6A	MT 365(A): Optimization Techniques MT 365(B): Calculus of Variation and Classical Mechanics MT 365(C): Financial Mathematics
Select any one out of three		Select any one out of three	
DSE-3B	MT 356(A): Machine Learning-I MT 356(B): Number Theory MT 356(C): Laplace Transform and Fourier Series	DSE-6B	MT 366(A): Machine Learning-II MT 36 (B): Computational Geometry MT 366 (C): Lebesgue Integration
Practical Lab		Practical Lab	
DSE-1	MT 357: Practical Course Lab-I (on Metric Space and Real Analysis-I)	DSE-4	MT 367: Practical Course Lab-I (on Complex Analysis and Real Analysis-II)
DSE-2	MT 358: Practical Course Lab-II (on Group Theory and Ordinary Differential equations)	DSE-5	MT 368: Practical Course Lab-II (on Ring Theory and Partial Differential Equations)
DSE-3	MT 359: Practical Course Lab-III (on DSE-3A and DSE-3B)	DSE-6	MT 369: Practical Course Lab-III (on DSE-6A and DSE-6B)
SEC-I	MT -3510: Programming in Python -I	SEC-III	MT 3610: Programming in Python-II
SEC-II	MT-3511: LaTeX for Scientific Writing	SEC-IV	MT 3611: Mathematics into LaTeX

Note.

i) Papers MT-351 to MT-354 are compulsory, a student can opt one paper from MT-355 (A) to MT-355 (C) and opt one paper from MT-356 (A) to MT-356 (C) in fifth semester.

ii) Papers MT-361 to MT-364 are compulsory, a student can opt one paper from MT-365 (A) to MT-365 (C) and opt one paper from MT-366 (A) to MT-366 (C) in sixth semester.

iii) For MT-351 to MT-359 and MT-361 to MT-369 each course is of 50 marks (35 marks external examination and 15 marks internal examination).

iv) For SEC: MT-3510, MT-3511, MT-3610 and MT-3611 each course is of 50 marks (15 marks internal evaluation: assignments/ tutorial/seminar/test and 35 marks external theory and practical examination).

Examination:

A) Pattern of examination: **Semester wise.**

B) Standard of passing: 20 Marks out of 50 marks for each paper. (But for passing a student should obtain minimum 14 marks out of 35 in the external University examination and should obtain minimum 06 marks out of 15 in the internal examination). For Skill enhancement courses a student should obtain minimum 06 marks out of 15 in internal examination and theory/practical external examination 14 marks out of 35 in the external University examination.

C) Pattern of question papers: For MT-351 to MT-354 and MT-361 to MT-364.

Q.1. Attempt any 05 out of 07 questions each of 01 marks. [05 Marks]

Q.2. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q.3. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q.4. Attempt any 02 out of 04 questions each of 10 marks. [10 Marks].

D) External Students: **Not allowed.**

E) Verification / Revaluation: **Allowed for Theory papers only.**

F) Qualifications for Teacher: **M.Sc. Mathematics (with NET /SET as per UGC existing rules).**

Equivalence of Previous syllabus along with new syllabus:

New Course	Old Course	New Course	Old Course
Semester-V	**Semester-III**	**Semester-VI**	**Semester-IV**
MT-351: Metric Spaces	MT 331 : Metric Spaces	MT 361: Complex Analysis	MT 341: Complex Analysis
MT-352: Real Analysis-I	MT 332: Real Analysis-I	MT 362 : Real Analysis-II	MT 342: Real Analysis-II
MT 353: Group Theory	MT 334 : Group Theory	MT 363 : Ring Theory	MT 344: Ring Theory
MT 354 : Ordinary Differential Equations	MT 335 : Ordinary Differential Equations	MT 364 : Partial Differential Equations	MT 345: Partial Differential Equations
MT 355 (A): Operations Research	MT 337 A. Operations Research	MT 365 (A): Optimization Techniques	MT 347 A : Optimization Techniques
MT 355 (B): Differential Geometry	MT 337 D: Lattice Theory	MT 365 (B): Calculus of Variation and Classical Mechanics	MT 347 B : Differential Geometry
MT 355 (C): C-Programming	MT 337 B. Dynamical System	MT 365(C): Financial Mathematics	MT 347 E: Lebesgue Integration
MT 356 (A): Machine Learning-I	MT 347D. Graph theory	MT 366 (A): Machine Learning-II	MT 347 C: C-Programming-II
MT 356 (B): Number Theory	MT 337 F. Number Theory	MT 366 (B): Computational Geometry	MT 347F : Computational Geometry
MT 356 (C): Laplace Transform and Fourier Series	MT 337 C. C- Programming I	MT 366(C): Lebesgue Integration	MT 337 E. Financial Mathematics
MT 357: Practical Course Lab-I: Metric Spaces and Real Analysis-I	MT 333 : Problem Course on MT 331 and MT 332	MT 367: Practical Course Lab-I: Complex Analysis and Real Analysis-II	MT 343 : Problem Course on MT 341 and MT 342
MT 358: Practical Course Lab-II: Group Theory and Ordinary Differential Equations	MT 336 : Problem Course on MT 334 and MT 334	MT 368: Practical Course Lab-II: Ring Theory and Partial Differential Equations	MT 346 : Problem Course on MT 344 and MT 345
MT 359: Practical Course Lab-III: DSE-3A and DSE-3B	MT 338: Practical based on papers selected from 337 A to 337 F	MT 369: Practical Course Lab-III: DSE 6A and DSE-6B	MT 348: Practical based on papers selected from 347 A to 347 F
MT 3510: Programming in Python -I		MT 3610: Programming in Python -II	
MT 3511: LaTeX for Scientific Writing		MT 3611: Mathematics Into Latex	

Note.

i) Papers MT-351 to MT-354 are compulsory, a student can opt one paper from MT-355 (A) to MT-355 (C) and opt one paper from MT-356 (A) to MT-356 (C) in fifth semester.

ii) Papers MT-361 to MT-364 are compulsory, a student can opt one paper from MT-365 (A) to MT-365 (C) and opt one paper from MT-366 (A) to MT-366 (C) in sixth semester.

iii) For MT-351 to MT-359 and MT-361 to MT-369 each course is of 50 marks (35 marks external examination and 15 marks internal examination).

iv) For SEC: MT-3510, MT-3511, MT-3610 and MT-3611 each course is of 50 marks (15 marks internal evaluation: assignments/ tutorial/seminar/test and 35 marks external theory and practical examination).

Examination:

A) Pattern of examination: **Semester wise.**

B) Standard of passing: 20 Marks out of 50 marks for each paper. (But for passing a student should obtain minimum 14 marks out of 35 in the external University examination and should obtain minimum 06 marks out of 15 in the internal examination). For Skill enhancement courses a student should obtain minimum 06 marks out of 15 in internal examination and theory/practical external examination 14 marks out of 35 in the external University examination.

C) Pattern of question papers: For MT-351 to MT-354 and MT-361 to MT-364.

Q.1. Attempt any 05 out of 07 questions each of 01 marks. [05 Marks]

Q.2. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q.3. Attempt any 02 out of 04 questions each of 05 marks. [10 Marks].

Q.4. Attempt any 02 out of 04 questions each of 10 marks. [10 Marks].

D) External Students: **Not allowed.**

E) Verification / Revaluation: **Allowed for Theory papers only.**

F) Qualifications for Teacher: **M.Sc. Mathematics (with NET /SET as per UGC existing rules).**

Equivalence of Previous syllabus along with new syllabus:

New Course	Old Course	New Course	Old Course
Semester-V	**Semester-III**	**Semester-VI**	**Semester-IV**
MT-351: Metric Spaces	MT 331 : Metric Spaces	MT 361: Complex Analysis	MT 341: Complex Analysis
MT-352: Real Analysis-I	MT 332: Real Analysis-I	MT 362 : Real Analysis-II	MT 342: Real Analysis-II
MT 353: Group Theory	MT 334 : Group Theory	MT 363 : Ring Theory	MT 344: Ring Theory
MT 354 : Ordinary Differential Equations	MT 335 : Ordinary Differential Equations	MT 364 : Partial Differential Equations	MT 345: Partial Differential Equations
MT 355 (A): Operations Research	MT 337 A. Operations Research	MT 365 (A): Optimization Techniques	MT 347 A : Optimization Techniques
MT 355 (B): Differential Geometry	MT 337 D: Lattice Theory	MT 365 (B): Calculus of Variation and Classical Mechanics	MT 347 B : Differential Geometry
MT 355 (C): C-Programming	MT 337 B. Dynamical System	MT 365(C): Financial Mathematics	MT 347 E: Lebesgue Integration
MT 356 (A): Machine Learning-I	MT 347D. Graph theory	MT 366 (A): Machine Learning-II	MT 347 C: C-Programming-II
MT 356 (B): Number Theory	MT 337 F. Number Theory	MT 366 (B): Computational Geometry	MT 347F : Computational Geometry
MT 356 (C): Laplace Transform and Fourier Series	MT 337 C. C- Programming I	MT 366(C): Lebesgue Integration	MT 337 E. Financial Mathematics
MT 357: Practical Course Lab-I: Metric Spaces and Real Analysis-I	MT 333 : Problem Course on MT 331 and MT 332	MT 367: Practical Course Lab-I: Complex Analysis and Real Analysis-II	MT 343 : Problem Course on MT 341 and MT 342
MT 358: Practical Course Lab-II: Group Theory and Ordinary Differential Equations	MT 336 : Problem Course on MT 334 and MT 334	MT 368: Practical Course Lab-II: Ring Theory and Partial Differential Equations	MT 346 : Problem Course on MT 344 and MT 345
MT 359: Practical Course Lab-III: DSE-3A and DSE-3B	MT 338: Practical based on papers selected from 337 A to 337 F	MT 369: Practical Course Lab-III: DSE-6A and DSE-6B	MT 348: Practical based on papers selected from 347 A to 347 F
MT 3510: Programming in Python -I		MT 3610: Programming in Python -II	
MT 3511: LaTeX for Scientific Writing		MT 3611: Mathematics Into Latex	

Details of Syllabus:

Semester-V

DSE-1A: MT 351: Metric Spaces (2 credits)

Course Objectives: The course aims at providing the basic knowledge pertaining to metric spaces such as neighborhood, interior, closure, open and closed balls, continuity, completeness, compactness and connectedness etc.

Course Learning Outcomes: The course will enable the students to:

i) understand the introductory concepts of metric spaces;
ii) correlate these concepts to their counter parts in modern analysis by studying examples;
iii) learn to analyze mappings between spaces.
iv) attain background for advanced courses in real analysis, functional analysis, and topology.
v) appreciate the abstractness of the concepts such as open balls, closed balls, compactness, connectedness etc. beyond their geometrical imaginations.

Course Contents:

Unit 1: Basic Notions
1.1 Definition and examples
1.2 Open Balls and Open Sets [09 Lectures]

Unit 2: Convergence
2.1 Convergent Sequences
2.2 Limit and Cluster points [09 Lectures]
2.3 Cauchy Sequences and Completeness
2.4 Bounded Sets
2.5 Dense Sets
2.6 Boundary of a set

Unit 3: Continuity
3.1 Continuous Functions
3.2 Equivalent Definitions of Continuity
3.3 Topological Property [08 Lectures]
3.4 Uniform Continuity
3.5 Limit of a Function
3.6 Open and closed maps

Unit 4: Compactness and Connectedness
4.1 Compact Spaces and their Properties
4.2 Connected Spaces [10 Lectures]

Text Book:

1. **Topology of Metric Spaces, S. Kumaresan, Narosa Publishing House (2nd edition), 2011.**
   Unit 1: Chapter 1; 1.1 to 1.2 (Except theorems 1.1.14,1.1.15,1.1.21,1.1.35,1.1.36,1.1.37)
   Unit 2: Chapter 2; 2.1 to 2.5 (Except theorems- 2.2.28, 2.3.12, Lemma 2.5.6), 2.7
   Unit 3: Chapter 3; 3.1 to 3.6 (Except theorems-3.2.33, 3.2.46, 3.2.49, 3.4.10)
   Unit 4: Chapter 4; 4.1 to 4.39 Except theorems- Lemma 4.1.28,4.2.13,4.3.14,4.3.24), Chapter 5; 5.1

Reference Books:

1. Metric Spaces, Q.H. Ansari: Narosa Publishing House, New Delhi, Chapters 1 – 5.
2. Metric Spaces, Satish Shirali, H. Vasudeva, Springer.
3. First Course in Metric Spaces, B. K. Tyagi, Cambridge University Press
4. M. O. Searcoid: Metric spaces, Springer, 2007.

DSE-1B: MT: 352 Real Analysis-I (2 credits)

Course Objectives: The course will provide students with a thorough understanding of real lines and distinguishing concepts in order to prove convergence and divergence of real number sequences and series. These principles have a wide variety of real-world applications.

Course Learning Outcomes: This course will enable the students to:

i) learn the basic facts in logic and set theory
ii) learn to define sequence in terms of functions from N to a subset of R and to understand several properties of the real line.
iii) recognize bounded, convergent, divergent, Cauchy and monotonic sequences and to calculate their limit superior, limit inferior, and the limit of a bounded sequence.
iv) use the ratio, root, alternating series and limit comparison tests for convergence and absolute convergence of an infinite series of real numbers.

Course Contents:

Unit 1: Logic and Set Theory [10 Lectures]
1.1 Introduction
1.2 "And" and "Or"
1.3 "Not" and "If-Then"
1.4 Contrapositive, Converse, and Iff
1.5 Quantifiers
1.6 Set Theory and Venn Diagrams
1.7 Relations and Functions
1.8 Countable and Uncountable Sets

Unit 2: Sequences of Real Numbers [07 Lectures]
2.1 Definition of sequence and subsequence
2.2. Limit of a sequence
2.3 Convergent sequences
2.4 Divergent sequences
2.5 Bounded sequences
2.6 Monotone sequences

Unit 3: Operations on convergent sequences and Limit Superior, Limit Inferior [07 Lectures]
3.1 Operations on convergent sequences
3.2 Operations on divergent sequences
3.3 Limit superior and limit inferior

3.4 Cauchy sequences

Unit 4: Series of Real Numbers **[12 Lectures]**

4.1 Convergence and divergence

4.2 Series with nonnegative terms

4.3 Alternating series

4.4 Conditional convergence and absolute convergence

4.5 Rearrangements of series

4.6 Tests for absolute convergence

4.7 Series whose terms form a non-increasing sequence

4.8 The class l^2.

Text Books: -

1. **Real Analysis and Foundations, Second Edition, Steven G. Krantz, Chapman and Hall/CRC.**
   Unit 1: Chapt. 1- Sec.: 1.1, 1.2,1. 3, 1.4, 1.5, 1.6, 1.7, 1.8
2. **Methods of Real Analysis, Second Edition, Richard R. Goldberg, John Wiley & Sons, Inc.**
   Unit 2: Chapt.-2: Sec.: 2.1, 2.2, 2.3, 2.4, 2.5, 2.6,
   Unit3: Chapt.-2 Sec.: 2.7, 2.8, 2.9, 2.10,
   Unit 4: Capt.- 3: Sec.: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.10

Reference Books: -

1. Real Analysis, N.L. Carothers, Cambridge University Press
2. Introduction to Real Analysis, Third edition, Robert, G. Bartle, Donald Sherbert , John Wiley and Sons.
3. A Basic Course in Real Analysis, Ajit Kumar and S.Kumaresan ,CRC Press, Second Indian, . CRC Press (Chapman and Hall)
4. A course of Mathematical Analysis, Revised edition, Shantinarayan and Mittal - S. Chand and Co. (2002).
5. Mathematical Analysis, third Edition, S.C. Malik and Savita Arora - New Age International Publications.

DSE-2A: MT-353: Group Theory (2 credits)

Course Objectives: The course objective is to introduce students to the fundamental theory of groups and their homomorphisms. Symmetric groups and symmetries in groups, Lagrange's theorem are also studied in depth.

Course Learning Outcomes: The course will enable the students to:

i) recognize the mathematical objects that are groups, and classify them as abelian, cyclic and permutation groups, etc;
ii) analyze consequences of Lagrange's theorem
iii) learn about structure preserving maps between groups and their consequences.
iv) explain the significance of the notion of cosets, normal subgroups, and factor groups.

Course Contents:

Unit 1. Groups **[06 lectures]**

1.1 Binary Operation

1.2 Isomorphic Binary Structures

1.3 Groups

Unit 2. Subgroups **[06 lectures]**

2.1 Subgroups

2.2 Cyclic Groups

Unit 3. Permutations **[12 lectures]**

3.1 Groups of Permutations

3.2 Orbits

3.3 Cycles

3.4 Alternating Groups

3.5 Cosets and the Theorem of Lagrange

3.6 Direct Products

Unit 4. Homomorphisms and Factor Groups **[12 lectures]**

4.1 Homomorphisms

4.2 Factor Groups

4.3 Factor Group Computations and Simple Groups

Text book:

1. **John B. Fraleigh, A First Course in Abstract Algebra, Seventh Edition, Pearson. Sections:** 2,3,4,5.6,8,9,10, 11(only Direct Product), 13,14,15.

Reference Books:

1. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, Second Ed., Foundation Books, New Delhi, 1995.
2. I. N. Herstien, Topics in Algebra, John Wiely and Sons.
3. N.S. Gopalakrishnan, University Algebra. Second Edition, New Age International, New Delhi, 1986.
4. Joseph. A. Gallian, Contemporary Abstract Algebra,(4th Edition). Narosa Publishing House.

DSE-2B: MT-354- Ordinary Differential Equations (2 credits)

Course Objectives: The main objectives of this course are to introduce the students to the exciting world of differential equations, system of differential equations and their applications.

Course Learning Outcomes: The course will enable the students to:

i) understand the genesis of ordinary differential equations.
ii) learn various techniques of getting exact solutions of solvable first order differential equations and linear differential equations of higher order.
iii) grasp the concept of a general solution of a linear differential equation of an arbitrary order and also learn a few methods to obtain the general solution of such equations.

Course Contents:

Unit 1. Linear Differential Equations with constant coefficients **[12 lectures]**

1.1 Constant coefficient homogeneous equations

1.2 Characteristic equations

1.2.1 distinct real roots
1.2.2 repeated roots
1.2.3 complex roots
1.3 Particular solution
1.4 Initial value problem
1.5 The operator $\frac{1}{f(D)}$ and its evaluation for the functions $x^m, e^{ax}, e^{ax}v, xv$ and the operator $\frac{1}{D^2+a^2}$ acting on $\sin ax$ and $\cos ax$ with proofs.

Unit 2. Non -Homogeneous Linear Equations **[08 lectures]**
2.1 Principle of superposition
2.2 Method of undetermined coefficients
2.3 Method of reduction of order
2.4 Method of variation of parameters.

Unit 3. Series Solutions of Linear Second Order Equations **[06 lectures]**
3.1 Review the properties of power series
3.2 Series solution near an ordinary point
3.3 Regular singular points
3.4 Euler equations

Unit 4. System of Equations **[10 lectures]**
4.1 Introduction to system of differential equations
4.2 Linear systems: basic theory of homogeneous linear systems, constant coefficient
4.3 Homogeneous systems.

Text Books:

1. **William F Trench , Elementary Differential Equations with Boundary Value Problems** , E book (Free download)
   Unit 1 : Chapter 5: Sections 2 to 3 . Unit 2 : Chapter 5: Sections 4 to 7 .
   Unit 3: Chapter 7: sections 1 to 4. Unit 4 : Chapter 10 : sections 1 to 6.
2. **Frank Ayres JR, Theory and Problems on Differential Equations, Schaum's outline Series, SI (metric) edition.** Unit 1 Chapter 16 Short methods

Reference Books:

1. M. D. Raisinghania , Ordinary and Partial Differential Equations , S. Chand and Company LTD 2009.
2. Elementary Differential Equations seventh edition by Earl D. Rainville and Philip E Bedient.
3. George F. Simmons and Stevan G. Krantz , Differential Equations, Tata McGraw-Hill.
4. W. R. Derrick and S. I. Grossman, A First Course in Differential Equations with Applications . CBS Publishers and Distributors , Delhi 110032, Third Edition.
5. Daniel Murray, Introductory Course in Differential Equations, Orient Longman.

DSE-3A: MT 355(A): Operations Research (2 credits)

Course Objectives: This course develops the ideas underlying the Simplex method for Linear programming problem, as an important branch of operations research. The course covers Linear programming with applications to Transportation and Assignment problem. Such problems arise in manufacturing resource planning and financial sectors.

Course Learning Outcomes: This course will enable the students to learn:

i) Analyze and solve linear programming models of real-life situations.
ii) The graphical solution of LPP with only two variables, and illustrate the concept of convex set and extreme points. The theory of the simplex method is developed.
iii) The relationships between the primal and dual problems and their solutions with applications to transportation, assignment and two-person zero-sum game problem.

Course Contents:

Unit 1. Modeling with Linear Programming **[08 Lectures]**
1.1Two variable LP Model
1.2 Solution of LP Model by Graphical Method
1.3 Selected LP Model Applications
1.4 Graphical Sensitivity analysis.

Unit 2. The Simplex Method and Duality **[12 Lectures]**
2.1 LP Model in equation form
2.2 Transition from graphical to algebraic solutions
2.3 The Simplex method.
2.4 Definition of the dual problem
2.5 Primal dual relationship
2.6 Economic interpretation of Duality.

Unit 3. Transportation Model **[10 Lectures]**
3.1 Definition of the Transportation model
3.2 The Transportation algorithm.

Unit 4. The Assignment Model **[06 Lectures]**
4.1 The Hungarian method
4.2 Simplex explanation of the Hungarian method.

Text Book:

1. **Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.**
   Unit 1: Chapter-2: 2.1, 2.2, 2.3(2.3.4, 2.3.5, 2.3.6).
   Unit 2: Chapter-3: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6 (3.6.1), Chapter-4: 4.2, 4.3
   Unit 3: Chapter -5: 5.1, 5.3 (5.3.1, 5.3.2, 5.3.3), **Unit 4: Chapter-5**: 5.4 (5.4.1, 5.4.2).

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operation Research (Eighth Edition) Tata McGraw Hill.
2. J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmillan India Ltd.
3. Hira and Gupta, Operation Research.

DSE-3A: MT-355(B): Differential Geometry (2 credits)

Course Objectives: This course enables the students to understand differential geometry of curves, their fundamental properties like torsion, curvature etc. along with their different forms. Also, to make understand different forms of curves and surfaces, along with their diverse properties through the use of differential calculus.

Course Learning Outcomes: The course will enable the students to:

i) Gain an understanding to solve problems with the use of differential geometry to diverse situations in mathematical contexts.
ii) Develop different properties associated with curves and surfaces.
iii) Demonstrate a depth of understanding in advanced mathematical topics in relation to geometry of curves and surfaces Learn to analyze mappings between spaces.
iv) Apply the theory of differential geometry to specific research problems in mathematics or other fields.

Course Contents:

Unit 1: Curves in the plane and in space
1.1 What is a curve?
1.2 Arc-length
1.3 Reparameterization
1.4 Level Curves vs. Parameterized Curves
[04 Lecture]

Unit 2 : How much does a curve?
2.1 Curvature
2.2 Plane Curves
2.3 Space Curves
[06 Lecture]

Unit 3 : Global Properties of curves
3.1 Simple Closed Curves
3.2 The Isoperimetric Inequality
3.3 The Four Vertex Theorem
[06 Lecture]

Unit 4 : Surfaces in three dimensions
4.1 What is a Surface?
4.2 Smooth Surfaces
4.3 Tangents, Normal and Orientability
4.4 Examples of surfaces
4.5 Quadratic Surfaces
4.6 Triply orthogonal Systems
4.7 Applications of the Inverse Function Theorem
[06 Lecture]

Unit 5 : The first fundamental form
5.1 Lengths of Curves on Surfaces
5.2 Isometries of Surfaces
5.3 Conformal Mappings of Surfaces
5.4 Surface Area
5.5 Equiareal Maps and Theorem of Archimedes
[07 Lecture]

Unit 6 : Curvature of surfaces
6.1 The Second Fundamental Theorem
6.2 The Curvature of Curves on a Surface
6.3 The Normal and Principal Curvatures
6.4 Geometric Interpretation of Principal Curvatures.
[07 Lecture]

Text book:

1. **Andrew Pressley: Elementary Differential Geometry, Springer International Edition, Indian Reprint 2004.**

Unit 1: Chapter 1: Section 1.1 to 1.4, Unit 2: Chapter 2: Section 2.1 to 2.3,
Unit 3: Chapter 3: Section 3.1 to 3.3, Unit 4: Chapter 4: Section 4.1 to 4.7,
Unit 5: Chapter 5: Section 5.1 to 5.5, Unit 6: Chapter 6: Section 6.1 to 4.4.

Reference Books:

1. John A. Thorpe, Differential Geometry, Springer International Edition, Indian Reprint 2004.
2. M. DoCarmo, Diffrential geometry of Curves and surfaces, Prentice Hall, 1976.

DSE-3A: MT 355(C): C-Programming (2 credits)

Course Objectives: The **course** is designed to provide complete knowledge of **C-language**. Students will be able to develop logics which will help them to create **programs**, applications in **C**. Also, by **learning** the basic **programming** constructs they can easily switch over to any other **language** in future.

Course Learning Outcomes: After the completion of this course, the students will be able to develop applications.

Course Contents:

Unit 1. Fundamentals of C – programming: [06 Lectures]
1.1 Introduction to C, The character set. Identifier and keywords. Data types, Constants.
1.2 Variables and arrays.
1.3 Declarations. Expressions., Statements, Symbolic constants, Operators and Expressions.

Unit 2. Data Input and Output: [06 Lectures]
2.1 Preliminaries. Single character input- the getchar() function
2.2 Single character output-the putchar() function.
2.3 Entering input data- the scanf() function.
2.4 Writing output data- the printf function.
2.5 The gets and puts functions.

Unit 3. Preparing, running a complete C Program and Control Statements: [10 Lectures]
3.1 Preliminaries. The while statement. The do-while statement.
3.2 The for statement. Nested loops. The if-else statement. The switch statement.
3.3. The break statement. The continue statement. The comma operator. The goto statement. [14 Lectures]

Unit 4. Functions and Arrays:
4.1 Introduction to a function. Defining a function. Accessing a function.
4.2 Passing arguments to a function. Function prototypes, Recursion, Defining an array.
4.3 Processing an array. Passing arrays to functions. Multidimensional arrays. Arrays and strings.

Text Book:

1. **Programming with C. By Byron S. Gottfried. Schaum's Outline series.**
   Unit-1: Chapters: 1, 2, 3, Unit-2: Chapter: 4, Unit-3: Chapters: 5, 6.
   Unit-4: Chapters: 7, 9.

Reference Books:

1. The C Programming Language. By Brian W. Kernighan, Dennis M. Ritchie, 2nd Edition.
2. Spirit of C: An Introduction to Modern Programming. By Henry Mullish and Herbert L. Cooper, Jaico Publishers,

DSE-3B: MT-356(A): Machine Learning-I (2 credits)

Course Objectives:

Students will try to learn:

1. To introduce students to the basic concepts and techniques of Machine Learning.
2. To become familiar with **introduction to NumPy Array and Matrices.**
3. To become familiar with discover and visualize data to gain insights.
4. To become familiar with Fine-tuning the model - Grid Search, Randomized Search.
5. To develop the ability to write database applications in Python.

Course Learning Outcomes:

Upon successful completion of this course the student will be able to:

1. Gain knowledge about basic concepts of Machine Learning.
2. Identify machine learning techniques suitable for a given problem.
3. Solve the problems using various machine learning techniques.

Course Contents:

Unit 1: Introduction to Machine Learning [08 Lectures]

1.1 What & why behind machine learning
1.2 Types of Machine Learning - Supervised vs Unsupervised
1.3 Model Based Training
1.4 Main challenges of Machine Learning
1.5. Testing and Validating

Unit 2: Introduction to Python [08 Lectures]

2.1 The Way Of The Program
2.2 Variables, Expressions and Statements
2.3 Functions
2.4 Conditionals and Recursion
2.5 Strings
2.6 Lists

Unit 3: Understanding ML related Python Packages [10 Lectures]

3.1 Numpy Basics: Arrays and Vectorized Computation
1. The NumPy ndarray: A Multidimensional Array Object
2. Universal Functions: Fast Element-wise Array Functions
3. Data Processing Using Arrays
4. Linear Algebra

3.2 Getting Started with Pandas
1. Introduction to pandas Data Structures
2. Essential Functionality
3. Summarizing and Computing Descriptive Statistics
4. Handling Missing Data
5. Hierarchical Indexing

3.3 Plotting and Visualization
1. A Brief matplotlib API Primer
2. Plotting Functions in Pandas
3. Plotting Maps: Visualizing Haiti Earthquake Crisis Data [10 Lectures]

Unit 4: End to End Machine Learning Project

4.1 Get the data
4.2 Discover & Visualize the data to gain insights
4.3 Preparing the data for machine learning - Cleaning, Handling categorical values, Feature scaling
4.5 Select and Train a model - Training and Evaluating on the Training Set
4.4 Fine-tuning the model - Grid Search, Randomized Search

Text Books:-

1. **Hands-on Machine Learning with Scikit-Learn, Keras and Tensorflow – Aurelien Heron, Sections: 1, 2**
2. **Python for Data Analysis by Wes McKinney (O' Reilly publication) Chapter -4:4.1, 4.2, 4.3, 4.5, Chapter -5: 5.1, 5.2, 5.3, 5.4, 5.5, Chapter-8: 8.1, 8.2, 8.3**
3. **Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press Needham, Massachusetts, 2015, Sections - 1, 2, 3, 5, 8, 10**

Reference Book:-

1. Introduction to Machine Learning With Python - Andreas C. Muller & Sarah Guide
2. Head first Python by Paul Barry (O Reilly publication)
3. Jason Brownlee - Basics of Linear Algebra for Machine Learning, 2018
4. M. P. Deisenroth, A. A. Faisal, C. S. Ong - Mathematics for Machine Learning, Cambridge University Press, 2019
5. Dipanjan Sarkar, Raghav Bali, Tushar Sharma - Practical Machine Learning with Python, 2018.
6. **Extra Reference Resources -**
geeksforgeeks.org/machine-learning
https://towardsdatascience.com/search?q=machine%20learningwww.kaggle.com

DSE-3B: MT-356(B): Number Theory (2 credits)

Course Objectives: There are difficult open problems in number theory that are understandable at the undergraduate level; this course is designed to develop a micro aptitude for understanding the aesthetic aspect of mathematical instructions and to prepare young minds to ponder such problems. Another goal is to familiarise students with basic number theoretic techniques that can be used in data protection.

Course Learning Outcomes: This course will enable the students to learn:

i) some of the open problems related to prime numbers.
ii) about number theoretic functions and modular arithmetic.
iii) the Law of Quadratic Reciprocity and other methods to classify numbers as primitive roots, quadratic residues, and quadratic non-residues.

Course Contents: [06 Lectures]

Unit 1. Divisibility

1.1 Introduction
1.2 Divisibility
1.3 Primes

Unit 2. Congruences

2.1 Congruences
2.2 Solution of Congruences [08 Lectures]
2.3 The Chinese Remainder Theorem

Unit 3. Greatest integer function

3.1 Greatest integer function
3.2 Arithmetic functions [08 Lectures]
3.3 The Mobius Inversion formula

Unit 4. Quadratic Reciprocity

4.1 Quadratic residues
4.2 Quadratic reciprocity [08 Lectures]
4.3 The Jacobi Symbol

Unit 5. Diophantine Equations

5.1 Diophantine equations ax + by = c
5.2 Pythagorean triplets. [06 Lectures]

Text Book:

1. **I. Niven, H. Zuckerman and H.L. Montgomery, An Introduction to Theory of Numbers, 5th Edition, John Wiley and Sons.**
   Unit 1 : Chapter 1 Section 1.1- 1.3, Unit 2 : Chapter 2 Section 2.1- 2.3,
   Unit 3 : Chapter 3 Section 3.1- 3.3, Unit 4 : Chapter 4 Section 4.1 -4.3,
   Unit 5 : Chapter 5 Section 5.1 and 5.3

Reference Book:

1. David M. Burton, Elementary Number Theory (Second Ed.), Universal Book Stall, New Delhi, 1991.

DSE-3B: MT-356 (C): Laplace Transform and Fourier Series (2 credits)

Course Objectives: The main objective of this course is to determine properties of Laplace Transform and Fourier series which may be solved by application of special functions.

Course Learning Outcomes: This course will enable the students to learn:

i) Students will be able to know the use of Laplace transform in system modeling, digital signal processing, process control.
ii) Solve an initial value problem for an nth order ordinary differential equation using the Laplace transform.
iii) Find the Fourier series representation of a function of one variable

Course Contents:

Unit 1: The Laplace Transform

1.1 Definition, Laplace Transform of some elementary functions. [10 Lectures]
1.2 Sufficient condition for existence of Laplace Transform
1.3 Some important properties of Laplace Transform.
1.4 Methods of finding Laplace Transform: Direct Method, Series Method
1.5 Evaluation of Integration
1.6 Some Special Functions [10 Lectures]

Unit 2: The Inverse Laplace Transform

2.1 Definition, Some inverse Laplace Transform.
2.2 Some important properties of Inverse Laplace Transform.
2.3 Methods of finding inverse Laplace Transforms: Partial Fraction Method and Series Method.
2.4 The Heaviside's Expansion formula.
2.5 Beta function, Evaluation of Integration. [10 Lectures]

Unit 3: Applications to Differential Equations

3.1 Ordinary Differential Equations with constant coefficients.
3.2 Ordinary Differential Equations with variable coefficients.
3.3 Simultaneous Ordinary Differential Equations. [06 Lectures]

Unit 4: Fourier series

4.1 Even and Odd functions, Its properties.
4.2 Fourier series and its Examples.

Text Book:

1. **Schaum's Outline Series - Theory and Problems of Laplace Transform by Murray R.Spiegel.**
   Unit 1: Chapter 1, Unit 2: Chapter 2, Unit 3: Chapter 3 (Excluding Applications to Mechanics, Electrical circuits, Beam and PDE).
2. **Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co.Pvt. Ltd.(1970).**
   Unit 4: Chapter 12 (Only 12.1)

Reference Books:

1. Phil Dyke, An Introduction to Laplace Transforms and Fourier Series, Second Edition,Indian Reprint 2014.
2. Joel L. Schiff, The Laplace Transforms - Theory and Applications, Springer Verlag NewYork 1999.
3. Lokenath Debnath and Dambaru Bhatta, Integral Transforms and Their Applications,ThirdEdition, CRC Press.

DSE-1: MT 357: Practical Course Lab-I (Metric Spaces and Real Analysis-I) (2 credits)

Section-I: Metric Spaces Practical

Practical 1: Definition and examples of Metric Spaces (Unit-1; 1.1)

Practical 2: Open and Closed sets in metric spaces (Unit-1; 1.2)

Practical 3: Convergences (Unit 2)

Practical 4: Continuity (Unit 3)

Practical 5: Compactness (Unit 4)

Practical 6: Connectedness (Unit 4)

Section-II: Real Analysis-I Practical

Practical 1: Logic, Set Theory, Functions and Cardinality (Unit-1)

Practical 2: Convergent and Divergent Sequences of Real Numbers (Unit-2)

Practical 3: Monotone Sequences and Algebra of Convergent Sequences (Unit-2)

Practical 4: Limit Superior, Inferior and Cauchy Sequences (Unit-3)

Practical 5: Series of Real Numbers, Alternating Series and Conditional/Absolute Convergence (Unit-4)

Practical 6: Convergent and Divergent Series of Real Numbers (Unit-4)

DSE-2: MT 358: Practical Course Lab-II (Group Theory and Ordinary Differential Equations) (2 credits)

Section-I: Group Theory Practical

Practical 1: Isomorphic Binary Structures and Groups (Unit-1)

Practical 2: Subgroups and Cyclic Groups (Unit-2)

Practical 3: Groups of Permutations, Orbits and Cycles (Unit-3)

Practical 4: Alternating Groups, Cosets and the Theorem of Lagrange (Unit-3)

Practical 5: Direct Products and Homomorphisms (Unit-4)

Practical 6: Factor Groups, Factor Group Computations and Simple Groups (Unit-4)

Section-II: Ordinary Differential Equations Practical

Practical 1: Linear differential equations with constant coefficients (Unit 1.1 to 1.4)

Practical 2: Inverse differential operators (Short methods) (Unit 1.5)

Practical 3: Non homogeneous linear equations Part I (Unit 2.1 to 2.2)

Practical 4: Non homogeneous linear equations Part II (Unit 2.3 to 2.4)

Practical 5: Series solution of linear second order equations (Unit 3)

Practical 6: System of equations (Unit 4).

DSE-3: MT 359: Practical Course Lab-III (Based on DSE-3A and DSE-3B) (2 credits)

Section-I: Operations Research/ Differential Geometry/C-Programming

Section-I (A): Operations Research Practical

Practical 1: Modeling with Linear Programming (Unit-1)

Practical 2: The Simplex Method-I (Unit-2)

Practical 3: The Simplex Method-II (Unit-2)

Practical 4: Duality (Unit-2)

Practical 5: Transportation Model (Unit-3)

Practical 6: The Assignment Model (Unit-4)

OR

Section-I (B): Differential Geometry Practical

Practical 1: Curves in the plane and in space (Unit 1)

Practical 2: How much does a curve? (Unit 2)

Practical 3: Global Properties of curves (Unit 3)

Practical 4: Surfaces in three dimensions (Unit 4)

Practical 5: The first fundamental form (Unit 5)

Practical 6: Curvature of surfaces (Unit 6)

OR

Section-I (C): C- Programming Practical

Practical-1: Operators and expressions-I (Unit 1)

Practical-2: Operators and expressions-II (Unit 2)

Practical-3: Control statements-I (Unit 3)

Practical-4: Control statements-II (Unit 3)

Practical-5: Arrays (Unit 4)

Practical-6: Functions (Unit 4)

Section-II: Machine Learning-I/ Number Theory/Laplace Transform and Fourier Serie

Section-II (A): Machine Learning-I Practical

Practical 1: Introduction to Python, Python Data Types-I (Unit 2)

Practical 2: Python Data Types- II (Unit 2)

Practical 3: Control statements in Python-I (Unit 2)

Practical 4: Control statements in Python-II (Unit 2)

Practical 5: Python collection type - List (Unit 2)

Practical 6: Data handling with Panda - 1 (Unit 3)

Practical 7: Data handling with Panda - 2 (Unit 3)

Practical 8: Data visualization with Matplotlib (Unit 3)

Practical 9: Introduction to scikit-learn (Unit 3)

Practical 10: End to end model implementation - 1 (Unit 4)

Practical 11: End to end model implementation - 2 (Unit 4)

Practical 12: End to end model implementation - 3 (Unit 4)

OR

Section-II (B): Number Theory Practical

Practical 1: Divisibility and GCD – I (Unit 1)

Practical 2: Divisibility and GCD – II (Unit 1)

Practical 3: Congruences (Unit 2)

Practical 4: Quadratic Reciprocity (Unit 3)

Practical 5: Number Theoretic Functions (Unit 4)

Practical 6: Linear Diophantine Equations, Pythagorean Triplets (Unit 5)

OR

Section-II (C): Laplace Transforms and Fourier Series Practical

Practical 1: The Laplace Transform (Unit 1: 1.1, 1.2, 1.3, 1.4)

Practical 2: Special Functions (Unit 1: 1.5, 1.6)

Practical 3: The Inverse Laplace Transform-I (Unit 2: 2.1, 2.2, 2.3, 2.4)

Practical 4: The Inverse Laplace Transform-II (Unit 2:2.4, 2.5)

Practical 5: Applications to Differential Equations (Unit 3)

Practical 6: Fourier Series (Unit 4)

SEC-I: MT -3510: Programming in Python –I (2 credits)

Course Objectives:

1. To understand why Python is a useful scripting language for developers.
2. To learn how to use lists, tuples, and dictionaries in Python programs.
3. To learn and understand python looping, control statements and string manipulations.
4. To acquire programming skills in core Python.

Course Learning Outcomes: At the end of the course:

1. The student will be able to explain basic principles of Python programming language.
2. The student will implement object oriented concepts.

Course Contents: **[06 Lectures]**

Unit 1: Introduction to Python

1.1 Installation of Python
1.2 Values and types: int, float and str,
1.3 The Print Function: Print basics
1.4 Variables: assignment statements, printing variable values, types of variables.
1.5 Mathematical Operators, operands and precedence:+, -, /, *, **, % PEMDAS (Rules of precedence)
1.6 String operations: + : Concatenation, * : Repetition
1.7 Boolean operator:
  1.7.1 Comparison operators: ==, !=, >, =, <=
  1.7.2 Logical operators: and, or, not
1.8 Mathematical functions from math, cmath modules, random module
1.9 Keyboard input: input() statement
1.10 Calculus: Differentiation, Integration, Limit and Series **[06 Lectures]**

Unit 2: String, list, tuple

2.1 Strings:
  2.1.1 Length (Len function)
  2.1.2 String traversal: Using while statement, Using for statement
  2.1.3 String slice
  2.1.4 Comparison operators (>, <, ==)
2.2 Lists:
  2.2.1 List operations
  2.2.2 Use of range function
  2.2.3 Accessing list elements
  2.2.4 List membership and for loop
  2.2.5 List operations
  2.2.6 Updating list: addition, removal or updating of elements of a list
2.3 Tuples:
  2.3.1 Defining a tuple,
  2.3.2 Index operator,
  2.3.3 Slice operator,
  2.3.4 Tuple assignment,
  2.3.5 Tuple as a return value **[10 Lectures]**

Unit 3: Iterations and Conditional statements

3.1 Conditional and alternative statements, Chained and Nested Conditionals: if, if-else, if-elif-else, nested if, nested if-else
3.2 Looping statements such as while, for etc, Tables using while.
3.3 Functions:
  3.3.1 Calling functions: type, id
  3.3.2 Type conversion: int, float, str
  3.3.3 Composition of functions, Returning values from functions
  3.3.4 User defined functions, Parameters and arguments **[04 Lectures]**

Unit 4: Linear Algebra

4.1 Matrix construct, eye(n), zeros(n,m) matrices

4.2 Addition, Subtraction, Multiplication of matrices, powers and invers of a matrix.
4.3 Accessing Rows and Columns, Deleting and Inserting Rows and Columns
4.4 Determinant, reduced row echelon form, nullspace, columnspace, Rank
4.5 Solving systems of linear equations (Gauss Elimination Method, Gauss Jordan Method, LU- decomposition Method)
4.6 Eigenvalues, Eigenvectors, and Diagonalization

Unit 5: Numerical methods in Python **[06 Lectures]**

5.1 Roots of Equations
5.2 Newton-Raphson Method
5.3 False Position (RegulaFalsi) Mehtod
5.4 Numerical Integration:
5.4.1 Trapezoidal Rule,
5.4.2 Simpson's $1/3^{rd}$ Rule,
5.4.3 Simpson's $3/8^{th}$ Rule

Unit 6: 2D and 3D Graphs **[04 Lectures]**

6.1 Installation of numpy, matplotlib packages
6.2 Graphs plotting of functions
6.3 Different formats of graphs, PyDotPlus (Scalable Vector Graphics), PyGraphviz. **Decorate Graphs with Plot Styles and Types:** Markers and line styles, Control colors, Specifying styles in multiline plots, Control linestyles, Control marker styles. **Polar charts:** Navigation Toolbar with polar plots, Control radial and angular grids.
6.4 Three-dimensional Points and Lines
6.5 Three-dimensional Contour Plots, Wireframes and Surface Plots.

Practicals:

Practical 1: Introduction to Python, Python Data Types-I (Unit 1)
Practical 2: Python Data Types- II (Unit 2)
Practical 3: Control statements in Python-I (Unit 3- 3.1, 3.2)
Practical 4: Control statements in Python-II (Unit 3- 3.3)
Practical 5: Application: Matrices (Unit 4 – 4.1-4.3)
Practical 6: Application: Determinants, system of Linear Equations (Unit 4- 4.4, 4.5)
Practical 7: Application: System of equations (Unit 4- 4.5)
Practical 8: Application: Eigenvalues, Eigenvectors (Unit 4 – 4.6)
Practical 9: Application: Eigenvalues, Eigenvectors (Unit 4 – 4.6)
Practical 10: Application: Roots of equations (Unit 5 – 5.1)
Practical 11: Application: Numerical integration (Unit 5 – 5.2, 5.3, 5.4)
Practical 12: Graph Plotting (Unit 6)

Text Books:-

1. **Allen Downey, Think Python, How to Think Like a Computer Scientist, Green Tea Press Needham, Massachusetts, 2015,**
Unit1-1: Chapter-1: 1.1-1.5, Capter-2: 2.1-2.6, Chapter-3: 3.1-3.6, Chapter-5: 5.1-5.3
Unit1-2: Chapter-8: 8.1-1.5, Capter-10: 10.12, Chapter-12: 12.1.- 12.6
Unit-3: Chapter 5:5.4 -5.7, Chapter 7: 7.1-7-7.5
2. **Robert Johansson, Introduction to Scientific Computing in Python, 2016**
Unit-1: 6.5-6.8
Unit- 4: Chapter-4: 4.6 (4.6.1 - 4.6.6), Chapter-6: 6.9-6.10, Unit-5: Chapter-4: 4.8,
Unit-6: Chapter-5
3. **Hans-Petter Halvorsen, Python for Scientific engineering, 2020 Unit-5: Chapter-31**

Reference Books:-

1. Lambert K. A., Fundamentals of Python - First Programs, Cengage Learning India, 2015.
2. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
3. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015. Zelle, J., Python Programming: An Introduction to Computer Science, Franklin, Beedle and Assiciatesn Inc.
4. SandroTosi, Matplotlib for Python Developers, Packt Publishing Ltd. (2009) BIRMINGHAM – MUMBAI. (Use for 2D and 3D plots and also use Lambert K. A book).
5. Python: Notes for Professionals, Goalkicker.com, Free Programming books.

SEC-II: MT-3511: LaTeX for Scientific Writing (2 credits)

Course Objectives: The purpose of this course is
i) To provide an understanding of the basic mechanisms of LaTeX, using plain text as a vehicle
ii) To acquaint students with the latest typesetting skills, which shall enable them to prepare high quality typesetting.

Course Learning Outcomes: After studying this course the student will be able to:
i) Write a simple LaTeX input document based on the article class.
ii) Turn the input document into pdf with the pdflatex program.
iii) Format Words, Lines, and Paragraphs.
iv) Understand how to present data using tables. **[06 Lectures]**

Course Contents:

Unit 1. Introduction to LaTeX **[09 Lectures]**

1.1 Definition and application of LaTeX
1.2 Preparation and Compilation of LaTeX input file
1.3 LaTeX Syntax
1.4 Keyboard Characters in LaTeX

Unit 2. Formatting Words, Lines, and Paragraphs

2.1 Text and Math Mode Fonts.
2.2 Emphasized and Colored Fonts
2.3 Sectional Units
2.4 Labeling and Referring Numbered Items
2.5 Texts Alignment and Quoted text
2.6 New Lines and Paragraphs
2.7 Creating and Filling Blank Space

2.8 Producing Dashes Within Texts

Unit 3. Listing and Tabbing Texts **[09 Lectures]**

3.1 Listing Texts

3.2 Tabbing Texts Through the tabbing Environment

Unit 4. Table Preparation **[12 Lectures]**

4.1 Table Through the tabular Environment

4.2 Table Through the tabularx Environment

4.3 Vertical Positioning of Tables

4.4 Sideways (Rotated) Texts in Tables

4.5 Adjusting Column Width in Tables

4.6 Additional Provisions for Customizing Columns of Tables

4.7 Merging Rows and Columns of Tables.

Practicals:

Practical 1: Introduction to LaTeX (Unit-1; 1.1, 1.2)

Practical 2: Syntax and Keyboard Characters in LaTeX (Unit-1; 1.3, 1.4)

Practical 3: Fonts in LaTeX (Unit -2; 2.1, 2.2)

Practical 4: Sections, Labelling and Text Alignment in LaTeX (Unit-2; 2.3, 2.4, 2.5)

Practical 5: New Lines, Paragraphs, Blank Space and Dashes in LaTeX (Unit-2; 2.6-2.8)

Practical 6: Listing Texts -I (Unit-3; 3.1[Chapter 6, 6.1.1, 6.1.2])

Practical 7: Listing Texts -II (Unit-3; 3.1[Chapter 6, 6.1.3, 6.1.4, 6.1.5])

Practical 8: Tabbing Texts (Unit-3; 3.2)

Practical 9: Table Through the tabular Environment (Unit-4; 4.1)

Practical 10: Table Through the tabularx Environment (Unit-4; 4.2)

Practical 11: Positioning and Texts in Tables (Unit-4; 4.3, 4.4)

Practical 12: Customizing Tables in LaTeX (Unit-4; 4.5, 4.6, 4.7)

Text Book:

1. LaTeX in 24 Hours, A Practical Guide for Scientific Writing, Dilip Datta, Springer International Publishing AG, 2017.
Unit 1: Chapter 1; 1.1 to 1.6, Unit 2: Chapter 2; 2.1 to 2.4, Chapter 3: 3.1 to 3.7
Unit 3: Chapter 6; 6.1, 6.2, Unit 4: Chapter 7; 7.1 to 7.7

Reference Books:

1. LaTeX, A Document Preparation System, User's Guide and Reference Manual, Leslie Lamport, Addison-Wesley Publishing Company, Inc., 1994.
2. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing Ltd, 2011.
3. LaTeX and Friends, M.R.C. van Dongen, Springer-Verlag Berlin Heidelberg ,2012.

Semester-VI

DSE-4A: MT - 361: Complex Analysis (2 Credits)

Course Objectives: This course aims to introduce the basic ideas of analysis for complex functions in complex variables with visualization through relevant Practicals. Particular emphasis has been laid on Cauchy's theorems, series expansions and calculation of residues.

Course Learning Outcomes: The completion of the course will enable the students to:

i) Understand the significance of differentiability of complex functions leading to the understanding of Cauchy-Riemann equations.

ii) Evaluate the contour integrals and understand the role of Cauchy-Goursat theorem and the Cauchy integral formula.

iii) Expand some simple functions as their Taylor and Laurent series, classify the nature of singularities, find residues and apply Cauchy Residue theorem to evaluate integrals.

iv) Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

Course Contents: **[09 Lectures]**

Unit 1: Analytic functions

1.1 Functions of a Complex Variables

1.2 Limits, Theorems on limits (Without Proof), Limits involving the point at infinity, Continuity, Derivatives, Differentiation formulas (Without Proof)

1.3 Cauchy- Riemann Equations, Sufficient Conditions for differentiability (Only Statement and Examples) **[07 Lectures]**

1.4 Polar coordinates, Analytic functions, Harmonic functions.

Unit 2: Elementary Functions

2.1 The Exponential functions

2.2 The Logarithmic function. Branches and derivatives of logarithms. Some identities involving logarithms **[11 Lectures]**

2.3 Complex exponents, Trigonometric functions.

Unit 3. Integrals

3.1 Derivatives of functions, Definite integrals of functions

3.2 Contours, Contour integral, Examples

3.3 Upper bounds for Moduli of contour integrals, Anti-derivatives (Only Examples)

3.4 Cauchy-Goursat Theorem (without proof), Simply and multiply Connected domains. Cauchy integral formula, Derivatives of analytic functions. Liouville's Theorem and Fundamental Theorem of Algebra (Without Proof). **[04 Lectures]**

Unit 4. Series

4.1 Convergence of sequences and series (Theorems without proof)

4.2 Taylor's series (without proof), Laurent series (without proof), examples only. **[05 Lectures]**

Unit 5. Residues and Poles

5.1 Isolated singular points, Residues

5.2 Cauchy residue theorem (Without Proof), residue at infinity, types of isolated singular points, residues at poles

5.3 Zeros of analytic functions, zeros and poles.

Text Book:

1. **J.W. Brown and R.V. Churchill, Complex Variables and Applications, International Student Edition, 2009. (Eighth Edition).**
   Unit -1: Chapter 1: Sec.11, 12, 15 to 26. Unit-2: Chapter 3: Sec.29 to 34.
   Unit -3: Chapter 4: Sec. 37 to 44, 46 and 48 to 53.
   Unit -4: Chapter 5:Sec. 55 to 60 and 62. Unit – 5: Chapter 6: Sec.68 to 76.

Reference Books:

1. S. Ponnusamy, Complex Analysis, Second Edition (Narosa).
2. S. Lang, Complex Analysis, (Springer Verlag).
3. A.R. Shastri, An Introduction to Complex Analysis, (MacMillan).
4. L.V.Ahlfors, Complex Analysis, 3rd edition, McGraw Hill, 2000.
5. H.A.Priestley, Introduction to Complex Analysis, 2nd edition (Indian), Oxford, 2006.

DSE-4B: MT: 362 Real Analysis-II (2 Credits)

Course Objectives: To comprehend bounded function integration on a closed and bounded interval, as well as its extension to situations where either the integration interval is infinite or the integrand has infinite limits at a finite number of points on the integration interval. The sequence and series of real-valued functions.

Course Learning Outcomes: The course will enable the students to learn about:

i) some of the families and properties of Riemann integrable functions, and the applications of the fundamental theorems of integration.
ii) beta and gamma functions and their properties.
iii) recognize the difference between pointwise and uniform convergence of a sequence of functions.
iv) illustrate the effect of uniform convergence on the limit function with respect to continuity, differentiability, and integrability.

Course Contents:

Unit 1: Riemann Integration [12 Lectures]

1.1 Sets of Measure zero
1.2 Definition of the Riemann Integral
1.3 Existence of the Riemann Integral
1.4 Properties of the Riemann Integral
1.5 Fundamental Theorems of Calculus

Unit 2: Improper Integrals [10 Lectures]

2.1 Improper Integrals on Closed and Bounded Intervals
2.2 Tests for Convergence of Positive Integrands
2.3 Improper Integrals on Unbounded Intervals and Tests for their Convergence
2.4 Tests for Convergence of the Integral of Product

Unit 3: Sequences of Functions [07 Lectures]

3.1 Pointwise convergence of sequences of functions
3.2 Uniform convergence of sequences of functions
3.3 Consequences of uniform convergence

Unit 4: Series of Functions [07 Lectures]

4.1 Convergence and uniform convergence of series of functions
4.2 Integration and differentiation of series of functions

Text Books:

1. **Methods of Real Analysis, Second Edition, Richard R. Goldberg, John Wiley and amp; Sons, Inc.**
   Unit -1:Sec.: 7.1,7.2,7.3,7.4,7.8, Unit -3: Sec.: 9.1, 9.2, 9.3, Unit-4: Sec.9.4, 9.5
2. **Introduction to Real Analysis, Eighth Edition, S.K. Mapa, Sarat Book House**
   Unit-2: Sections: 12.1, 12.2, 12.3, 12.4,12.5, 12.6, 12.7, 12.8, 12.9, 12.10

Reference Books:

1. Real Analysis, N.L. Carothers, Cambridge University Press
2. Introduction to Real Analysis, Third edition, Robert, G. Bartle, Donald Sherbert, John Wiley and Sons.
3. A Basic Course in Real Analysis, Ajit Kumar and S. Kumaresan, CRC Press, Second Indian, CRC Press (Chapman and Hall)
4. A course of Mathematical Analysis, Revised edition, Shanti Narayan and Mittal - S. Chand and Co. (2002).
5. Mathematical Analysis, third Editions'. Malik and Savita Arora - New Age International Publications

DSE-5A: MT: 363 Ring Theory (2 Credits)

Course Objectives: The objective of this course is to introduce the fundamental theory of rings and their corresponding homomorphisms. The basic concepts of ring of polynomials and irreducibility tests for polynomials over ring of integers.

Course Learning Outcomes: The course will enable the students to learn about:

i) The fundamental concept of Rings, Fields, subrings, integral domains and the corresponding morphisms.
ii) Learn in detail about polynomial rings, fundamental properties of finite field extensions, and classification of finite fields.
iii) Appreciate the significance of unique factorization in rings and integral domains.

Course Contents:

Unit 1: Rings and Fields [08 lectures]

1.1 Ring, Subring, Fields.
1.2 Divisors of zero, Integral Domain, The Characteristics of a Ring.
1.3 The Field of Quotients of an Integral Domain.

Unit 2: Rings of Polynomials & Factorization [08 lectures]

2.1 Polynomials in an determinate,
2.2 The Evaluation Homomorphism Zeros.
2.3 Factorization of a Polynomial over a Field: The Division Algorithm in F[x]
2.4 Irreducible Polynomials, Uniqueness of Factorization in F[x].

Unit 3: Ideals and Factor Rings [12 Lectures]

3.1 Homomorphism, Properties of Homomorphism
3.2 Ideals, Factor Ring, Fundamental Homomorphism Theorem.
3.3 Maximal Ideal, Prime Ideal, Ideal Structure in F[x].

Unit 4: Factorization

4.4 Unique Factorization Domain, Principal Ideal Domain, Gauss Lemma, D[x] is a UFD.
4.5 Euclidean Norm, Euclidean Domain, Euclidean Algorithm (Without Proof).
4.6 Gaussian Integers, Multiplicative Norm.

Text Book:

1. **John B. Fraleigh, A First Course In Abstract Algebra, 7th Edition, Pearson.**
   Unit 1: Section 18, 19, 21. Unit 2: Section 22 and 23.
   Unit 3: Section 26 and 27. Unit 4: Section 45, 46 and 47 (except theorem 47.10).

Reference Books:

1. Josheph A. Gallian, Contemporary Abstract Algebra, 7th Edition, Narosa Publishing House.
2. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Edition, Jonh Wiley and Sons, Inc.
3. I.N. Herstein, Abstract Algebra, 3rd Edition, Prentice Hall of India.
4. P.B. Bhattacharya, S.K. Jain and S.R. Nagpal, Basic Abstract Algebra, 2nd Edition, Cambridge University Press.

DSE-5B: MT 364: Partial Differential Equations (2 credits)

Course Objectives: The main goals of this course are to teach students how to form, solve, and apply partial differential equations to solve physical problems. Also, to introduce first and second order partial differential equations and their classifications and methods of finding solutions of these partial differential equations.

Course Learning Outcomes: The course will enable the students to:

i) formulate, classify and transform partial differential equations into canonical form.
ii) solve linear partial differential equations using various methods and apply these methods in solving some physical problems.
iii) solve Laplace equations using various analytical methods demonstrate uniqueness of solutions of certain kinds of these equations.

Course Contents:

Unit 1: Introduction to Ordinary and Partial Differential Equations [10 Lectures]

1.1 Surfaces and Curves in Three Dimensions
1.2 Simultaneous Differential Equations of the First Order and the First Degree in Three Variables.
1.3 Methods of solution of $dx/P = dy/Q = dz/R$
1.4 Pfaffian Differential Forms and Equations.
1.5 Solution of Pfaffian Differential Equations in Three Variables

Unit 2: Partial Differential Equations [08 Lectures]

2.1 Introduction to Partial Differential Equations
2.2 Origin of first order Partial Differential Equations
2.3 Linear Equations of First order equations
2.4 Integral surfaces passing through given curve

Unit 3: Second Order Partial Differential Equations [10 lectures]

3.1 The Origin of Second Order Partial Differential Equations.
3.2 Linear Partial Differential Equations with constant coefficients.
3.3 Methods of solving Linear Partial Differential Equations
3.3.1. Solution of reducible equations
3.3.2. Solution of irreducible equations with constant coefficients
3.3.3. Rules of finding complementary functions
3.3.4. Rule of finding particular integrals

Unit 4 : Classification of Partial Differential Equations [08 lectures]

4.1 Classification of second order partial differential equations, canonical forms
4.2 Solution of Laplace equations by separation variables methods
4.3 Solution of periodic differential equations by separation variables method
4.4 Solution of wave equation by separation variables method.

Text Books:

1. **Ian Sneddon, Element of Partial Differential Equations, McGraw-Hill Book Company, McGraw-Hill Book Company.**
   Unit-1: Chapter-1 : 1,2,3,5 , Unit-2: Chapter-2 :1,2,4,5, Unit-3: Chapter-3: 1,4,5
2. **J.N. Sharma, Kehar Singh, Partial Differential equations for Engineers and Scientists, second Edition, Narasa Publications.**
   Unit-4: Chapter No.3: 3.3, Chapter No.4: 4.3 , Chapter No.5: 5.5

Reference Books:

1. T. Amaranath, An Elementary Course in Partial Differential Equations, Narosa Publishing, House 2nd Edition, 2003 (Reprint, 2006).
2. K. Sankara Rao, Introduction to Partial Differential Equations, Third Edition, PHI.

DSE-6A: MT 365 (A): Optimization Techniques (2 Credits)

Course Objectives: This course enables the students to get an idea about the

i) Network and basic components. Determination of critical path: Critical Path Method (CPM), Project Evaluation and Review Techniques (PERT). Time-cost optimization Algorithm.
ii) Problem of Sequencing, Processing n Jobs through Two Machines, Processing n Jobs through 3 Machines and Processing n Jobs through k Machines.

Course Learning Outcomes: The course will enable the students to:

i) understand fundamentals of Network Analysis using CPM and PERT.
ii) solve a sequencing Problem for various jobs and machines.

[10 Lectures]

Course Contents:

Unit 1: Network Models [08 Lectures]

1.1 CPM and PERT, Network representation, Critical Path Computations
1.2 Construction of the time schedule, PERT networks.

Unit 2: Game Theory [08 Lectures]

2.1 Game theory, Some basic terminologies
2.2 Optimal solution of two person zero sum game
2.3 Solution of mixed strategy games (Graphical solution of games only).

Unit 3: Replacement and Maintenance Models

3.1 Introduction, Types of failure
3.2 Replacement of items whose efficiency deteriorates with time.

Unit 4: Sequencing Problems

4.1 Introduction, Notation, terminology and assumptions **[05 Lectures]**

4.2 processing n jobs through two machines, processing n jobs through three machines.

Unit 5: Classical Optimization Theory

5.1 Unconstrained problems, Necessary and sufficient conditions **[05 Lectures]**

5.2 Newton Raphson method, Constrained problems, Equality constraints (Lagrangian Method Only).

Text Book:

1. **Hamdy A. Taha, Operation Research (Eighth Edition, 2009), Prentice Hall of India Pvt. Ltd, New Delhi.**
   Unit-11: Ch.6: 6.5 (6.5.1 to 6.5.3 & 6.5.5), Unit-2: Ch.13: 13.4(13.4.1,13.4.2,13.4.3), Unit-4: Ch.18: 18.1(18.1.1, 18.1.2), 18.2 (18.2.1).
2. **J K Sharma, Operations Research (Theory and Applications, second edition, 2006), Macmilan India Ltd.**
   Unit-5: Ch.17: 17.1,17.2, 17.3, Ch.20: 20.1, 20.2, 20.3, 20.4.

Reference Books:

1. Frederick S. Hillier, Gerald J. Lieberman, Introduction to Operation Research (Eighth Edition) Tata McGraw Hill.
2. Hira and Gupta, Operation Research

DSE-6A: MT 365(B): Calculus of Variation and Classical Mechanics (2 credits)

Course Objectives: Using mathematical methods, the course seeks to comprehend various definitions of physical quantities and their effects on various bodies. It stresses the acquisition of knowledge in order to apply mathematics to the real world.

Course Learning Outcomes: The course will enable the students to:

i) understand problems, methods and techniques of calculus of variations.
ii) understand necessary conditions for the equilibrium of particles acted upon by various forces and learn the principle of virtual work for a system of constraint forces acting on a rigid body.
iii) deal with the kinematics and kinetics of the rectilinear and planar motions of a particle including the constrained oscillatory motions of particles.
iv) determine the center of gravity of some materialistic systems and discuss the equilibrium of a uniform cable hanging freely under its own weight.

Course Contents:

Unit 1: Variational Problems with Fixed Boundaries **[06 Lectures]**

1.1 Necessary condition of extremum of functionals
1.2 Euler equation
1.3 Euler-Poisson equation
1.4 Euler-ostrogradsky equation
1.5 Euler equation in parametric form
1.6 Isoperimetric problems
1.7 Principle of reciprocity

Unit 2: Variational Problems with Moving Boundaries **[06 Lectures]**

2.1 Moving boundaries in explicit form
2.2 Moving boundaries in implicit form
2.3 One sided variation
2.4 Functional in parametric form **[03 Lectures]**

Unit 3: Sufficient Conditions of Extremum

3.1 Higher order variations
3.2 Sufficient condition for extremum
3.3 Jacobi equation and Jacobi equation **[06 Lectures]**

Unit 4: Mechanics of a Particle and System of Particles

4.1 Conservation principles (laws)
4.2 Conservation of linear momentum
4.3 Conservation of angular momentum
4.4 Conservation of energy, Constrained motion, constraints, degrees of freedom
4.5 Generalized co-ordinates
4.6 Limitations of Newton's laws **[15 Lectures]**

Unit 5: Variational Principle and Lagrangian Formulation

5.1 Hamilton's variational principle
5.2 Deduction of Lagrange's equations of motion from Hamilton's principle
5.3 Deduction of Lagrange's equations by D'Alembert's Principle
5.4 Lagrangian for charged particle in an electromagnetic field, gyroscopic forces, nonconservative forces.
5.5 Deduction of Hamilton's principle form D'Alembert's Principle
5.6 Deduction of Newton's second law of motion from Hamilton's principle
5.7 Deduction of Lagrange's equations of motion using variational principle for non-conservative systems
5.8 Applications of Lagrange's equations of motion
5.9 Non-holonomic systems
5.10 Conservation theorems
5.11 Worked Examples

Text Books:

1. Classical Mechanics by SL Gupta, V. Kumar and H.V. Sharma Pragati Prakashan. Unit-4: Chapter 1: 1.1 to 1.6, Unit-5: Chapter-2: 2.1 to 2.12
2. An elementary course on variational problems in Calculus, Naveen Kumar Narosa Publishing House. Unit-1: Chapter 1: 1.1 to 1.9, Unit-2: Chapter-2: 2.1 to 2.4, Unit-3: Chapter-3: 3.1 to 3.3.

Reference Books:

1. Classical Mechanics by Herbert Goldstein, Pearson Publication.
2. Introduction to classical Mechanics: with problems and solutions by David J. Morrin Cambridge University Press.
3. Mathematical Methods of Classical Mechanics by V.I. Arnold. Springer Publication.

DSE-6A: MT 365 (C): Financial Mathematics (2 credits)

Course Objectives:
This course enables the students to understand the basic securities, organization of financial markets, the concept of interest rates, present and future value of cash flow.

Course Learning Outcomes: The course will enable the students to:

i) describe and explain the fundamental features of a financial instruments.
ii) demonstrate a clear understanding of financial research planning, methodology and implementation.
iii) demonstrate understanding of basic concepts in linear algebra, relating to linear equations, matrices, and optimization.
iv) demonstrate understanding of concepts relating to functions and annuities.

Course Contents:

Unit 1: Mathematical models in economics, recurrences, and the elements of finance

1.1 Introduction, a model of the market, market equilibrium and excise tax.
1.2 The first-order recurrence, limits, special cases, continuous compounding of interest. **[08 Lectures]**
1.3 Interest and capital growth, income generation, the interval of compounding.

Unit 2: The Cobweb model, and Introduction to optimization

2.1 Stability of market equilibrium, the general linear case and economic interpretation. **[10 Lectures]**
2.2 Marginal cost as a derivative, Profit maximization, critical points, optimization in an interval and infinite intervals.

Unit 3: The derivative in economics

3.1 Elasticity of demand, profit maximization again.
3.2 Competition versus monopoly, the efficient small firm, startup and break-even points. **[08 Lectures]**

Unit 4: Linear equations and the input-output model

4.1 Making money with matrices, a two-industry 'economy', arbitrage portfolios and spot prices and IS-LM analysis. **[10 Lectures]**
4.2 An economy with many industries and the technology matrix.

Text Book:

1. Martin Anthony and Norman Biggs, Mathematics for Economics and Finance: Methods and Modelling, Cambridge University Press, Reprint 2012.
   Unit-1: Chapters-3: 3.2, 3.3, 3.4 and Chapter-4,
   Unit-2: Chapter-5, Chapter-6: 6.3, Chapter-8
   Unit-3: Chapter-9, Chapter-10,
   Unit-4: Chapter-15:15.3, Chapter-16:16.1, Chapter-17:17.4, Chapter-18:18.5, Chapter- 19.

Reference Books:

1. Edward T. Dowling, Mathematical Economics, Second Edition, Schaum's Outline Series, McGraw Hill International Edition.
2. Aswath Damodaran, Corporate Finance- Theory and Practice, John Wiley and Sons, Inc.
3. Sheldon M. Ross, An Introduction to Mathematical Finance, Cambridge University Press.

DSE-6B: MT-366(A): Machine Learning-II (2 Credits)

Course Objectives:
The main goal of this course is to help students learn, understand, and practice machine learning approaches, which include the study of modern computing big data technologies and scaling up machine learning techniques focusing on industry applications.

Course Learning Outcomes:
The students learning outcomes are designed to specify what the students will be able to perform after completion of the course: Ability to select and implement machine learning techniques and computing environment that are suitable for the applications under consideration.

Course Contents: **[10 Lectures]**

Unit 1: Classification of MNIST dataset

1.1 MNIST
1.2 Training a Binary Classifier
1.3 Performance Measures - Measuring accuracy using Cross Validation, Confusion Matrix, Precision and Recall
1.4 Multiclass Classification **[10 Lectures]**
1.5 Multilabel Classification

Unit 2: Linear Regression

2.1 Linear Regression
1. The Normal Equation
2.2 Gradient Descent
1. Batch Gradient Descent
2. Stochastic Gradient Descent
3. Mini-batch Gradient Descent **[06 Lectures]**
2.3 Polynomial Regression

Unit 3: Logistic Regression

3.1 Estimating Probabilities
3.2 Training and Cost Function **[10 Lectures]**
3.3 Decision Boundary
3.4 Softmax Regression

Unit 4: Other Supervised Algorithms

4.1 K Nearest Neighbors
4.2 Decision Trees
4.3 Ensembles of Decision Trees - Random Forest
4.4 Support Vector Machines

Text Books:-

1. **Hands-on Machine Learning with Scikit-Learn, Keras and Tensorflow – Aurelien Geron. Chapter-3:** Sections: 3.1, 3.2, 3.3, 3.4, 3.6, Chapter-4: 4.1, 4.2, 4.3, 4.6
2. **Introduction to Machine Learning With Python - Andreas C. Muller & Sarah Guido,** Chapter-2: Sections: 2.2.2, 2.2.5, 2.2.6, 2.2.7

Reference Book:-

1. Introduction to Machine Learning With Python - Andreas C. Muller & Sarah Guide.
2. Head first Python by Paul Barry (O Reilly publication).
3. Jason Brownlee - Basics of Linear Algebra for Machine Learning, 2018.
4. M. P. Deisenroth, A. A. Faisal, C. S. Ong - Mathematics for Machine Learning, Cambridge University Press, 2019.
5. Dipanjan Sarkar, Raghav Bali, Tushar Sharma - Practical Machine Learning with Python, 2018.
6. Andrew Ng Playlist - https://www.youtube.com/playlist?list=PLLssT5z_DsK-h9vYZkQkYNWcItqhlRJLN **(First 4 Lectures (till 4.6))**

geeksforgeeks.org/machine-learning

https://towardsdatascience.com/search?q=machine%20learningwww.kaggle.com

DSE-6B: MT- 366(B): Computational Geometry (2 credits)

Course Objectives: This course enables the students to gain detailed knowledge of the fundamental problems within computation geometry and general techniques for solving problems within computational geometry and practical experience with implementation issues involved in converting computation geometry algorithms into running programs.

Course Learning Outcomes: The course will enable the students to:

v) construct algorithms for simple geometrical problems.

vi) characterize invariance properties of Euclidean geometry by groups of transformations.

vii) describe and construct basic geometric shapes and concepts by computational means.

Course Contents:

Unit 1: Two Dimensional Transformations [12 Lectures]

1.1 Introduction.
1.2 Representation of points.
1.3 Transformations and matrices.
1.4 Transformation of – points, straight lines.
1.5 Midpoint Transformation.
1.6 Transformation of – parallel lines, intersecting lines.
1.7 Transformation: rotations, reflections, scaling.
1.8 Combined transformations.
1.9 Transformation of a unit square.
1.10 Solid body transformations.
1.11 Translations and homogeneous coordinates.
1.12 Rotation about an arbitrary point.
1.13 Reflection through an arbitrary line.
1.14 Projection – A Geometric Interpretation of Homogeneous Coordinates.
1.15 Overall Scaling.
1.16 Points at Infinity.

Unit 2: Three Dimensional Transformations **[08 Lectures]**

2.1 Introduction.
2.2 Three dimensional – Scaling, shearing, rotation, reflection, translation.
2.3 Multiple transformations.
2.4 Rotation about – an axis parallel to coordinate axes, an arbitrary axis in space.
2.5 Reflection through an arbitrary plane.

Unit 3: Projection **[08 Lectures]**

3.1 Orthographic projections.
3.2 Axonometric projections.
3.3 Oblique projections.
3.4 Perspective Transformations.

Unit 4: Plane and Space Curves

4.1 Introduction.
4.2 Curve representation.
4.3 Parametric curves.
4.4 Parametric representation of a circle.
4.5 Bezier Curves – Introduction, definition, properties (without proof), Curve fitting (up to n = 3), equation of the curve in matrix form (up to n = 3).

Textbook:

2. **D. F. Rogers, J. A. Adams, Mathematical Elements for Computer Graphics, Tata McGraw Hill, Second Edition.**
   Unit 1: Chapter 2: Sec. 2.1 to 2.20, Unit 2: Chapter 3: Sec. 3.1 to 3.10.
   Unit 3: Chapter 3: Sec. 3.12 to 3.15, Unit 4: Chapter 4: Sec. 4.1, 4.2, 4.4, 4.5, Chapter 5: Sec. 5.1, 5.8.

Reference Books:

1. Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition).
2. Schaum Series, Computer Graphics by Zhigang Xiang and Roy A. Plastock.

DSE-6B: MT-366(C): Lebesgue Integration (2 Credits)

Course Objectives: To develop skills and to acquire knowledge on basic concepts of Lebesgue Measure, The Lebesgue Integral, Measurable Functions, Convergence and completeness.

Course Learning Outcomes: The course will enable the students:

i) To understand the concept of measure and properties of Lebesgue measure.

ii) To study the properties of Lebesgue integral and compare it with Riemann integral.

[08 Lectures]

Course Contents:

Unit 1. Measurable Sets: **[08 Lectures]**

1.4 Length of open sets and closed sets
1.5 Inner and outer measure
1.6 Measurable sets
1.7 Properties of measurable sets.

Unit 2. Measurable Functions:

2.1 Definition of measurable functions and other criteria for measurability equivalent
2.2 Sums, Products, and limits of a measurable functions

2.3 Sequences of a measurable function

Unit 3. The Lebesgue integral for bounded function **[10 Lectures]**

3.1 Measurable partition, lower sum, upper sum,

3.2 Lebesgue integral for bounded measurable function

3.3 Properties of Lebesgue integrals for bounded measurable functions

Unit 4. The Lebesgue integral for unbounded function **[10 lectures]**

4.1 The Lebesgue integral for non-negative valued function

4.2 The Lebesgue integral for real valued function

4.3 Properties of Lebesgue integrals for unbounded functions

4.4 Some fundamental theorems

Text-Book:

1. **Richard R. Goldberg, Methods of Real Analysis, Oxford and IBH Publishing Co. Pvt. Ltd. (1970).**

Unit 1: Chapter 11: Sec 11.1 to 11.3. (Theorem No. 11.1B and 11.1C Statements only).
Unit 2: Chapter 11: Sec 11.4. Unit 3: Chapter 11: Sec 11.5 to 11.4.
Unit 4: Chapter 11: Sec. 11.5 to 11.8 (Theorem 11.8 D statement only)

Reference Books:

1. Tom M. Apostol, Mathematical Analysis, Second Edition, Narosa Publishing House.
2. D. Somasundaram and B. Choudhari, A first course in Mathematical Analysis, Narosa Publishing House.
3. R.G. Bartle and D.R. Scherbert, Introduction to real analysis Fourth Edition, Wiley India Edition.
4. Inder K. Rana, An Introduction to Measure and Integration Second Edition, Narosa Publishing House.
5. G. de Barra, Measure Theory and Integration, New Age International (P) Limited, Publishers.

MT 367: Practical Course Lab-I (Complex Analysis and Real Analysis-II) (2 Credits)

Section-I: Complex Analysis Practical

Practical No. 1: Analytic Functions (Unit 1)

Practical No. 2: Elementary Functions (Unit 2)

Practical No. 3: Integrals - I (Unit 3 up to and including Anti-derivatives)

Practical No. 4: Integrals – II (Unit 3 from Cauchy-Goursat's Theorem onwards)

Practical No. 5: Series (Unit 4)

Practical No. 6: Residues and Poles (Unit 5)

Section-II: Real Analysis-II Practical

Practical 1: Definition and Existence of Riemann Integral (Unit 1)

Practical 2: Properties of Riemann Integrals and Applications (Unit 1)

Practical 3: Improper Integrals (Unit 2)

Practical 4: Pointwise Convergence of Sequences of Functions (Unit 3)

Practical 5: Uniform Convergence of Sequences of Functions (Unit 3)

Practical 6: Series of Functions: Convergence and Divergence (Unit 4)

MT 368: Practical Course Lab-II (Ring Theory and Partial Differential equations) (2 credits)

Section-I: Ring Theory Practical

Practical 1: Rings and Fields (Unit 1)

Practical 2: Rings of Polynomials (Unit 2)

Practical 3: Homomorphism and Factor Ring (Unit 3: 3.1)

Practical 4: Ideals in a Ring (Unit 3: 3.2)

Practical 5: Unique Factorization Domain (Unit 4: 4.1)

Practical 6: Euclidean Domain and Gaussian Integers (Unit 4: 4.2, 4.3)

Section-II: Partial Differential Equations Practical

Practical 1: Simultaneous Differential Equations of the First Order and the First Degree in Three Variables (Unit 1: 1.1, 1.2, 1.3)

Practical 2: Pfaffian Differential Equations and their Solution (Unit 1: 1.4, 1.5)

Practical 3: Solution of First order Partial Differential Equations (Unit 2: 2.1, 2.2, 2.3)

Practical 4: Linear Equations of First order equations and Integral surfaces passing through given curve (Unit 2: 2.3, 2.4)

Practical 5: Solution of Second order Partial Differential Equations (Unit 3)

Practical 6: Canonical Forms and Solution of Second order Partial Differential Equations by Separation Variables Method (Unit 4)

MT 369: Practical Course Lab-III (Based on DSE-6A and DSE-6B) (2 credits)

Section-I: Optimization Techniques/Calculus of Variation and Classical Mechanics/Financial Mathematics

Section-I (A): Optimization Techniques Practical

Practical 1: Network Models (Unit 1)

Practical 2: Game Theory (Unit 2)

Practical 3: Network Models and Game Theory (Unit 1, Unit 2)

Practical 4: Replacement Theory (Unit 3)

Practical 5: Sequencing (Unit 4)

Practical 6: Classical Optimization Theory (Unit 5)

OR

Section-I (B): Calculus of variation and classical Mechanics Practical

Practical 1: Applications of Euler -Lagrange's equation (Unit 1)

Practical 2: Isoperimetric Problems and Variational Problems with Moving Boundaries (Unit 1 and Unit 2)

Practical 3: Degrees of freedom and Generalized coordinates (Unit 3)

Practical 4: Problems on Conservation laws (Unit 4)

Practical 5: Lagrangian Formulation and worked examples-I (Unit 5)

Practical 6: Lagrangian Formulation and worked examples-II (Unit 5)

OR

Section-I (C): Financial Mathematics Practical

Practical 1: Mathematical Models in Economics (Unit 1)

Practical 2: Rrecurrences and the elements of finances (Unit 1)

Practical 3: The Cobweb model (Unit 2)

Practical 4: Introduction to Optimization (Unit 2)

Practical 5: The derivative in Economics (Unit 3)

Practical 6: Linear Equations and the Input Output Model (Unit 4)

Section-II (A): Machine Learning-II Practical

Practical 1: Revision of python and scikit learn (Unit 1)

Practical 2: MNIST classification with python - 1 (Unit 1)

Practical 3: MNIST classification with python - 1 (Unit 1)

Practical 4: Linear Regression Implementation - 1 (Unit 2)

Practical 5: Linear Regression Implementation - 2 (Unit 2)

Practical 6: Logistic Regression Implementation 1 (Unit 3)

Practical 7: Logistic Regression Implementation 2 (Unit 3)

Practical 8: Dealing with Data (Unit 4)

Practical 9: KNN Implementation (Unit 4)

Practical 10: Decision Tree Implementation 4 (Unit 4)

Practical 11: Random Forest Implementation 4 (Unit 4)

Practical 12: Support Vector Machine Implementation 4 (Unit 4)

OR

Section-II (B): Computational Geometry Practical

Practical 1: Two Dimensional Transformation-I (Unit 1)

Practical 2: Two Dimensional Transformation-II (Unit 1)

Practical 3: Two and three Dimensional Transformation-I (Unit 1, Unit 2)

Practical 4: Three Dimensional Transformation-II (Unit 2)

Practical 5: Projection (Unit 3)

Practical 6: Plane and Space Curve (Unit 4)

OR

Section-II (C): Lebesgue Integration Practical

Practical 1: Length of Open and closed sets (Unit 1:1.1, 1.2)

Practical 2: Measurable Sets (Unit 1: 1.2, 1.3)

Practical 3: Measurable functions (Unit 2)

Practical 4: Lebesgue Integral - I (Unit 3: 3.1, 3.2, 3.3)

Practical 5: Lebesgue Integral - II (Unit 3: 3.3, 3.4)

Practical 6: Fourier Series (Unit 4: 4.1, 4.2)

SEC-III: MT-3610: Programming in Python – II (2 Credits)

Course Objectives:

1. To acquire Object Oriented Skills in Python.
2. To develop the skill of designing Graphical user Interfaces in Python.
3. To understand and Understand Python programming basics and paradigm.
4. To develop the concepts of visualization of data and database connectivity.
5. To develop the ability to write database applications in Python.

Course Outcomes:

Upon successful completion of this course the student will be able to:

1. Demonstrate the use of Python in Mathematics such as operations research and computational Geometry etc.
2. Study graphics and design and implement a program to solve a real world problem.
3. The students will implement the concepts of data with python and database connectivity.

[06 Lectures]

Course Contents:

Unit 1: Graphics

1.1 Turtle Graphics: Overview of Turtle Graphics , Turtle Operations, Object Instantiation and the turtle graphics Module.

1.2 Drawing Two-Dimensional Shapes

1.3 Taking a Random Walk

1.4 Colors and the RGB System

1.5 Drawing with Random Colors
1.6 Using the str Function with Objects.

Unit 2: Data Visualization with Python **[04 Lectures]**

2.1 Seaborn
2.2 Matplotlib
2.3 Plotly
2.4 MayaVI

Unit 3: Dictionary and Sorting, Minimum and Maximum: **[08 Lectures]**

3.1 Introduction to Dictionary , Avoiding Key Error Exceptions, Iterating Over a Dictionary, Accessing values of a dictionary, Merging dictionaries, Accessing keys and values, Unpacking dictionaries using the ** operator.
3.2 Dictionary with default values, Creating dictionary, Creating an ordered dictionary,
3.3 Sorting, Minimum and Maximum: Special case: dictionaries, Using the key argument, Default Argument to max, min, Getting a sorted sequence, Extracting N largest or N smallest items from an iterable, Getting the minimum or maximum of several values, Minimum and Maximum of a sequence.

Unit 4: Computational Geometry **[10 Lectures]**

4.1 Points: The distance between two points, Lists of Points - the PointList class, Integer point lists, Ordered Point sets, Extreme Points of a PointList, Random sets of Points not in general position.
4.2 Points: Displaying Points and other geometrical objects, Lines, rays, and line segments, The geometry of line segments, Displaying lines, rays and line segments.
4.3 Polygon: Representing polygons in Python, Triangles, Signed area of a triangle, Triangles and the relationships of points to lines, is Collinear, is Left, is Left On, is Right, is Right On, Between
4.4 Two dimensional rotation and reflection
4.5 Three dimensional rotation and reflection
4.6 Generation of Bezier curve with given control points

Unit 5: Study of Operational Research in Python
5.1 Linear Programming in Python
5.2 Introduction to Simplex Method in Python [08 Lectures]

Practicals:

Practical 1: Turtle Graphics (Unit 1)

Practical 2: Data Visualization (Unit 2)

Practical 3: Dictionary and Sorting, Minimum and Maximum (Unit 3)

Practical 4: Application to Computational Geometry-I (Unit 4)

Practical 5: Application to Computational Geometry-II (Unit 4)

Practical 6: Application to Computational Geometry-II (Unit 4)

Practical 7: Study of Graphical aspects of Two dimensional transformation matrix using Matplotlib (Unit 4)

Practical 8: Study of Graphical aspects of Three dimensional transformation matrix using Matplotlib (Unit 4)

Practical 9: Study of Graphical aspects of Three dimensional transformation matrix using Matplotlib and Study of effect of concatenation of Two dimensional and Three dimensional transformations(Unit 4)

Practical 10: Generation of Bezier curve using given control points (Unit 4)

Practical 11: Study of Operational Research in Python (Unit 5-5.1)

Practical 12: Study of Operational Research in Python (Unit 5-5.2)

Text Books:

1. **Kenneth A. Lambert, Fundamentals of Python:From First Programs to Data Structure, Martin Osborne, 2010, Course Technology, Cengage Learning.** Unit-1: Chapter-7: Sec-7.1.1 to 7.1.8
2. **Python: Notes for Professionals, Goalkicker.com, Free Programming books.** Unit-2: Chapter-108, Unit-3: Chapter-19 Section:19.1 to 19.10 and Chapter-72: Section:72.1 to 72.8
3. **Jim Arlow, Interactive Computational Geometry in Python.** Unit-4: Chapter-1: Sec.-1 to 7, Chapter-2: Sec.-1 to 2, Chapter-3: Sec.-1, 3 to 11, Chapter-4: Sec.-1 to 3, :Chapter-5: Sec.-3 to 7.
4. **Operations Research: Unit-5: (a) https//pypi.org/project/PuLP/ and (b) PuLP: ALinear Programming Toolkit for Python by Stuart Mitchell.**

Reference Books:

1. Guzdial, M. J., Introduction to Computing and Programming in Python, Pearson India.
2. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.
3. Zelle, J., Python Programming: An Introduction to Computer Science, Franklin, Beedle and Associates Inc.
4. Jim Arlow, Interactive Computational Geometry in Python.
5. Robert Johansson, Introduction to Scientific Computing in Python.
6. Jason Brownlee, Basics of Linear Algebra for Machine Learning, Discover the Mathematical Language of Data in Python.
7. Svein Linge, Hans Petter Langtangen, Numerical Methods in Engineering with Python, Cambridge University Press, (2005).

SGC-IV: MT-3611: Mathematics with LaTeX (2 Credits)

Course Objectives: The purpose of this course is to acquaint students with typesetting basic Mathematics in LaTeX.

Course Learning Outcomes: After studying this course the student will be able to:
i) typeset mathematical formulas, use nested list, tabular and array environments.
ii) import figures and pictures that are stored in external files.

Course Contents: **[06 Lectures]**

Unit 1. Figure Insertion

1.1 Commands and Environment for Inserting Figures
1.2 Inserting a Simple Figure
1.3 Side-by-Side Figures
1.4 Sub-numbering a Group of Figures
1.5 Figures in Tables

Unit 2. Equation Writing -I **[12 Lectures]**

2.1 Basic Mathematical Notations and Delimiters.
2.2 Mathematical Operators
2.3 Mathematical Expressions in Text-Mode
2.4 Simple Equations
2.5 Array of Equations
2.6 Left Aligning an Equation
2.7 Sub-numbering a Set of Equations

Unit 3. Equation Writing -II **[12 Lectures]**

3.1 Texts and Blank Space in Math-Mode
3.2 Conditional Expression
3.3 Evaluation of Functional Values
3.4 Splitting an Equation into Multiple Lines
3.5 Vector and Matrix
3.6 Overlining and Underlining
3.7 Stacking Terms
3.8 Side-by-Side Equations

Unit 4. User-Defined Macros **[06 Lectures]**

4.1 Defining New Commands
4.2 Defining New Environments

Practicals:

Practical 1: Commands and Environment for Inserting Figures (Unit 1: 1.1, 1.2)

Practical 2: More about Figure Insertion (Unit-1; 1.3, 1.4, 1.5)

Practical 3: Mathematical Notations, Operators and Expression in LaTeX (Unit 2: 2.1- 2.3)

Practical 4: Simple Equations (Unit-2: 2.4)

Practical 5: Array of Equations (Unit-2: 2.5)

Practical 6: Alignment and numbering a Set of Equations (Unit-2: 2.6, 2.7)

Practical 7: Texts, Blank Space and Conditional Expression in Math mode (Unit-3: 3.1, 3.2)

Practical 8: Evaluation of Functional Values and Splitting an Equation (Unit-3: 3.3, 3.4)

Practical 9: Vector and Matrix (Unit-3: 3.5)

Practical 10: More about equation writing in LaTeX (Unit-3: 3.6, 3.7, 3.8)

Practical 11: New Commands in LaTeX (Unit-4: 4.1)

Practical 12: New Environments in LaTeX (Unit-4: 4.2)

Text Book:

1. **LaTeX in 24 Hours, A Practical Guide for Scientific Writing, Dilip Datta, Springer International Publishing AG 2017.**

   Unit 1: Chapter 9; 9.1 to 9.4, 9.8, Unit 2: Chapter 11; 11.1 to 11.7

   Unit 3: Chapter 12; 12.1 to 12.8 , Unit 4: Chapter 13; 13.1, 13.3 (13.3.1, 13.3.2, 13.3.3)

Reference Books:

1. LaTeX, A Document Preparation System, User's Guide and Reference Manual, Leslie Lamport, Addison-Wesley Publishing Company, Inc., 1994.
2. LaTeX Beginner's Guide, Stefan Kottwitz, Packt Publishing Ltd, 2011.
3. LATEX and Friends, M.R.C. van Dongen, Springer-Verlag Berlin Heidelberg ,2012.
4. Math into LaTeX, George Gratzer, Springer Science Business Media New York, 1996.

Modalities For Conducting The Practical and The Practical Examination:

1. There will be one 4 hours and 20 minutes (260 minutes) practical session for each batch of 15 students per week for each practical course.
2. The College will conduct the Practical Examination at least 15 days before the commencement of the Main Theory Examination. The University practical examination will consist of written examination of 30 marks and oral examination of 05 marks.
3. There will be external examiner; the practical exam will be of the duration of 3 hours. The teacher will set a question paper at the time of paper setting meeting conducted by Savitribai Phule Pune University, Pune based on respective papers I and II given in **Practical Lab-I, Practical Lab-II and Practical Lab-III**, and the pattern is as follows

   Q1. Any 3 out of 5 each question of 5 marks on paper – I (from Practical Lab-I, Practical Lab-II and Practical Lab-III).

   Q2. Any 3 out of 5 each question of 5 marks on paper – II (fromPractical Lab-I, Practical Lab-II and Practical Lab-III).

4. UEC: MT -3510, MT -3511, MT -3610, MT -3611 University practical will have a distribution of 30 marks, of each batch of 15 students, of 3 hours duration and 100 marks.
5. The courses MT-356(A): Machine Learning-I, MT-366(A): Machine Learning-II, MT -3510: Programming in Python -I, MT -3610: Programming in Python -II, MT -3511: LaTeX for Scientific Writing and MT-3611: Mathematics into LaTeX will teach in Computer Laboratory with live sessions for better understanding of students.
6. Each student will maintain a journal to be provided by the college. The internal 15 marks will be given on the basis of journal prepared by student and the cumulative performance of student at practical. **Methods of assessment for Internal exams:** Seminars, Viva-voce, Projects, Surveys, Field visits, Tutorials, Assignment, Group Discussion.
7. It is recommended that concept may be illustrated using computer software (Python, Maxima etc.) and graphing calculators wherever possible.
8. Study tours may be arranged at places having important mathematical institutes or historical places.
9. **Special Instruction:**

a) There should be well equipped mathematics practical laboratory of size 20x20 sq. fts containing at least 20 computers because there are six papers based on Software's (**like Machine Learning-I & II, Programming in Python –I & II, LaTeX Software for Scientific Writing and Mathematics into LaTeX**).

b) Examiners should set separate question papers, solutions and scheme of marking for each batch and claim the remuneration as per University rule.

c) Before starting each practical necessary introduction, basic definitions, intuitive inspiring ideas and prerequisites must be discussed.

Savitribai Phule Pune University
Practical Manual for the course
SEC-IV: MT-3611: Mathematics into LaTeX (2 Credits)

Practical 1: Figure Insertion-I

Q. Answer the following questions

Q.1 Explain the following LaTeX command:

```
\includegraphics[opt]{fname}
```

Q.2 What types of image formats can import from external source in LaTeX?

Q.3 Write a simple program for inserting a figure in LaTeX.

Q.4 Write a simple program in LaTeX which display serial number and title to figure. ?

Q.5 How to fix vertical position of figure in LaTeX.

Q.6 Write a program in LaTeX showing both height and width of image.

Q.7 Write a LaTeX program which produce a scaled form of the original figure.

Practical 2: Figure Insertion-II

Q. Answer the following questions

Q.1 Write a LaTeX program to rotate a figure counter-clock wise by an angle 45°.

Q.2 Write a LaTeX program to rotate a figure clock wise by an angle 45°.

Q.3 Write a LaTeX program to insert three images side by side in a single figure.

Q.4 Using *minipage* environment, write a LaTeX program to insert three images side by side in a single figure.

Q.5 Write a LaTeX program for inserting three figures with a sub-numbering in a single row.

Q.6 Write a LaTeX program for inserting four figures with a sub-numbering in two rows.

Q.7 Write a LaTeX program for inserting a figures in a table.

Practical 3: Mathematical Notations, Operators and Expression in LaTeX

Q. Answer the following questions

Q.1 What packages are required to write mathematical expressions in LaTeX?

Q.2 Make a list of LaTeX commands for the frequently used mathematical notations.

Q.3 Make a list of LaTeX commands for the frequently used delimiters.

Q.4 Make a list of LaTeX commands for the frequently used binary operators.

Q.5 Make a list of LaTeX commands for the frequently used basic relational operators.

Q.6 Make a list of LaTeX commands for the frequently used operators in calculus.

***

Practical 4: Equation Writing: Simple equations, Array of Equations

Q. Answer the following questions

Q.1 Explain in-line and display math mode for writing mathematical expressions in LaTeX.

Q.2 Create a LaTeX code that formats the text shown below

The equation

$$ax^2 + bx + c$$

has as solution

$$x_{12} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Q.3 Write a simple LaTeX code for following equation.

$$\lim_{x \to 0} \frac{Sinx}{x} = 1.$$

Q.4 Write a simple LaTeX code for following equation.

$$p_1(n) = \lim_{n \to \infty} \sum_{r=0}^{\infty} \left(1 - cos^{2m}(r!\frac{\pi}{n})\right) \quad (1)$$

Q.5 Typeset the following expression as in-line and displayed mathematical text:
$\forall x \in R, \exists y \in R$ such that $y > x$.

Q.6 Typeset the following integral in LaTeX

$$\int_0^1 3x^2 dx = 1.$$

***

Practical 5: Equation Writing: Alignment and numbering a Set of Equations

Q. Answer the following questions

Q.1 Write a simple LaTeX code for following system of equation using gather environment.

$$x = rcos\phi sin\theta, \tag{2}$$
$$y = rsin\phi sin\theta,$$
$$z = rcos\theta. \tag{3}$$

Q.2 Write a simple LaTeX code for following system of equation using eqnarray environment.

$$\begin{aligned} x + 2y - 2z &= -11 \\ y + z &= 11 \\ z &= 21 \end{aligned} \tag{4}$$

Q.3 Write a simple LaTeX code for following system of equation using align environment.

(a)

$$x - 1 = y \tag{5}$$
$$x = y + 1 \tag{6}$$

(b)

$$f(u) = \sum_{j=1}^{n} x_j f(u_j) \tag{7}$$
$$= \sum_{j=1}^{n} x_j \sum_{i=1}^{m} a_{ij} v_i \tag{8}$$
$$= \sum_{j=1}^{n} \sum_{i=1}^{m} a_{ij} x_j v_i \tag{9}$$

Q.4 Write a simple LaTeX code for following system of equation using alignat environment.

(a)

m	módulo	$m > 0$
a	multiplicador	$0 < a < m$
c	constante aditiva	$0 \leq c < m$
x_0	valor inicial	$0 \leq x_0 < m$

(b)

$$ABC = ABC - AB \tag{10}$$
$$ABCD = ABC - ABCDEFG \tag{11}$$

Q.5 Write a simple LaTeX code for following system of equation using left align environment.

$$f(u) = \sum_{j=1}^{n} x_j f(u_j) \tag{12}$$
$$= \sum_{j=1}^{n} x_j \sum_{i=1}^{m} a_{ij} v_i$$
$$= \sum_{j=1}^{n} \sum_{i=1}^{m} a_{ij} x_j v_i$$

Q.6 Write a simple LaTeX code for following system of equation using sub numbering environment.

$$y = d \tag{13a}$$
$$y = cx + d \tag{13b}$$
$$y = bx^2 + cx + d \tag{13c}$$
$$y = ax^3 + bx^2 + cx + d \tag{13d}$$

* * *

Practical 6: Text and Blank space in Math-Mode

Q. Answer the following questions

Q.1 What are the commands used for text spacing and blank space in LaTeX?

Q.2 Write a following equations in LaTeX using spacing rule.

$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x +10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$
$$f(x) = x^3 - 4x^2 + 5x + 10$$

Q.3 Write a LaTeX code for following texts in Math-Mode environment.

$$S = \{z \in \mathbb{C} \,|\, |z| < 1\} \quad \text{and} \quad S_2 = \partial S$$

Q.4 Write a LaTeX code for following texts in Math-Mode environment.

$$\lim_{x \to \infty} e^{-kx} = 0 \quad \text{if} \quad k > 0. \tag{14}$$

Q.5 Write a LaTeX code for following texts in Math-Mode environment.

$$\text{Updated value} \quad x = x^{\text{low}} + yd \ .$$

Q.6 Write a LaTeX code for following texts in Math-Mode environment.

$$\begin{aligned} \text{Maximize} \quad & f(\boldsymbol{x}) \\ \text{Subject to} \quad & g_i(\boldsymbol{x}) \leq 0; \quad i = 1, \ldots, m \\ & h_k(\boldsymbol{x}) = 0; \quad k = 1, \ldots, p \\ & x_j \geq 0: \qquad j = 1, \ldots, n \end{aligned}$$

* * *

Practical 7: Conditional Expressions, Evaluation and splitting of equations

Q. Answer the following questions

Q.1 Write a LaTeX code for following conditional expression using cases environment.

$$f(x) = \begin{cases} -x, & \text{if } x < 0; \\ 0, & \text{if } x = 0; \\ x, & \text{if } x > 0. \end{cases}$$

Q.2 Write a LaTeX code for following conditional expression using array environment.

$$\lim_{x\to\infty} e^{-kx} = \begin{cases} 0, & \text{if } k > 0; \\ \infty, & \text{if } k < 0; \\ 1, & \text{if } k = 0. \end{cases}$$

Q.3 Write a LaTeX code for following conditional expression using eqnarray environment.

$$\begin{aligned} \lim_{x\to\infty} e^{-kx} &= 0, \quad \text{if } k > 0; \\ &= \infty, \quad \text{if } k < 0; \\ &= 1, \quad \text{if } k = 0. \end{aligned}$$

Q.4 Write a LaTeX code for evaluating following functional values.

(a)

$$\text{Let } f(x,y) = x^2 + y^2 + xy$$
$$\therefore \frac{\partial f}{\partial x} = 2x + y$$
$$\therefore \left(\frac{\partial f}{\partial x}\right)_{(1,1)} = 3$$

(b)

$$T(s) = \left.\frac{1}{H(\hat{S})}\right|_{\hat{S}=e^{1/n\frac{s}{\omega P}}}$$

Q.5 Write a LaTeX code for splitting an equation using multiline environment.

$$5x_1 + 2x_2 + 3x_3 - x_4 - 4x_5 + 5x_6 + 7x_7 + 3x_8 - 6x_9 - 2x_{10} - 5x_{11} = 7634 \quad (15)$$

Q.6 Write a LaTeX code for splitting an equation using split environment.

(a)

$$f(x,y) = h\left[\frac{1}{2}(x+y) + x^2 + y^3 + \frac{1}{3}z^2\right] \quad (16)$$

(b)

$$\begin{aligned} f(x) &= x^3 + 2x^2 - 5x + 10 \\ &= (2)^3 + 2(2)^2 - 5(2) + 10 \\ &= 16 \end{aligned}$$

Q.7 Write a LaTeX code for splitting an equation using eqnarray environment.

(a)

$$\begin{aligned} 10xy^2 + 15x^2y - 5xy &= 5\left(2xy^2 + 3x^2y - xy\right) && (17) \\ &= 5x\left(2y^2 + 3xy - y\right) && (18) \\ &= 5xy\left(2y + 3x - 1\right) && (19) \end{aligned}$$

(b)

$$f(x,y) = h\left[\frac{1}{2}(x+y) + x^2 + y^3 + \frac{1}{3}z^2\right] \quad (20)$$

* * *

Practical 8: Vectors, Matrices, Overlining and Underlining, Side-by-Side equations

Q. Answer the following questions

Q.1 Write a LaTeX code for constructing the following using matrices.

(a)
$$\begin{matrix} 5 & -6 & 7 \\ 1 & 4 & 3 \\ 3 & 7 & 2 \end{matrix}$$

(b)
$$\begin{pmatrix} 5 & -6 & 7 \\ 1 & 4 & 3 \\ 3 & 7 & 2 \end{pmatrix}_{3\times3}$$

(c)
$$\begin{bmatrix} 5 & -6 & 7 \\ 1 & 4 & 3 \\ 3 & 7 & 2 \end{bmatrix}_{3\times3}$$

(d)
$$\begin{vmatrix} 5 & -6 & 7 \\ 1 & 4 & 3 \\ 3 & 7 & 2 \end{vmatrix}$$

(e) $\begin{Vmatrix} 5 & -6 & 7 \\ 1 & 4 & 3 \\ 3 & 7 & 2 \end{Vmatrix}$

Q.2 Write a LaTeX code for following using array environment.

First number	x	8
Second number	y	15
Sum	$x+y$	23
Difference	$x-y$	-7
Product	xy	120

Q.3 Write a LaTeX code for following using Overlining and Underlining environment.

(a) Let $\overline{u} = (u_1, u_2, u_3)$ and $\overline{v} = (v_1, v_2, v_3)$ be any two vectors. Then dot product of $\overline{u}$ and $\overline{v}$ is defined as $\overline{u} \cdot \overline{v} = u_1v_1 + u_2v_2 + u_3v_3$.

(b) $\vec{x}\ \overline{x}\ \underline{x}\ \mathbf{x}\ \vec{\mathbf{x}}\ \overline{\mathbf{x}}\ \underline{\mathbf{x}}$

(c) $$\underbrace{1+1/2+1/3}_{\geq 1/2} + \overbrace{1/4+1/5+1/6+1/7+1/8}^{<1/2} + \cdots$$

Q.4 Write a LaTeX code for following using stack environment.

(a) $z_i = a_j + b_k \quad \begin{smallmatrix} i=1,\ldots,a \\ j=1,\ldots,b \\ k=1,\ldots,n \end{smallmatrix}$

(b) $$\text{Total expected loss of diversity} = \sum_{\substack{\text{all} \\ \text{languages}}} \left(\begin{smallmatrix}\text{Language} \\ \text{Distinctiveness}\end{smallmatrix}\right) \cdot \Pr\left(\begin{smallmatrix}\text{Language} \\ \text{dies}\end{smallmatrix}\right)$$

Q.5 Write a LaTeX code for following Side-by-Side Equations (21)

(a) $$a \leq b \qquad c \leq d$$

(b)
$$\begin{aligned} y &= x \\ 5x &= y \\ 4 + 2x &= 1 + y \\ x &= y \end{aligned} \qquad \begin{aligned} a &= z \\ 4z &= \frac{4}{2}z \\ q + 2 &= 4 + a \\ q &= a \end{aligned} \qquad \begin{aligned} b &= a + c \\ z &= y \\ we &= cd \\ c &= a + b \end{aligned}$$

(c)

$$x_1 = \frac{A - A_0}{\frac{1}{2} \cdot (A_A - A_a)} \qquad x_2 = \frac{B - B_0}{\frac{1}{2} \cdot (B_A - B_a)} \qquad x_3 = \frac{C - C_0}{\frac{1}{2} \cdot (C_A - C_a)} \tag{22}$$

***

Practical 9: User-Defined Macros : New Commands-I

Q. Answer the following questions

Q.1 Write a syntax to define newcommand.

Q.2 Write a syntax to define newcommand without argument.

Q.3 Write a syntax to define newcommand with compulsory argument.

Q.4 Try typing up the following code in latex and observe output:

```
\documentclass{scrartcl}
\newcommand*{\keyword}[1]{\textsf{#1}}
\begin{document}
A \keyword{command} usually begins with a backslash.
Segments of code may be \keyword{grouped}.
Some \keyword{commands} take one or more \keyword{arguments}.
\end{document}
```

Q.5 Define a newcommand for repeatedly used word "Trigonometric functions".

Q.6 Define a newcommand for repeatedly used word "Arca of Triangle"

***

Practical 10:User-Defined Macros: New commands-II

Q. Answer the following questions

Q.1 Define a newcommand for partial derivative $\frac{\partial^2 f}{\partial t^2}$, which takes input function f from user.

Q.2 Define a newcommand for ordinary derivative $\frac{d^5 f}{dt^5}$, which takes input function f from user. Also set a default value $\cos t$.

Q.3 Write newcommand that replaces the bullet marking of the items with small circles.

Q.4 Write newcommand that replaces the 'Chapter' with 'Module'.

Q.5 Write newcommand that replaces the 'section' with 'lecture'.

Q.6 Write a new command to print $\sin^2\theta$ with particular values θ.

* * *

Practical 11:User-Defined Macros: New Environments

Q. Answer the following questions

Q.1 Write a syntax to define newenvironment.

Q.2 Define a new environment for remarks.

Q.3 Define a new environment for abstract.

Q.4 Define a new environment for conclusion.

Q.5 Define new user-defined floating environment "code" for presenting programming code in boldface.

Q.6 Redefine a environment for nested list of numbered items, which is emphasizing the items of every alternate loop.

* * *

Three Year B.Sc. Degree Program in Mathematics
(Faculty of Science and Technology)
T. Y. B. Sc. (Mathematics)
SEC-III: MT 3610: Programming in Python –II (2 credits)
Practicals

Practical 1: Turtle Graphics (Unit 1)

1. Initialize the Turtle canvas and draw the following commands:
   (a) Move forward 150 pixel.
   (b) Rotate clockwise 45 degree.
   (c) Move forward 180 pixel without drawing.
   (d) Draw circle with radius 200 pixel with green color.
   (e) Goto home.
   (f) Draw a circle in clockwise direction with fill color blue with radius 40 pixel.
   (g) Print the current position of turtle.
   (h) Print the current direction of turtle.
   (i) clear all screen.
2. Write a python programme to define a function, which plot a circle of a given radius starting with its current position.
3. Draw a letter "W" usin turtle methods with width 3.
4. Draw a circle radius 250 pixel centered at (150,150).
5. Using random function, draw a random walk with 60 steps which travels forward between 20 and 100 and moves right between 0 and 360 randomly.
6. Draw a circles of different radius with random colors.
7. Draw a random walk with random color having 100 steps using random function.
8. Use "for" loops to make a turtle draw these regular polygons (regular means all sides the same lengths, all angles the same):
   (a) An equilateral triangle
   (b) A square
   (c) A hexagon (six sides)
   (d) An octagon (eight sides)

Practical 2: Data Visualization (Unit 2)

1. Plot the scatter plot pyplot interface for the data $x = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12]$ and $y = [5, -1, 6, -7, 4, 5, -6, 4, 2, 9, 1, -1, 6]$

2. Plot the scatter plot and line plot in pyplot interface for the data $x = [-6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6]$ and $y = x^3$

3. Plot the scatter graph for "iris" dataframe with bubble charts.

4. Create a kernel density estimation and rug plot for randomly generated data using seaborn.

5. Draw a set of vertical bar plots for the following data using seaborn. $x = [1, 2, 3, 4, 5, 6, 7, 8], y = [101, 105, 114, 164, 120, 100, 200, 175]$

6. Plot the scatter plot for randomly genrated date using plotly.

7. Plot the random points in 3D, with markers and different sizes using mayaVI.

8. Plot a pie chart for the data: $Data = [83, 82, 10, 5, 120]$.

Practical 3: Dictionary (Unit 3)

1. Create dictionary with keys as $\{1, 2, 3..., 8\}$ and correspoding values $\{'one', 'two', ..., 'eight'\}$.

2. In the above dictionary d, delete the elements correspond to keys 3, 5 and change the value for key 7 to 's'

3. Print all key-value pairs from dictionary:
$D = \{'a' : 'one', 'b' : 'two', 'c' : 'three', 'd' : 'four'\}$

4. Consider the following dictionary
$d = \{0 : 'Peter', 2 : 'Joseph', 3 : 'Ricky', 'Empoges' : (20, 33, 24)\}$
i) Set default value "Joseph2" to key "4".
ii) Print value for key "4".

5. Merge the following dictionaries
$d1 = \{"a" : 1, "b" : 2, "c" : 3\}$
$d2 = \{"d" : 8, "e" : 9, "f" : 6\}$

6. Use ** to unpack the dictionary and define a function, which add values from dictionary.
$d = \{'a' : 2, 'b' : 3\}$

7. Create the ordered dictionary for the data
$keys = \{0, 1, 4, 5, 6, 3, 2\}$
$values = \{-9, -7, -4, -6, -3, 3, 4\}$

Practical 4: Sorting, Minimum and Maximum in dictionary (Unit 3)

1. Finding the minimum and maximum of a sequence of sequences.
L=[[5,3,4,7,8,-6,-8,-3,0],[6,5,6,3],[7,4,3,5]]

2. Extract the 3 largest elements from the list
$l = [8, -6, -8, -3, 0]$

3. Find minimum, maximum form the given dictionary.
$adict = \{'n' : 1, 's' : 2, 'r' : 2, 'u' : 2, 't' : 1\}$
Also, sort the dictionary

4. Create the ordered dictionary for the data
$keys = \{0, 1, 4, 5, 6, 3, 2\}$
$values = \{-9, -7, -4, -6, -3, 3, 4\}$

5. Find minimum, maximum form the given dictionary.
$adict = \{'a' : 3, 'b' : 5, 'c' : 1\}$

6. Find minimum, maximum form the given dictionary.
$adict = \{'one' : 'uno', 'three' : 'tres', 'two' : 'dos'\}$

7. Finding the minimum and maximum of a sequence of sequences.
$L = [[1, 2], [6, 5], [6, 3], [7, 4], [3, 5]]$

8. Extract the 3 largest elements from the list
$l = [5, 3, 4, 7, 8, -6, -8, -3, 0]$

Practical 5: Applicatiou to Computational Geometry-I (Points) (Unit 4)

1. Disscus the importance of Sympy module in Python.

2. Find the distance between points x and y, y and w, x and z, if $x = [1, -1], y = [-2, 4], z = [-1, -1]$ and $w = [3, 5]$.

3. Reflect the given points through respective lines.
   (a) $(-3, 6)$, $x + 2y = 0$
   (b) $(2, -6)$, $2x + 3y = -1$
   (c) $(5, -2$, $x - y = 5$
   (d) $(6.3, 3.6)$, $x - 4y = 1$
   (e) $(-5, 8)$, $4x + 3y = 11$

4. Reflect the point $P\,[-3 \quad 6]$ through the line $\frac{3}{\sqrt{2}}x - 2y + \frac{4}{3} = 0$.

5. Apply each of the following transformations on the point $P = [2, -5]$.
   (a) Reflection through X-axis.
   (b) Scaling in X-coordinate by factor 4.

(c) Scaling in Y-coordinate by factor 5.

(d) Reflection through the line $y = -2x$.

(e) Shearing in Y direction by 2 units.

(f) Scaling in X and Y direction by $\frac{4}{5}$ and 7 units respectively.

(g) Shearing in both X and Y direction by -3 and 1 units respectively.

(h) Rotation about origin by an angle 45 degrees.

6. Apply each of the following transformations on the point $P = [-2, 4]$.

(a) Scaling in X and Y direction by $\frac{7}{2}$ and 4 units respectively.

(b) Shearing in both X and Y direction by 4 and 7 units respectively.

(c) Reflection through the line $y = 2x + 3$.

(d) Shearing in Y direction by 7 units.

(e) Rotation about origin by an angle 48 degrees.

(f) Reflection through line $3x + 4y = 5$.

(g) Scaling in X-coordinate by factor 6.

(h) Scaling in Y-coordinate by factor 4.1.

7. Apply each of the following transformations on the point $P = [-4.1]$.

(a) Scaling in X-coordinate by factor 3.

(b) Scaling in Y-coordinate by factor 4.

(c) Reflection through the line $y = 2x - 3$.

(d) Shearing in Y direction by 7 units.

(e) Scaling in X and Y direction by $\frac{5}{2}$ and 4 units respectively.

(f) Rotation about origin by an angle 35 degrees.

(g) Reflection through line $x + 4y = 0$.

Practical 6: Application to Computational Geometry-II(line, line-segment, ray) (Unit 4)

1. Rotate the line passing through points A$[5 \quad 1]$ and B$[2 \quad 5]$ about origin through an angle 270^0.

2. Rotate the line passing through points A$[0 \quad -1]$ and B$[2 \quad -5]$ about origin through an angle 80^0.

3. If the line segment joining the points $A\begin{bmatrix}-2 & 5\end{bmatrix}$, $B\begin{bmatrix}-4 & 3\end{bmatrix}$ is transformed to the line segment A^*B^* by the transformation matrix, $[T] = \begin{bmatrix}2 & -2\\ 3 & -6\end{bmatrix}$, then find the midpoint and length of A^*B^*.

4. Reflect the line segment joining the points $A[5, 2]$ and $B[-3, 4]$ through the line $y = 2x - 1$.

5. Rotate the line by 75 degrees having two points $(0, 0)$ and $(0, 1)$. Also find its equation after applying rotation.

6. Rotate the segment by 180 degrees having end points $(1, 0)$ and $(2, -1)$.

7. Rotate the ray by 90 degrees having starting point $(0, 0)$ in the direction of $(4, 4)$.

8. Reflect the line $4x + 3y = 5$ through line $x + y = 0$ and find the equation of reflected line.

9. Reflect the segment having two endpoints $(2, 3), (4, 6)$ through line $7x + 6y = 3$.

10. Reflect the line segment having starting point $(0, 0)$ in the direction of $(2, 4)$ through line $x - 2y = 3$.

Practical 7: Application to Computational Geometry-III(line, line-segment, ray)(Unit 4)

1. If the line with points $A\begin{bmatrix}2 & 1\end{bmatrix}$, $B\begin{bmatrix}4 & -1\end{bmatrix}$ is transformed by the transformation matrix, $[T] = \begin{bmatrix}1 & 2\\ 2 & 1\end{bmatrix}$, then find the equation of transformed line.

2. Rotate the line passing through points A$[1 \quad 1]$ and B$[5 \quad 5]$ about origin through an angle 90^0.

3. If the line segment joining the points $A\begin{bmatrix}2 & 5\end{bmatrix}$, $B\begin{bmatrix}4 & 3\end{bmatrix}$ is transformed to the line segment A^*B^* by the transformation matrix, $[T] = \begin{bmatrix}2 & -3\\ 4 & 1\end{bmatrix}$, then find the midpoint of A^*B^*.

4. Reflect the line segment joining the points $A[5 \ -3]$ and $B[1 \ 4]$ through the line $y = 2x + 3$.

5. Suppose that the line segment between the points $A\begin{bmatrix}1 & 4\end{bmatrix}$ and $B\begin{bmatrix}3 & 6\end{bmatrix}$ is transformed to the line segment A^*B^* using the transformation matrix $[T] = \begin{bmatrix}2 & -1\\ 1 & -3\end{bmatrix}$. Find slope of the transformed line segment A^*B^*.

6. If the two lines $2x - y = 5$ and $x + 3y = -1$ are transformed using the transformation matrix $[T] = \begin{bmatrix}-2 & 3\\ 1 & 1\end{bmatrix}$ then find the point of intersection of the transformed lines.

7. If we apply shearing on the line $2x + y = 3$ in x and y directions by 2 and -3 units respectively, then find the equation of the resulting line.

Practical 8: Polygons (Unit 4)

1. Write a python programme to draw a polygon with vertices $(0, 1)$, $(1, 0), (-2, 2), (1, -4)$ and find its area and perimeter.
2. Write a python programme to draw a regular polygon with 8 sides and radius 6 centered at origin and find its area and perimeter.
3. Write a python programme to draw a regular polygon with 6 sides and radius 1 centered at $(1, 2)$ and find its area and perimeter.
4. Write a python programme to draw a regular polygon with 7 sides and radius 1.5 centered at $(2, 2)$ and reflect it through line $x - y = 5$
5. Write a python programme to draw a polygon with vertices $(0, 0)$, $(2, 0), (2, 3), (1, 6)$ and rotate by 180 degrees and find internal angle at each vertex.
6. Write a python programme to draw a polygon with vertices $(0. 0)$, $(1, 0), (2, 2), (1, 4)$ and find its area and perimeter.
7. Write a python programme to draw a regular polygon with 4 sides and radius 6 centered at origin and find its area and perimeter.
8. Write a python programme to draw a regular polygon with 8 sides and radius 2 centered at $(-1, 2)$ and find its area and perimeter.
9. Write a python programme to draw a regular polygon with 7 sides and radius 6 centered at $(-2, 2)$ and reflect it through line $x - 2y = 5$
10. Write a python programme to draw a polygon with vertices $(0. 0)$, $(-2.0), (5, 5), (1, -6)$ and rotate by 180 degrees and find internal angle at each vertex.

Practical 9: Triangles (Unit 4)

1. Reflect the pol ABC through the line $y = 3$, where $A[1\ 0]$, $B[2\ -1]$, $C[-1\ 3]$.
2. Rotate the triangle ABC by 90 degree, where $A[1\ 2]$, $B[2\ -2]$, $C[-1\ 2]$.
3. Find the area and perimeter of the triangle ABC, where $A[0\ 0]$, $B[5\ 0]$, $C[3\ 3]$.
4. Find the angle at each vertices of the triangle ABC, where $A[0\ 0]$, $B[2\ 2]$, $C[0\ 2]$.

5. Find the angle at each vertices of the triangle PQR, where $P[1\ 0]$, $Q[2\ 3]$, $R[0\ -2]$.
6. Reflect the triangle ABC through the line $y = -3$, where $A[1\ 1]$, $B[2\ -3]$, $C[-1\ 5]$.
7. Rotate the triangle ABC by 90 degree, where $A[1\ -2]$, $B[4\ -6]$, $C[-1\ 4]$.
8. Find the area and perimeter of the triangle ABC, where $A[0\ 1]$, $B[-5\ 0]$, $C[3\ -3]$.
9. Find the angle at each vertices of the triangle ABC, where $A[1\ 1]$, $B[1\ 2]$, $C[0\ 1]$.
10. Reflect the triangle ABC through the line $y = x + 3$, where $A[-1\ 0]$, $B[2\ -1]$, $C[1\ 3]$.
11. Rotate the triangle ABC by 270 degree, where $A[-1\ 2]$, $B[2\ -5]$, $C[-1\ 7]$.
12. Find the area and perimeter of the triangle ABC, where $A[0\ 1]$, $B[-5\ 0]$, $C[-3\ 3]$.

Practical 10: Application to Computational Geometry-IV (Unit 4)

1. If a 2×2 transformation matrix $[T] = \begin{bmatrix} 1 & 7 \\ -2 & 5 \end{bmatrix}$ is used to transform a line L. then the equation of transformed line is $y^* = x^* + 3$. Find the equation of original line.
2. Find the combined transformation of the line segment between the points $A\ [-4\ \ 1]$ and $B\ [3\ \ 0]$ for the following sequence of transformations: first rotation about origin through an angle π^c; followed by scaling in x coordinate by 2 units; followed by reflection through the line $y = -x$.
3. Suppose that the line segment between the points $A\ [1\ \ -4]$ and $B\ [5\ \ -6]$ is transformed to the line segment A^*B^* using the transformation matrix $[T] = \begin{bmatrix} 3 & -1 \\ -5 & 3 \end{bmatrix}$. Find slope of the transformed line segment A^*B^*.
4. If the two lines $2x + y = 0$ and $x - 3y = 1$ are transformed using the transformation matrix $[T] = \begin{bmatrix} 2 & -3 \\ -1 & -1 \end{bmatrix}$ then find the point of intersection of the transformed lines.

7. If we apply shearing on the line $2x + y = 3$ in x and y directions by 2 and -3 units respectively, then find the equation of the resulting line.

Practical 8: Polygons (Unit 4)

1. Write a python programme to draw a polygon with vertices $(0, 1)$, $(1, 0), (-2, 2), (1, -4)$ and find its area and perimeter.
2. Write a python programme to draw a regular polygon with 8 sides and radius 6 centered at origin and find its area and perimeter.
3. Write a python programme to draw a regular polygon with 6 sides and radius 1 centered at $(1, 2)$ and find its area and perimeter.
4. Write a python programme to draw a regular polygon with 7 sides and radius 1.5 centered at $(2, 2)$ and reflect it through line $x - y = 5$
5. Write a python programme to draw a polygon with vertices $(0, 0)$, $(2, 0), (2, 3), (1, 6)$ and rotate by 180 degrees and find internal angle at each vertex.
6. Write a python programme to draw a polygon with vertices (0.0), $(1, 0), (2, 2), (1, 4)$ and find its area and perimeter.
7. Write a python programme to draw a regular polygon with 4 sides and radius 6 centered at origin and find its area and perimeter.
8. Write a python programme to draw a regular polygon with 8 sides and radius 2 centered at $(-1, 2)$ and find its area and perimeter.
9. Write a python programme to draw a regular polygon with 7 sides and radius 6 centered at $(-2, 2)$ and reflect it through line $x - 2y = 5$
10. Write a python programme to draw a polygon with vertices (0.0), $(-2.0), (5, 5), (1, -6)$ and rotate by 180 degrees and find internal angle at each vertex.

Practical 9: Triangles (Unit 4)

1. Reflect the pol ABC through the line $y = 3$, where $A[1\ 0]$, $B[2\ -1]$, $C[-1\ 3]$.
2. Rotate the triangle ABC by 90 degree, where $A[1\ 2]$, $B[2\ -2]$, $C[-1\ 2]$.
3. Find the area and perimeter of the triangle ABC, where $A[0\ 0]$, $B[5\ 0]$, $C[3\ 3]$.
4. Find the angle at each vertices of the triangle ABC, where $A[0\ 0]$, $B[2\ 2]$, $C[0\ 2]$.

5. Find the angle at each vertices of the triangle PQR, where $P[1\ 0]$, $Q[2\ 3]$, $R[0\ -2]$.
6. Reflect the triangle ABC through the line $y = -3$, where $A[1\ 1]$, $B[2\ -3]$, $C[-1\ 5]$.
7. Rotate the triangle ABC by 90 degree, where $A[1\ -2]$, $B[4\ -6]$, $C[-1\ 4]$.
8. Find the area and perimeter of the triangle ABC, where $A[0\ 1]$, $B[-5\ 0]$, $C[3\ -3]$.
9. Find the angle at each vertices of the triangle ABC, where $A[1\ 1]$, $B[1\ 2]$, $C[0\ 1]$.
10. Reflect the triangle ABC through the line $y = x + 3$, where $A[-1\ 0]$, $B[2\ -1]$, $C[1\ 3]$.
11. Rotate the triangle ABC by 270 degree, where $A[-1\ 2]$, $B[2\ -5]$, $C[-1\ 7]$.
12. Find the area and perimeter of the triangle ABC, where $A[0\ 1]$, $B[-5\ 0]$, $C[-3\ 3]$.

Practical 10: Application to Computational Geometry-IV(Unit 4)

1. If a 2×2 transformation matrix $[T] = \begin{bmatrix} 1 & 7 \\ -2 & 5 \end{bmatrix}$ is used to transform a line L, then the equation of transformed line is $y^* = x^* + 3$. Find the equation of original line.
2. Find the combined transformation of the line segment between the points $A\begin{bmatrix} -4 & 1 \end{bmatrix}$ and $B\begin{bmatrix} 3 & 0 \end{bmatrix}$ for the following sequence of transformations: first rotation about origin through an angle π^c; followed by scaling in x coordinate by 2 units; followed by reflection through the line $y = -x$.
3. Suppose that the line segment between the points $A\begin{bmatrix} 1 & -4 \end{bmatrix}$ and $B\begin{bmatrix} 5 & -6 \end{bmatrix}$ is transformed to the line segment A^*B^* using the transformation matrix $[T] = \begin{bmatrix} 3 & -1 \\ -5 & 3 \end{bmatrix}$. Find slope of the transformed line segment A^*B^*.
4. If the two lines $2x + y = 0$ and $x - 3y = 1$ are transformed using the transformation matrix $[T] = \begin{bmatrix} 2 & -3 \\ -1 & -1 \end{bmatrix}$ then find the point of intersection of the transformed lines.

5. If we apply shearing on the line $2x - y = 8$ in x and y directions by 4 and 6 units respectively, then find the equation of the resulting line.

6. If a -3×2 transformation matrix $[T] = \begin{bmatrix} 1 & 3 \\ 2 & 2 \end{bmatrix}$ is used to transform a line L, then the equation of transformed line is $y^* = x^* - 3$. Find the equation of original line.

7. Find the combined transformation of the line segment between the points $A\begin{bmatrix} 4 & 1 \end{bmatrix}$ and $B\begin{bmatrix} -3 & 0 \end{bmatrix}$ for the following sequence of transformations: first rotation about origin through an angle π^c; followed by scaling in x coordinate by 3 units; followed by reflection through the line $y = 3x + 9$.

Practical 11: Study of Operational Research in Python (Unit 5-5.1)

1. Solve the following LLP:

$$\begin{aligned} \text{Max } Z &= 150x + 75y \\ \text{subject to,} \\ 4x + 6y &\leq 24 \\ 5x + 3y &\leq 15 \\ x \geq 0, y &\geq 0 \end{aligned}$$

2. Solve the following LLP:

$$\begin{aligned} \text{Min. } Z &= 3.5x + 2y \\ \text{subject to,} \\ x + y &\geq 5 \\ x &\geq 4 \\ y &\leq 2 \\ x \geq 0, y &\geq 0 \end{aligned}$$

3. Solve the following LLP:

$$\begin{aligned} \text{Max. } Z &= 3x + 5y + 4z \\ \text{subject to,} \\ 2x + 3y &\leq 8 \\ 2y + 5z &\leq 10 \\ 3x + 2y + 4z &\leq 15 \\ x \geq 0,\ y \geq 0\ z &\geq 0 \end{aligned}$$

4. Solve the following LLP:

$$\begin{aligned} \text{Min. } Z &= x + 2y + z \\ \text{subject to,} \\ x + \tfrac{1}{2}y + \tfrac{1}{2}z &\leq 1 \\ \tfrac{3}{2}x + 2y + z &\geq 8 \\ x \geq 0, y \geq 0, z &\geq 0 \end{aligned}$$

5. Solve the following LLP:

$$\begin{aligned} \text{Min. } Z &= x + y \\ \text{subject to,} \\ x &\geq 6 \\ y &\geq 6 \\ x + y &\leq 11 \\ x \geq 0, y &\geq 0 \end{aligned}$$

6. Solve the following LLP:

$$\begin{aligned} \text{Max. } Z &= x + y \\ \text{subject to,} \\ x - y &\geq 1 \\ x + y &\geq 2 \end{aligned}$$

7. Solve the following LLP:

$$\begin{aligned} \text{Max. } Z &= 4x + y + 3z + 5w \\ \text{subject to,} \\ 4x + 6y - 5z - 4x &\geq -20 \\ -3x - 2y + 4z + w &\leq 10 \\ -8x - 3y + 3z + 2w &\leq 20 \\ x \geq 0, y \geq 0, z \geq 0, w &\geq 0 \end{aligned}$$

8. Solve the following LLP using Python and find optimal solution if exist.

   (a) Max. $Z = 3x + 5y + 4z$ subject to, $2x + 3y \leq 8$; $2y + 5z \leq 10$; $3x + 2y + 4z \leq 15$; $x \geq 0,\ y \geq 0\ z \geq 0$

   (b) Min. $Z = x + 2y + z$ subject to, $x + \frac{1}{2}y + \frac{1}{2}z \leq 1$; $\frac{3}{2}x + 2y + z \geq 8$; $x \geq 0, y \geq 0, z \geq 0$

   (c) Min. $Z = x + y$ subject to, $x \geq 6$; $y \geq 6$; $x + y \leq 11$; $x \geq 0, y \geq 0$

   (d) Max. $Z = 4x + y + 3z + 5w$ subject to, $4x + 6y - 5z - 4x \geq -20$; $-3x - 2y + 4z + w \leq 10$; $-8x - 3y + 3z + 2w \leq 20$; $x \geq 0, y \geq 0, z \geq 0, w \geq 0$

Practical 12: Study of Operational Research in Python (Unit 5-5.2)

1. A beer company has two warehouses from which it distributes beer to four carefully chosen shops. At the start of every week, each bar sends an order to the brewery's head office for so many crates of beer, which is then dispatched from the appropriate warehouse to the bar. The brewery would like to have an interactive computer program which they can run week by week to tell them which warehouse should supply which bar so as to minimize the costs of the whole operation. For example, suppose that at the start of a given week the brewery has 2000 cases at warehouse A, and 4500 cases at warehouse B, and that the bars require 600, 1000, 1600, 150 and 800 cases respectively. Transportation costs (dollars per crate) is given in the following table.

From Warehouse to Bar	A	B
1	3	2
2	4	3
3	6	3
4	2	1

Which warehouse should supply which bar?

2. Let us assume that there is a leading global automotive supplier company named JIM. JIM has it's production plants in many countries and supplies products to all the top automotive makers in the world. For instance, let's consider that there are three plants in India at places M, N, and O. The capacity of the plants is 700, 300, 550 per day. The plant supplies four customers A, B, C, and D, whose demand is 650, 200, 450, 250 per day. The cost of transport per unit per km in INR and the distance between each source and destination in Kms are given in the tables below.

Cost per Km

From / To	A	B	C	D
M	14	22	17	14
N	17	13	14	19
O	13	19	26	14

Distance between the source and demand

From / To	A	B	C	D
M	500	1200	800	600
N	1500	300	700	1000
O	400	900	1400	500

Here, the objective is to determine the unknown while satisfying all the supply and demand restrictions. The cost of shipping from a source to a destination is directly proportional to the number of units shipped.

3. The Company has three plants located throughout a state with production capacity 60, 85 and 35 units of products. Each day the firm must furnish its four retail shops R1, R2, R3, and R4 with at least 30, 25 , 55, and 65 units respectively. The transportation costs (in Rs.) are given below.

Company	R1	R2	R3	R4	Supply
A	6	5	1	6	50
B	2	5	8	2	75
C	8	7	9	2	25
Demand	25	30	50	65	

4. A boutique brewery has two warehouses from which it distributes beer to five carefully chosen bars. At the start of every week, each bar sends an order to the brewery's head office for so many crates of beer, which is then dispatched from the appropriate warehouse to the bar. The brewery would like to have an interactive computer program which they can run week by week to tell them which warehouse should supply which bar so as to minimize the costs of the whole operation. For example, suppose that at the start of a given week the brewery has 1000 cases at warehouse A, and 4000 cases at warehouse B, and that the bars require 500, 900, 1800, 200, and 700 cases respectively. Transportation costs (dollars per crate) is given in the following table.

From Warehouse to Bar	A	B
1	2	3
2	4	1
3	5	3
4	2	2
5	1	3

Which warehouse should supply which bar?

5. The ICARE Company has three plants located throughout a state with production capacity 50, 75 and 25 gallons. Each day the firm must furnish its four retail shops R1, R2, R3, and R4 with at least 20, 20 , 50, and 60 gallons respectively. The transportation costs (in Rs.) are given below.

Company	R1	R2	R3	R4	Supply
A	3	5	7	6	50
B	2	5	8	2	75
C	3	6	9	2	25
Demand	20	20	50	60	

Savitribai Phule Pune University, Pune

(Formerly University of Pune)

Two Year Degree Program in Mathematics

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. - Mathematics

Part-I

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System Syllabus

To be implemented from the Academic Year 2019-2020

Title of the Course: M.Sc./M.A. (Mathematics)

Preamble :

Savitribai Phule Pune University has decided to change the syllabi of various faculties from June,2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of M.Sc./M. A. Semester - I and Semester- II (w.e.f. 2019-20) Mathematics course under the Choice Based Credit System (CBCS).
The model curriculum as developed by U. G. C. is used as a guideline for the present syllabus.

Aims and Objectives of the new curriculum :

i) To maintain updated curriculum.
ii) To take care of fast development in the knowledge of mathematics.
iii) To enhance the quality and standards of Mathematics Education.
iv) To provide a broad common frame work, for exchange, mobility and free dialogue across the Indian Mathematical and associated community.
v) To create and aptitude for Mathematics in those students who show a promise for higher studies and creative work in Mathematics.
vi) To create confidence in others, for equipping themselves with that part of Mathematics which is needed for various branches of Sciences or Humanities in which they have aptitude for higher studies and original work.

Sr. No.	Courses		% of Assessment		Total Marks	Credit
	Semester-I	Semester-II	I A	U E		
1	MTUT111: Linear Algebra	MTUT 121: Complex Analysis	30	70	100	4
2	MTUT112: Real Analysis	MTUT 122: General Topology	30	70	100	4
3	MTUT113. Group Theory	MTUT 123: Ring Theory	30	70	100	4
4	MTUT114. Advance Calculus	MTUT 124: Advance Numerical Analysis	30	70	100	4
5	MTUT115: Ordinary Differential Equations	MTUT 125: Partial Differential Equations	30	70	100	4

The study tour is important to learn, network and collaborate with academics, students and industry professionals in Science and Technology, Engineering and Mathematics recruiters . It is also important to know and understand different cultures, easily adapt to new environments, skillfully negotiate business deals. **Therefore department of Mathematics should arrange a student's study tour in each academic year .**

Equivalence of previous syllabus with new syllabus:

Semester I and Semester II Old Courses Equivalent New Courses

Old Courses	New Courses
MT 501: Real Analysis	MTUT112: Real Analysis
MT 502: Advanced Calculus	MTUT114: Advanced Calculus
MT 503: Group Theory	MTUT113: Group Theory
MT 504: Numerical Analysis	MTUT124: Advanced Numerical Analysis
MT 505: Ordinary Differential Equations	MTUT115: Ordinary Differential Equations
MT 601: Complex Analysis	MTUT121: Complex Analysis
MT 602:General Topology	MTUT122: General Topology
MT 603: Rings and Modules	MTUT123: Rings and Modules
MT 604: Linear Algebra	MTUT111: Linear Algebra
MT 605:Partial Differential Equations	MTUT125: Partial Differential Equations

Details of Syllabus:

Semester I

MTUT-111: LINEAR ALGEBRA

[06 Hours]

Unit I. Vector Spaces.

1.1 Vector Spaces,
1.2 Subspaces and linear dependence,
1.3 The concepts of basis and dimension **[06 Hours]**
1.4 Some general theorems about finitely generated vector spaces..

Unit II. Linear Transformation and Matrices.

2.1 Linear Transformations
2.2 Addition and multiplication of matrices. **[10 Hours]**
2.3 Linear Transformations and matrices.

Unit III. Vector Spaces with an Inner product.

3.1 The concept of symmetry **[10 Hours]**
3.2 Inner Product.

Unit IV. The Theory of a single Linear Transformation.

4.1 Basic Concepts
4.2 Invariant Subspaces **[14 Hours]**
4.3 The Triangular form theorem
4.4 The rational and Jorden canonical forms.

Unit V. Dual Vector Spaces and Multilinear Algebra.

5.1 Quotient spaces and dual vector spaces
5.2 Bilinear forms and duality **[14Hours]**
5.3 Direct sums and tensor products
5.3 A proof of the elementary divisor theorem.

Unit VI. Orthogonal and Unitary Transformations

6.1 The structure of orthogonal transformations
6.2 The principal axis theorem
6.3 Unitary transformation and the spectral theorem.

Recommended Book:

Charles W. Curtis: Linear Algebra An Introductory Approach, Springer.
Chapter 2: Sect- 3, 4, 5, 7. Chapter 3: Sect-11 (except Theorem 11.7, Definition

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MT 601: Complex Analysis	MTUT121: Complex Analysis
MT 602:General Topology	MTUT122: General Topology
MT 603: Rings and Modules	MTUT123: Rings and Modules
MT 604: Linear Algebra	MTUT111: Linear Algebra
MT 605:Partial Differential Equations	MTUT125: Partial Differential Equations

Details of Syllabus:

Semester I

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[06 Hours]

Unit I. Vector Spaces.
1.1 Vector Spaces,
1.2 Subspaces and linear dependence,
1.3 The concepts of basis and dimension
1.4 Some general theorems about finitely generated vector spaces..

[06 Hours]

Unit II. Linear Transformation and Matrices.
2.1 Linear Transformations
2.2 Addition and multiplication of matrices.
2.3 Linear Transformations and matrices.

[10 Hours]

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3.1 The concept of symmetry
3.2 Inner Product.

[10 Hours]

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4.2 Invariant Subspaces
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[14 Hours]

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5.1 Quotient spaces and dual vector spaces
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5.3 A proof of the elementary divisor theorem.

[14Hours]

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6.1 The structure of orthogonal transformations
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Chapter 2: Sect- 3, 4, 5, 7. Chapter 3: Sect-11 (except Theorem 11.7, Definition

11.8, Theorem 11.7′, Definition 11.10, Theorem 11.11, Theorem 11.12), 13.
Chapter 4: Section 15. Chapter 7: Sections 22, 23, 24, 25. Chapter 8: Sections 26, 27, 28, 29.
Chapter 9: Sections 30, 31,32

Reference Books:

1) Vivek Sahai, Vikas Bist, Linear Algebra, Narosa Publication.
2) K. Hoffman, Ray Kunze, Linear Algebra, Prentice Hall of India Private Ltd.
3) P. B. Bhattacharya, S. R. Nagpaul, S. K. Jain, First Course in Linear Algebra, 2 nd Edition, New Age International Publishers.
4) S. Kumaresan, Linear Algebra A Geometric Approach, PHI Learning Private Ltd

MTUT-112 : REAL ANALYSIS

Unit-I. Lebesgue Measure: **[20 Hours]**

1.1 Lebesgue Outer Measure
1.2 σ- algebra of Lebesgue Measurable Sets
1.3 Outer and Inner Approximation of Lebesgue Measurable Sets
1.4 Countable Additivity
1.5 Contiuity
1.6 Borel-Cantelli Lemma
1.7 Non-measurable Set, Cantor Set, Cantor-Lebesgue Function.

Unit-II. Lebesgue Measurable Functions: **[18 Hours]**

2.1 Definition and algebra of Lebesgue Measurable Functions
2.2 Sequential Point wise Limits and Approximations by Simple Functions
2.3 Littlewood's Three Principles
2.4 Egoroff's Theorem
2.5 Lusin's Theorem.

Unit-III. Differentiation and Integration: **[22 Hours]**

3.1 Continuity of Monotone Functions
3.2 Lebesgue's Differentiation Theorem
3.3 Functions of Bounded Variation
3.4 Jordan's Theorem, Absolutely Continuous Functions
3.5 Integration of Derivatives
3.6 Differentiation of Indefnite Integral
3.7 Fundamental Theorem of Calculus.

Recommended Book:

Real Analysis-Fourth Edition, Authors: H. L. Royden, P. M. Fitzpatrick.
Sections: Chapter 2 - sections 2.1 to 2.7, Chapter 3 - sections 3.1 to 3.3, Chapter 6 - sections 6.1 to 6.5.

Reference Books:

1. Real Analysis: Authors: Elias M. Stein, Rami Shakarchi.
2. Basic Real Analysis: Author: Anthony W. Knapp.
3. Beginning Functional Analysis: Authors: Karen Saxe (Springer International Edition)

MTUT- 113: GROUP THEORY

UNIT-I: Groups, Subgroups and Cyclic Groups **[12 HOURS]**

1.1 Definition and Examples of Groups; Properties of Groups; Order of a finite group; Order of an element in group; Subgroups; Subgroup Tests.
1.2 Cyclic Groups; Properties of Cyclic Groups; Classification of Subgroups of Cyclic Groups.

UNIT-II: Permutation Groups- Isomorphism **[12 HOURS]**

2.1 Permutations Groups; Definition and notation; Cycles; Properties of Permutations; Even and odd permutations; Alternating Group of degree n.
2.2 Isomorphism of Group; Properties of Isomorphisms; Cayley's Theorem; Automorphisms.

UNIT-III: Cosets, Lagrange's Theorem, External Direct Product **[12 HOURS]**

3.1 Cosets; Lagrange's Theorem and consequences; Stabilizer and orbit; Orbit stabilizer theorem.
3.2 External Direct Products; Properties of External Direct Products; Group of units modulo n as an external direct product.

UNIT-IV: Normal Subgroups, Homomorphisms **[8 HOURS]**

4.1 Normal Subgroups; Factor Groups; Application of Factor Groups; Internal Direct Products.
4.2 Group Homomorphisms; Definition and examples; Properties of Homomorphisms; First Isomorphism Theorem.

UNIT-V: Sylow Theorems **[4 HOURS]**

5.1 Fundamental Theorem of Finite Abelian Groups; Isomorphism Classes of Abelian Groups; Proof of the Fundamental Theorem.
5.2 Conjugacy Classes; Class Equation; The Sylow Theorems; Applications of Sylow's Theorems.

UNIT-VI: Group Actions

6.1 Group Actions; Definition and examples; Permutation representation associated to a given action; Faithful action; Kernel; Left regular action.

Recommended Books:

1) **Joseph Gallian, Contemporary Abstract Algebra**, 9 th Edition, Cengage Learning India Pvt. Ltd. ISBN-10 9353502527
Chapters 2, 3, 4, 5 (except last article: A check Digit Scheme based on D5).
Chapters 6, 7 (except: Rotations of a cube and Soccer Ball and subsequent Article). Chapter 8 (except: Applications). Chapters 9, 10, 11, 24.
2) **David S. Dummit, Richard M. Foote**, Abstract Algebra, 2 nd Edition, John Wiley and Sons (Indian Edition)
In chapter 1 only Article 1.7.

Reference Books:

1) I. S. Luthar, I. B. S. Passi, Algebra (Vol 1), Groups; Narosa Publication House.
2) I. N. Herstein, Topics in Algebra, Wiley Eastern Ltd.
3) M. Artin, Algebra, Prentice Hall.
4) N. S. Gopalkrishnan, University Algebra, Wiley Eastern Ltd.
5) J. B. Fraleigh, A First Course in Abstract Algebra, 7 th Edition, Pearson Edition Ltd.

MTUT 114: ADVANCED CALCULUS

UNIT-I: Differential Calculus of Scalar and Vector Fields **[20 Hours]**

1.1 Functions from R^n to R^m. Scalar and vector fields; Limits and continuity.
1.2 The derivative of a scalar field with respect to a vector; Directional derivatives and partial derivatives; Partial derivatives of higher order; Inverse function theorem and Implicit Function theorem . (without proof)
1.3 Directional derivatives and continuity; The total derivatives; The gradient of a scalar field; A sufficient condition for differentiability.

1.4 A chain rule for derivatives of scalar fields; Applications to geometry. Level sets.Tangent planes; Derivatives of vector fields; Differentiability implies continuity; The chain rule for derivatives of vector fields; Matrix form of the chain rule.

UNIT-II: Line Integrals **[10 Hours]**

2.1 Paths and line integrals; Other notations for line integrals; Basic properties of line integrals.

2.2 The concept of work as a line integral; Line integrals with respect to arc length; Further applications of line integrals.

2.3 Open connected sets. Independence of the path; The first and second fundamental theorem of calculus for line integrals; Necessary and sufficient conditions for a vector field to be a gradient; Necessary conditions for a vector field to be a gradient.

UNIT-III: Multiple Integrals **[15 Hours]**

3.1 Partitions of rectangles. Step functions; The double integral of a step function; The definition of the double integral of a function defined and bounded on a rectangle ; Upper and lower double integrals; Evaluation of double integral by repeated one- dimensional integration; Geometric interpretation of the double integral as a volume; Worked examples.

3.2 Integrability of continuous functions; Integrability of bounded functions with discontinuities ; Double integrals extended over more general regions; Applications to area and volume; Worked examples.

3.3 Green's theorem in the plane; Some applications of Green's theorem; A necessary and sufficient condition for a two dimensional vector field to be a gradient.

3.4 Change of variables in a double integral; Special cases of the transformation formula with proof; General case of the transformation formula with proof; Extensions to higher dimensions; Change of variables in an n-fold integral; Worked examples.

UNIT-IV: Surface Integrals **[15 Hours]**

4.1 Parametric representation of a surface; The fundamental vector product; The fundamental vector product as a normal to the surface; Area of a parametric surface.

4.2 Surface integrals; Change of parametric representation ; Other notations for surface integrals

4.3 The theorem of Stokes; Curl and divergence of a vector field; Properties of curl and divergence; the divergence theorem (Gauss' theorem) and applications of divergence theorem.

Recommended Book:

1) **Tom M. Apostol**, Calculus Volume II (Second Edition) Indian Reprint 2016 (John Wiley & Sons, Inc) ISBN:978-81-265-1520-2.
Unit 1: Chapt 8 : 8.1 to 8.22. ;Unit 2: Chapt 10 : 10.1 to 10.11, 10.14 to 10.16.
Unit 3: Chapt 11 : 11.1 to 11.15; 11.19 to 11.22, 11.26 to 11.34.;
Unit 4: Chapt 12: 12.1 to 12.15, 12.19 and 12.21.
2) For " Inverse Function Theorem" and "Implicit Function Theorem", use Tom M. Apostol, Mathematical Analysis 2nd Edition Narosa Publication 20th Reprint 2002. ISBN 978-81-85015-66-8. Unit-I: Chapter 13: Sections 13.3 and 13.4.

Reference Books:

1) Gerald B. Folland, Advanced Calculus , Pearson Edn 2012. 2) A Devinatz, Advanced Calculus (Holt , Reinhart & Winston) 1968.

MTUT 115: ORDINARY DIFFERENTIAL EQUATIONS

Unit I: Linear equations of the first order **[04 hours]**

1.1 Linear equations of the first order
1.2 The equation y'+ay=0
1.3 The equation y'+ay=b(x)
1.4 The general linear equations of first order

Unit II: Linear equations with constant coefficients **[14 hours]**

2.1 Second order homogeneous equations
2.2 Initial value problems for second order equations
2.3 Linear dependence and independence
2.4 Formula for the Wronskian
2.5 Non homogeneous equations of order two
2.6 Homogeneous equations of order n
2.7 Non homogeneous equations of order n
2.8 Algebra of constant coefficients equations

Unit III: Linear equations with variable coefficients **[14 hours]**

3.1 Initial value problems for the homogeneous equation
3.2 Solutions of the homogeneous equation
3.3 Wronskian and linear independence
3.4 Reduction of order of the homogeneous equation
3.5 Non homogeneous equations with analytic coefficients
3.6 Homogeneous equations
3.7 Legendre equation

Unit IV: Linear Equations with regular singular points **[14 hours]**

4.1 Euler equation
4.2 Second order equation with regular singular points
4.3 Exceptional cases
4.4 Bessel's equation
4.5 Regular singular point at infinity

Unit V: Existence and uniqueness of solutions to first order equations **[14 hours]**

5.1 Equations with variables separated
5.2 Exact equations
5.3 Method of successive approximations
5.4 Lipschitz condition
5.5 Approximation to, and uniqueness of, solutions

Recommended Book:

E. A. Coddington, An Introduction to Ordinary Differential Equations (Prentice-Hall).
Chapter- 1.4 -1.7; 2.1-2.12; 3.1-3.8; 4.1- 4 .4, 4.6- 4.8; 5.1 -5.8.

Reference Books :

G. F. Simmons and S. G. Krantz, Dfferential Equatins (Tata McGraw-Hill).

SEMESTER-II

MTUT 121: COMPLEX ANALYSIS

Unit I: Basic Properties of Complex Numbers: [04 hours]
- 1.1 Arithmetic of Complex Numbers
- 1.2 The Fundamental Theorem of Algebra

Unit II Complex Differentiability and Conformality: [10 hours]
- 2.1 Definition and Basic Properties
- 2.2 Polynomials and Rational Functions
- 2.3 Analytical Functions: Power Series
- 2.4 Cauchy- Riemann Equations
- 2.5 Review of Calculus of Two Real Variables

Unit III: Contour Integration: [14 hours]
- 3.1 Definition and Basic Properties
- 3.2 Existence of Primitives
- 3.3 Cauchy-Goursat Theorem
- 3.4 Cauchy's Theorem via Green's Theorem
- 3.5 Cauchy's Integral Formulae
- 3.6 Analyticity of Complex Differentiable Functions
- 3.7 A Global Implication: Liouville
- 3.8 Mean Value and Maximum Modulus

Unit IV: Zeros and Poles: [14 hours]
- 4.1 Zeros of Holomorphic Functions
- 4.2 Open Mapping Theorem
- 4.3 Singularities
- 4.4 Laurent Series
- 4.5 Residues

Unit V: Application to Evaluation of Definite Real Integrals: [12 hours]
- 5.1 Trigonometric Integrals
- 5.2 Improper Integrals
- 5.3 Jordan's Inequality

Unit VI: Local And Global Properties: [06 hours]
- 6.1 Schwarz's Lemma
- 6.2 Local mapping

Recommended Book:

1. **Anant R. Shastri, Basic Complex Analysis of One Variable**, Macmillan Publishers India, 2010 .
   Ch. 1: 1.1 , 1.8.1 , Ch. 2: 2.1,2.2, 2.3(only 2.3.1); Ch. 3: 3.1, 3.2,
   Ch. 4: 4.1 to 4.5, 4.7,4.8 , Ch. 5: 5.1 to 5.5, Ch. 6: 6.1 to 6.3; Ch. 7: 7.1, 7.2

Reference Books:

1. J. W. Brown and R.V. Churchill, Complex Variables and Applications, Indian Edition. (Eighth Edition)
2. John. B. Conway, Functions of One Complex Variable, Springer International Student Edition. (Second Edition)
3. S. Ponnusamy, Foundation of Complex Analysis, Narosa Publications. (Second Edition)
4. L.V. Alfors, Complex Analysis, McGraw Hill, 1979.

MTUT- 122 : GENERAL TOPOLOGY

Unit 1. Prerequisites [10 hours]
- 1.1 : Cartesian Products
- 1.2 : Finite Sets
- 1.3 : Countable and Uncountable Sets
- 1.4 : Infinite Sets and Axiom of Choice
- 1.5 : Well Ordered Sets

Unit 2. Topological Spaces and Continuous Functions [20 hours]
- 2.1 : Topological Spaces
- 2.2 : Basis for a Topology
- 2.3 : Order Topology
- 2.4 : Product Topology on X× Y
- 2.5 : Subspace Topology
- 2.6 : Closed Sets and Limit Points
- 2.7 : Continuous Functions
- 2.8 : The Product Topology, Metric Topology
- 2.9 : Quotient Topology

Unit 3. Connected and Compact Spaces [15 hours]
- 3.1 : Connected spaces
- 3.2 : Connected Subspaces of Real Line
- 3.3 : Components and Local Connectedness
- 3.4 : Compact spaces
- 3.5 : Compact Subspaces of the Real Line
- 3.6 : Limit point compactness
- 3.7 : Local Compactness

Unit 4. Countablity and Separation Axioms [15 hours]
- 4.1 : The Countability Axioms
- 4.2 : The Separation axioms and Normal Spaces
- 4.3 : Urysohn Lemma (State Only)
- 4.4 : The Urysohn Metrization Theorem (State Only)
- 4.5 : Tietze Extension Theorem
- 4.6 : Tychonoff's Theorem.

Text Book:
J. R. Munkres, Topology: A First Course, (Prentice Hall, Second Edition), 2000.
Chapter 1 : Sec. 5 to 7, Sec. 9 to 10. ;Chapter 2: Sec.12 to 22.
Chapter 3 : Sec. 23 to 29. ; Chapter 4 : Sec. 30 to 35 ; Chapter 5 : Sec. 37.

Reference Books:
1. K J¨anich. Topology. Springer, 1984.
2. M A Armstrong. Basic Topology. Springer, 1983.
3. O Viro, O Ivanov, V Kharlamov, and N Netsvetaev. Elementary Topology: Problem Textbook, AMS Publication, 2008.
4. K. D. Joshi, Introduction to General Topology, John Wiley & Sons .

MTUT123: RING THEORY [16 hours]

Unit I : Rings
- 1.1 Basic Terminologies
- 1.2 Rings of Continuous functions

1.3 Matrix Rings, Polynomial Rings, Power Series Rings, Laurent Rings, Boolean Rings, Some Special Rings,
1.4 Direct Products
1.5 Several Variables
1.6 Opposite Rings
1.7 Characteristic of a Ring.

Unit II : Ideals **[12 hours]**

2.1 Definitions
2.2 Maximal Ideals
2.3 Generators
2.4 Basic Properties of Ideals
2.5 Algebra of Ideals
2.6 Quotient Rings
2.7 Ideals in Quotient Rings
2.8 Local Rings.

Unit III : Homomorphisms of Rings **[10 hours]**

3.1 Definitions and Basic Properties
3.2 Fundamental theorems
3.3 Endomorphism Rings
3.3 Field of Fractions, Prime fields.

Unit IV : Factorisation Domains **[12 hours]**

4.1 Division in Domains
4.2 Euclidean Domains
4.3 Principal Ideal Domains
4.4 Factorisation Domains
4.5 Unique Factorisation Domains
4.6 Eisenstein's Crieterion.

Unit V : Modules **[10 hours]**

5.1Definitions and Examples
5.2 Direct Sums
5.3 Free Modules
5.4 Quotient Modules
5.5 Homomorphism
5.6 Simple Modules
5.7 Modules over PID.

Recommended Book:

C. Musili, Rings and Modules, 2nd Revised Edition, Narosa Publishing House. (Chapters 1, 2, 3, 4, 5)

Reference Books :

1. Dummit and Foote, Abstract Algebra, second edition (Wiley India).
2. Luther and Passi, Algebra II, Narosa Publishing House.
3. Jain and Bhattacharya, Basic Abstract Algebra, 2nd Edition, Cambridge University Press.
4. Joseph Gallian, Contemporary Algebra, 7th Edition, Narosa Publishing House.

MTUT 124: ADVANCED NUMERICAL ANALYSIS

UNIT-I: Root Finding Methods [10 HOURS]

1.1 Convergence; Floating Point Number Systems; Floating Point Arithmetic.
1.2 Fixed Point Interaction Schemes; Newton's Method; Secant Method; Accelerating Convergence.

UNIT-II: System of Equations [14 HOURS]

2.1 Gaussian Elimination; Pivoting Strategies.
2.2 Error Estimates and Condition Number; LU decomposition; Direct Factorization.
2.3 Iterative Techniques for Linear Systems: Basic Concepts and Methods.
2.4 Nonlinear Systems of Equations.

UNIT-III: Eigenvalues and Eigenvectors [10 HOURS]

3.1 The Power Method.
3.2 The Inverse Power Method.
3.3 Reduction to Symmetric Tridiagonal Form.
3.4 Eigenvalues of Symmetric Tridiagonal Matrices.

UNIT-IV: Differentiation and Integration [14 HOURS]

4.1 Numerical Differentiation, Part II.
4.2 Numerical Integration – The Basics and Newton-Cotes Quadrature; Composite Newton-Cotes Quadrature.

UNIT-V: Initial Value Problems of Ordinary Differential Equations [12 HOURS]

5.1 Euler's Method; Higher-Order One-Step Methods: Taylor Methods.
5.2 Runge-Kutta Methods.
5.3 Multistep Methods.
5.4 Convergence and Stability Analysis.

RECOMMEDNDED BOOK:

1) **Brian Bradie**, A Friendly Introduction to Numerical Analysis, Pearson Prentice Hall 2007, ISBN 978-81-317-0942-9.
Sections: 1.2 – 1.4, 2.3 – 2.6, 3.1, 3.2, 3.4 -3.6, 3.8, 3.10, 4.1, 4.2, 4.4, 4.5, 6.2, 6.4, 6.5, 7.2-7.6
2) **John H. Mathews, Kurtis D. Fink**, Numerical Methods Using Matlab, 4th Edition, Pearson Education (Singapore) Pte. Ltd., Indian Branch, Delhi 2005. (SciLab commands similar to MatLab commands can be used for problems)

REFERENCE BOOKS:

1) **K .E. Atkinson**, An Introduction to Numerical Analysis, Second Edition, John Wiley & Sons.
2) **J. L. Buchaman, P. R. Turner**, Numerical Methods and Analysis, McGraw Hill, 1992 cop.
3) **M.K. Jain, S.R.K. Iyengar, R.K. Jain**, Numerical Methods for Scientific &

MTUT 125: PARTIAL DIFFERENTIAL EQUATIONS

[12 Hours]

1. INTRODUCTION TO PARTIAL DIFFERENTIAL EQUATIONS OF FIRST ORDER **[16 Hours]**

1.1 Genesis of first order P.D.E.
1.2 Compatible systems
1.3 Charpit's method
1.4 Jacobi's method
1.5 Non Linear first order P.D.E

2. FUNDAMENTAL CONCEPTS

2.1 First order partial differential equations
2.2 Classification of Second Order PDE

2.3 Canonical Forms, Canonical Form for Hyperbolic Equation , Canonical Form for Parabolic Equation , Canonical Form for Elliptic Equation

2.4 Linear Partial Differential Equations with Constant Coefficients, General Method for Finding CF of Reducible Non-homogeneous Linear PDE ,General Method to Find CF of Irreducible Non-homogeneous Linear PDE

3. ELLIPTIC AND PARABOLIC DIFFERENTIAL EQUATIONS **[20 Hours]**

3.1 Occurrence of the Laplace and Poisson Equations , Derivation of Laplace Equation , Derivation of Poisson Equation

3.2 Boundary Value Problems (BVPs)

3.3 Green's first and second identities

3.4 Dirichlet Problem for a Rectangle

3.5 Occurrence of the Diffusion Equation

3.6 Boundary Conditions

3.7 Elementary Solutions of the Diffusion Equation

3.8 Dirac Delta Function

3.9 Separation of Variables Method (with examples)

4. HYPERBOLIC DIFFERENTIAL EQUATIONS

4.1 Occurrence of the Wave Equation **[12 Hours]**

4.2 Derivation of One-dimensional Wave Equation

4.3 Solution of One-dimensional Wave Equation by Canonical Reduction

4.4 Vibrating string- Variable separable solution(examples)

Recommended Books

1. An Elementary Course in Partial Differential Equations, T Amarnath ,Narosa Publication (Chapter 1)
2. Intoduction to Partial Differential Equations, K.Sankara Rao (Third Edition) PHI Learning Private Limited

Reference Books

1. Elements of Partial Differential Equations, Ian Sneddon, Dover Publication
2. An Introduction to Partial Differential Equations, Yehud Pinchor & Jaco Rubinstein, Cambridge University Press

Savitribai Phule Pune University, Pune

(Formerly University of Pune)

Two Year Degree Program in Mathematics

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. - Mathematics

Part-II

(For Colleges Affiliated to Savitribai Phule Pune University, Pune)

Choice Based Credit System Syllabus

To be implemented from the Academic Year 2020-2021

Title of the Course: M.Sc./M.A. (Mathematics)

Preamble :

Savitribai Phule Pune University has decided to change the syllabi of various faculties from June,2019. Taking into consideration the rapid changes in science and technology and new approaches in different areas of mathematics and related subjects, Board of studies in Mathematics after a thorough discussion with the teachers of Mathematics from different colleges affiliated to University of Pune has prepared the syllabus of M.Sc./M. A. Semester - III and Semester- IV (w.e.f. 2020-21) Mathematics course under the Choice Based Credit System (CBCS).

The model curriculum as developed by U. G. C. is used as a guideline for the present syllabus.

Aims and Objectives of the new curriculum :

i) To maintain updated curriculum.
ii) To take care of fast development in the knowledge of mathematics.
iii) To enhance the quality and standards of Mathematics Education.
iv) To provide a broad common frame work, for exchange, mobility and free dialogue across the Indian Mathematical and associated community.
v) To create and aptitude for Mathematics in those students who show a promise for higher studies and creative work in Mathematics.
vi) To create confidence in others, for equipping themselves with that part of Mathematics which is needed for various branches of Sciences or Humanities in which they have aptitude for higher studies and original work.

Syllabus for M.Sc /M.A.. Mathematics Semester III & IV

Sr. No.	Courses		
	Semester-III	Semester-IV	Credit
	Compulsory courses:		
1	MTUT 131: Functional Analysis	MTUT 141: Fourier Series and Boundary Value Problems	4
2	MTUT 132: Field Theory	MTUT 142: Differential Geometry	4
3	MTUT 133. Introduction to Data Science	MTUT 143: : Programming with Python	2+2=4 Theory+Practical
	O=Optional Courses (Any Two)		
4	MTUTO 134. Discrete Mathematics	MTUTO 144: Number Theory	4
5	MTUTO 135: Mechanics	MTUTO 145: Algebraic Topology	4
6	MTUTO 136: Advanced Complex Analysis	MTUTO 146: Representation Theory of Finite Groups	4
7	MTUTO 137: Integral Equations	MTUTO 147: Coding Theory	4
8	MTUTO 138: Differential Manifolds	MTUTO 148: Probability and Statistics	4
9	MTUTO 139: **Students can choose one course from Swayam /NPTEL / E- Pathashala etc, if interested**	MTUTO 149: **Students can choose one course from Swayam / NPTEL / E-Pathashala etc , if interested**	4

- **The educational tour is compulsory.**
- **The theory and practical examination will be as per University rules and regulations.**

Equivalence of previous syllabus with new syllabus:

Semester –III (Old)	**(New)**
MT 701 Combinatorics	MTUT 134. Discrete Mathematics
MT 702 Field Theory	MTUT 132 Field Theory
MT 703 Functional Analysis	MTUT 133 Functional Analysis
Following Papers are Departmental Papers having no equivalence syllabus	
MT 704 Graph Theory	
MT 705 Classical Mechanics	
MT 706 Topics in Algebra	
MT 707 Topic in Analysis	
MT 708 Topics in Geometry	
MT 709 Discrete Mathematics	
MT 710 Applied Mathematics	
MT 711 C Language	
MT 712 Mathematical Modeling	
Semester –IV (Old)	**(New)**
MT 801 Number Theory	MTUT 144: Number Theory
MT 802 Differential Geometry	MTUT 142 :Differential Geometry
MT 803 Fourier Analysis and Boundary Value Problems	MTUT 143: Fourier Series and Boundary Value Problems
Following Papers are Departmental Papers having no equivalence syllabus	
MT 804 Lattice Theory	
MT 805 Operations Research	
MT 806 Topics in Algebra	
MT 807 Topic in Analysis	
MT 808 Topics in Geometry	
MT 809 Discrete Mathematics	
MT 810 Applied Mathematics	
MT 811 C++ Language	

Syllabus

Semester-III

MTUT 131: FUNCTIONAL ANALYSIS [25 Hours]

UNIT-I: Banach Spaces

1.1 The definition and some examples.
1.2 Continuous linear transformations.
1.3 The Hahn-Banach theorem.
1.4 The natural imbedding of N in N**.
1.5 The open mapping theorem.
1.6 The conjugate of an operator.

UNIT-II: Hilbert Spaces [25 Hours]

2.1 The definition and some simple properties. 2.2 Orthogonal complements.
2.3 Orthonormal sets.
2.4 The conjugate space H*.
2.5 The adjoint of an operator.
2.6 Self-adjoint operators.
2.7 Normal and unitary operators.
2.8 Projections.

UNIT-III: Finite-Dimensional Spectral Theory [10 Hours]

3.1 Matrices.
3.2 Determinants and the spectrum of an operator. 3.3 The spectral theorem.
3.4 A survey of the situation.

Recommended Book:

G. F. Simmons, Introduction to Topology and Modern Analysis, Tata McGraw Hill. Chapters: 9, 10, 11.

Reference Books:

1) **B. V. Limaye**, Functional Analysis, Wiley Eastern Ltd.
2) **George Bachman, Lawrence Narici**, Functional Analysis, Dover Publications.
3) **E. Kreyszig**, Introductory Functional Analysis with Applications, John Wiley, 1989.

MTUT 132: FIELD THEORY

UNIT 1: Algebraic Extension of fields: **[12 Hours]**

1.1 Irreducible polynomials and Eisenstein criterion, adjunction of roots,
1.2 Algebraic extensions, algebraically closed fields.

UNIT 2: Normal and Separable extensions: **[12 Hours]**

2.1 Splitting fields,
2.2 Normal extensions, multiple roots, finite fields, separable extensions.

UNIT 3: Galois Theory: **[20 Hours]**

3.1 Automorphism groups and fixed fields,
3.2 Fundamental theorem of Galois theory,
3.3 Fundamental theorem of algebra.

UNIT 4: Applications of Galois theory to classical problems: **[16 Hours]**

4.1 Roots of unity and cyclotomic polynomials, cyclic extensions,
4.2 polynomials solvable by radicals, symmetric functions,
4.3 Ruler and compass constructions.

Recommended Book:

P. B. Bhattacharyya, S. K. Jain and S. R. Nagpaul, Basic Abstract Algebra , Cambridge University Press, Second Edition. *Chapter no: 15, 16, 17 and 18.*

Reference Books:

1. D. Dummit and R.M.Foote, Abstract Algebra, 2nd Edition, Wiley Eastern Ltd.
2. T. A. Hungerford, Algebra, Graduate Texts in Mathematics, Vol. 73, SpringerVerlag, 1980 (Indian Reprint 2004).
3. O. Zariski and P. Sammuel, Commutative Algebra, Vol. 1, Van Nostrand.
4. I. S. Luthar, I. B. S. Passi, Algebra, Vol. 4, Field Theory, Narosa Publishing House
5. M. Artin, Algebra, Prentice Hall India, Second Edition.

MTUT 133: INTRODUCTION TO DATA SCIENCE

1. **Data science in a big data world** **[08 Hours]**
   1.1. Benefits and uses of data science and big data
   1.2. Facets of data
   1.3. The data science process
   1.4. The big data ecosystem and data science **[10 Hours]**
2. **The data science process**
   2.1. Overview of the data science process
   2.2. Retrieving data
   2.3. Cleansing, integrating, and transforming data
   2.4. Exploratory data analysis **[08Hours]**
3. **Machine learning**
   3.1. What is machine learning
   3.2. The modelling process
   3.3. Types of machine learning **[14 Hours]**
   3.4. Semi-supervised learning
4. **Handling large data**
   4.1. General techniques for handling large volumes of data
   4.2. General programming tips for dealing with large data sets
   4.3. Case study Predicting malicious URLs **[10 Hours]**
5. **First steps in big data**
   5.1. Distributing data storage and processing with frameworks
   5.2. Case study: Assessing risk **[10 Hours]**
6. **Text mining and text analytics and Data visualization**
   6.1. Text mining techniques
   6.2. Data visualization options

Recommended Book:

1. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning Publications Co., 1st edition, 2016

Reference Books:

2. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten, Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
3. Introduction to Machine Learning, Ethem Alpaydin, Third Edition 2018 PHI Learning Private Limited

MTUTO 134: DISCRETE MATHEMATICS

A] Graph Theory **[15 Hours]**

UNIT-I: Topics in Graph Theory

1.1 Graphs; Graphs as Models; Matrices and Isomorphism; Decomposition and Special Graphs; Degree of a vertex; Counting and Bijections.
1.2 Paths, Cycles, Trails: Connection in Graphs; Bipartite Graphs; Eulerian Circuits; Hamiltonian Cycles.
1.3 Directed Graphs: Definition and Examples; Vertex Degrees; Eulerian Digraphs.

UNIT-II: Trees

2.1 Trees: Properties of Trees; Distance in Trees and Graphs. **[12 Hours]**

2.2 Enumeration of Trees: Spanning Trees in Graphs; Minimum Spanning Trees; Shortest Paths; Connectivity; Edge Connectivity.

UNIT-III: Matchings

3.1 Maximum Matchings ; Hall's Matching Condition . **[03 Hours]**

B] Combinatorics

UNIT-IV: Basic Counting Principles

4.1 Two Basic Counting Principles.

4.2 Simple Arrangements and Selections.

4.3 Arrangements and Selections with Repetitions. **[10 Hours]**

4.4 Distributions.; Binomial Identities.

UNIT-V: Generating Functions

5.1 Generating Functions Models.

5.2 Calculating Coefficients of Generating Functions. **[10 Hours]**

5.3 Partitions. ; Exponential Generating Functions.

UNIT-VI: Recurrence Relations

6.1 Recurrence Relations Models.

6.2 Solutions of Linear Recurrence Relations. **[10 Hours]**

6.3 Counting with Venn Diagrams.

6.4 Inclusion-Exclusion Formula.

Recommended Books:

1. Douglas B. West: Introduction to Graph Theory; 2nd Edn; PHI Learning Pvt. Ltd. Section 1.1, 1.2, 1.3 (Counting and Bijections) , Section 7.2 (Hamiltonian Cycles) Section 1.4 (Definitions, Vertex Degrees, Eulerian Digraphs) Section 2.1 (Properties of Trees; Distance) , Section 2.2 (Enumeration of Trees; Spanning Trees) Section 2.3 (Minimum Spanning Tree, Shortest Path); Section 4.1 (Connectivity, Edge-Connectivity); Section 3.1 (Maximum Matchings; Hall's Matching Condition)
2. Alan Tucker: Applied Combinatorics 6th Edn; Wiley India. Sections 5.1 to 5.5; 6.1 to 6.4; 7.1, 7.3; 8.1 to 8.2.

Reference Books:

1. B. Kolman, R. Busby, S.C. Ross: Discrete Mathematical Structures, 6th Edn , Pearson Edn.
2. John Clark, D. A. Holton: A First Look at Graph Theory, World Scientific , 1991.

MTUTO 135: MECHANICS

Unit –I Lagrange's Formulation **[18 Hours]**

1.1 Equation of Motion and conservation Theorems, Equation of Motion of a Particle, Equation of Motion of a System of Particle,

1.2 Conservation Theorem of Linear Momentum of the system of particles, Angular Momentum of the system of Particle, Constraint Motion, Examples of motion under constraints, Holonomic and Non – Holonomic Constraints, Scleronomic and Rheonomic Constraints, Degrees of Freedom and Generalized Co – ordinates,

1.3 Transformation Relations, Virtual work, Principle of Virtual Work, D ' Alembert's Principle, Conservation of Energy, Kinetic Energy as a Homogeneous quadratic function of generalized velocities, Another way of proving conservation Theorem for Energy, Lagrange's Equations for Non – holonomic Constraints. **[12 Hours]**

Unit -II: Variational Principles

2.1 Generalization of Theorem, Minimum surface of revolution, Brachistochrine Problem, A case of variable end points along vertical lines $x = a$ and $x = b$, Integrand as a function of more than two dependent variables,

2.2 Isoperimetric problems, variational problems with moving boundaries,

2.3 Functional dependent on functions of two dependent variables. **[18 Hours]**

Unit-III : Hamilton's Principle

3.3 Hamilton's Principle for Non – Conservative and Conservative Systems, Configuration Space and Phase Space, Lagrange's Equations of Motion from Hamilton's Principle, Hamiltonian Formulation, Hamiltonian Function, Hamilton's Canonical Equations of Motion for partially

3.2 Conservative and Partially Non – Conservative System, Derivation of Hamilton's Equations of Motion from Hamilton's Principle, Physical Meaning of the Hamiltonian,

3.3 Conservative and Scleronomic system, Non–conservative and Rheonomic system, partially conservative, Partially Non –conservative system, Cyclic co – ordinates in Hamiltonian, Routh's Procedure, Principle of Least Action. **[12 Hours]**

Unit IV : Two Body Central Force Motion

4.1 Reduction of Two body problem to an equivalent one Body problem, Equation of Motion and the First Integral,

4.2 Kepler's Laws of Planetary Motion, Kepler's First second and Third Law, Deduction of Kepler's Laws, Escape velocity,

4.3 Newton's law of Gravitation from Kepler's Laws of Planetary Motion, Differential Equation of the orbit of a Particle, Virial Theorem

Recommended Book:

Problems in Classical Mechanics by L. N. Katkar (Narosa Publication)

Chapter 1 To 4

Reference Books:

1) Classical Mechanics (3rd Ed.) by Herbert Goldstein, Charles Poole, John Safko (Pearson Education)
2) Classical Mechanics by Gupta, Kumar and Sharma (A Pragati Edition])
3) Classical Mechanics by Rana Joag (Mc Graw Hill India)
4) Classical Mechanics by R. N. Tiwari and B. S. Thakur (PHI)

MTUTO 136: ADVANCED COMPLEX ANALYSIS

Unit-I Cauchy's Theorem and it Applications: **[12 Hours]**

1.1 Revision

1.2 Further Applications : Sequences of holomorphic functions, Holomorphic functions defined in terms of integrals, Schwarz reflection principle, Runge's approximation theorem. **[20 Hours]**

Unit-II Conformal Mappings:

2.1 Conformal equivalences and examples:The disc and upperhalf plane,further examples, The Dirichlet in a strip

2.2 The Schwarz lemma, automorphism of the disc and upper half plane, Automorphism

of the disc, Automorphism of the upper half plane

Unit-III The Riemann mapping : **[20 Hours]**

3.1 The Riemann mapping theorem, Necessary conditions and statement of the theorem, Montel's theorem,proof of the Riemann mapping theorem

3.2 Conformal mappings onto polygons: Some examples, The Schwarz- Christoffle integral, boundary behaviour, The mapping formula

Unit-IV An introduction to elliptic functions: **[08 Hours]**

4.1 Elliptic functions: Liouville's theorem, The Weierstrass function

Recommended Book

1. Stein and Shakarchi, Complex Analysis, Princeton University Press, 2006 Chapter 2 : Sections 1 to 4 Revision, Section 5, Chapter 8: Sections 1, 2, 3, 4 Chpater 9: Section 1

Reference Books :

1. J. B. Conway , Functions of one complex variable, 2nd edition, GTM 11,Springer Verlag, 1973
2. A. R Shastri, Basic complex analysis of one variable, McMilan Publishers,India, Ltd. 2011

MTUTO 137: INTEGRAL EQUATIONS

Unit-I Introductory Concepts **[12Hours]**

1.1 Definitions
1.2 Classification of Linear Integral Equations
1.3 Solution of an Integral Equation
1.4 Converting Volterra Equation to ODE
1.5 Converting IVP to Volterra Equation
1.6 Converting BVP to Fredholm Equation

Unit-II Fredholm Integral Equations **[14 Hours]**

1.7 Introduction
1.8 The Decomposition Method
1.9 The Direct Computation Method
1.10 The Successive Approximation Method
1.11 The Method of Successive Substitutions
1.12 Comparison between Alternative Methods
1.13 Homogeneous Fredholm Equations

Unit-III Volterra Integral Equations **[14 Hours]**

1.14 Introduction
1.15 The Decomposition Method
1.16 The Series Solution Method
1.17 Converting Volterra Equation to IVP
1.18 The Successive Approximation Method
1.19 The Method of Successive Substitutions
1.20 Comparison between Alternative Methods
1.21 Volterra Equation of the First Kind

Unit-IV Integro-Differential Equations **[10 Hours]**

1.22 Introduction
1.23 Fredholm Integro-Differential Equations
1.24 Volterra Integro-Differential Equations

Unit-V Singular Integral Equations **[10 Hours]**

1.25 Definitions
1.26 Abel's Problem
1.27 The Weakly-Singular Volterra Equations

Recommond Book:

1. Abul-Majid Wazwaz, A First Course In Integral Equations, *World Scientific Publications,* 1997. Chapter-1 -5.

Reference Books: Kanwal Ram P., Linear Integral Equations, Birkhauser publication 1997.

1. Abdul J. Jerri, Introduction to Integral Equations With Applications, Wiley-Interscience; 2 edition (September 3, 1999)

MTUTO 138 : DIFFERENTIAL MANIFOLDS

[25 Hours]

Unit-I: Differential Manifolds

1.1 The Volume of a Parallelopiped.
1.2 The Volume of a Parameterized-Manifold.
1.3 Manifolds in Rn.
1.4 The Boundary of a Manifold.
1.5 Integrating a Scalar Function over a Manifold. **[20 Hours]**

Unit -II: Differential Forms

2.1 Multilinear Algebra.
2.2 Alternating Tensors.
2.3 The Wedge Product.
2.4 Tangent Vectors and Differential Forms.
2.5 The Differential Operator. **[15 Hours]**
2.6 The Action of a Differential Map.

Unit- III: Stokes' Theorem

3.1 Integrating Forms over Parameterized Manifolds.
3.2 Orientable Manifolds.
3.3 Integrating Forms over Oriented Manifolds.
3.4 The Generalized Stokes' Theorem.

Recommended Book:

James R. Munkres, Analysis on Manifolds (Westview Press), ISBN 0-201-31596-3. Chapter 5. Chapter 6 (except section 31). Chapter 7 (except section 36 and 38).

Reference Books:

1) **Michael Spivak**, Calculus on Manifolds, CRC Press (Taylor and Francis Group), Chapman and Hall Book, 1965.
2) **Guillemin and Pollack**, Differential Topology, AMS-Chelsea Publishing, 2010.

MTUTO 139:

Syllabus of MTUTO 139 is as per given by **Swayam /NPTEL / E- Pathashala etc.**

Syllabus

Semester -IV

MTUT 141 : FOURIER SERIES AND BOUNDARY VALUE PROBLEMS

Unit-I Fourier Series

1.1 Piecewise Continuous Functions ,Fouricr Cosine Series, Examples, **[10 Hours]**
1.2 Fourier Sine Series, Examples,
1.3 Fourier Series, Examples,
1.4 Adaptations to other Intervals

Unit-II Convergence Of Fourier Series

2.1 One-Sided Derivatives, Property of Fouricr Coefficients **[10 Hours]**
2.2 Two Lemmas, Fourier Theorem , Discussion of the theorem and its Corollary, Convergence on other intervals, Lemma
2.3 Absolute and uniform convergence of Fourier series, Differentiation of Fourier series, Integration of Fourier series

Unit-III The Fourier Method

3.1 Linear Operators, Principle of Superposition **[8 Hours]**
3.2 A Temperature Problem, A Vibrating String Problem

Unit-IV Boundary Value Problems

4.1 A Slab with Faces at Prescribed Temperatures, Related Problems, A Slab with Internally Generated Heat, Steady Temperatures in a Rectangular Plate **[12 Hours]**
4.2 Cylindrical Coordinates, String with Prescribed Initial Conditions, Resonance, Elastic Bar
4.3 Double Fourier Series, Periodic Boundary Conditions

Unit -V Orthonormal Sets

5.1 Inner Products and Orthonormal Sets, Examples **[10 Hours]**
5.2 Generalized Fourier series, Examples
5.3 Best approximation in the Mean, Bessel's Inequality and Parseval's Equation
5.4 Application to Fourier series

Unit-VI Sturm-Liouvilles Problems and Applications

6.1 Regular Sturm-Liouville Problems, Modifications, Orthogonality of Eigen functions, Real-Valued Eigen functions and Non negative Eigen Values, Methods of solution,
6.2 Examples of Eigen functions Expansions, A Temperature Problem in Rectangular Coordinates , Another Problem, Other Coordinates
6.3 Modification of the Method, Another Modification

Recommended Book:

J.W.Brown & R.V.Churchill: Fourier Series and Boundary Value Problems. VIIth Edition, McGraw Hill Education(India) Private Limited,New Delhi.
Chapter-1 (Art. 1 to 8) ,Chapter-2 (Art. 9 to 18), Chapter-4 (Art. 29 to 32), Chapter-5 (Art. 34 to 43), Chapter-7 (Art. 52 to 58), Chapter-8 (Art. 59 to 69)

Reference Book:

Murray Spiegel, Fourier Analysis with Applications to Boundary Value Problems, Schaum's Outline Series, McGraw Hill.

MTUT 142: DIFFERENTIAL GEOMETRY

[15 Hours]

Unit-I

1.1 Graphs and Level Sets,
1.2 Vector Fields,
1.3 The Tangent Space, **[15 Hours]**
1.4 Surfaces.

Unit-II

2.1 Vector Fields on Surfaces;
2.2 Orientation,
2.3 The Gauss Map, **[15 Hours]**
2.4 Geodesics,
2.5 Parallel Transport.

Unit-III

3.1 The Weingarten Map,
3.2 Curvature of Plane Curves, **[15 Hours]**
3.3 Arc Length and Line Integrals.

Unit-IV

4.1 Curvature of Surfaces.

Recommended Book:

J.A. Thorpe, Elementary Topics in Differential Geometry, First Indian Reprint, Springer Publication. Chapters: 1 to 12.

Reference Books:

1) Erwin Kryszig, Differential Geometry, Dover Publications Inc.
2) Christian Bar, Elementary Differential Geometry, Cambridge University Press.
3) Andrew Pressley, Elementary Differential Geometry, Springer.
4) T.J. Willmore, An Introduction to Differential Geometry, Dover Publications Inc.

MTUT 143: PROGRAMMING WITH PYTHON :

[4 Hours]

UNIT-I: Introduction to Python, Python Objects

1.1 Features of Python: Easy; Type and Run ; Syntax; Mixing; Dynamic Typing; Built in Object Types; Numerous Libraries and Tools.
1.2 Chronology and Uses: Chronology; Uses.
1.3 Installation of Anaconda.
1.4 Basic Data Types Revisited: Fractions. **[4 Hours]**
1.5 Strings.
1.6 Lists and Tuples: List; Tuples; Features of Tuples.

UNIT-II: Conditional Statements

2.1 if, if-else, and if-elif-else constructs.
2.2 The if-elif-else Ladder.
2.3 Logical Operators.
2.4 The Ternary Operator

2.5 The get Construct.
2.6 Examples.

UNIT-III: Looping
3.1 While. **[4 Hours]**
3.2 Patterns.
3.3 Nesting and Applications of Loops in Lists.

UNIT-IV: Functions
4.1 Features of a functions: Modular Programming; Reusability of Code; Manageability. **[6 Hours]**
4.2 Basic Terminology: Name of Functions; Arguments; Return Value.
4.3 Definition and Invocation: Working.
4.4 Type of Functions: Advantage of Arguments.
4.5 Implementing Search.
4.6 Scope.
4.7 Recursion: Rabbit Problem; Disadvantages of Using Recursion.

UNIT-V: Iterations, Generators, and Comprehensions
5.1 The Power of "For". **[4 Hours]**
5.2 Iterators.
5.3 Defining an Iterable Object.
5.4 Generators.
5.5 Comprehensions.

UNIT-VI: File Handling
6.1 The File Handling Mechanism.
6.2 The Open Function and File Access Modes. **[5 Hours]**
6.3 Python Functions for File Handling: The Essential Ones; The OS Methods; Miscellaneous Functions and File Attributes.
6.4 Command Line Arguments.
6.5 Implementation and Illustrations.

UNIT- VII: Strings
7.1 The Use of "For" and "While". **[5 Hours]**
7.2 String Operators: The Concatenation Operator (+); The Replication Operator; The Membership Operator.
7.3 Functions for String Handling: len(); Capitalize(); find(); count; Endswith(); Encode; Decode;Miscellaneous Functions.

UNIT-VIII: Introduction to Object Oriented Paradigm
8.1 Creating New Types.
8.2 Attributes and Functions: Attributes; Functions. **[5 Hours]**
8.3 Elements of Object- Oriented Programming: Class; Object; Encapsulation; Data Hiding; Inheritance; Polymorphism; Reusability.

UNIT-IX: Classes and Objects
9.1 Defining a Class.
9.2 Creating an Object. **[5 Hours]**
9.3 Scope of Data Members.
9.4 Nesting.
9.5 Constructor.
9.6 Constructor Overloading.
9.7 Destructors.

UNIT-X: Inheritance
10.1 Introduction to Inheritance and Composition : Inheritance and Methods, Composition. **[6 Hours]**
10.2 Inheritance: Importance and Types: Need of Inheritance; Types of Inheritance.
10.3 Methods: Bound Methods; Unbound Method; Methods are Callable Objects; The Importance and Usage of Super; Calling the Base Class Function Using Super.
10.4 Search in Inheritance Tree.
10.5 Class Interface and Abstract Classes. **[6 Hours]**

UNIT-XI: Operator Overloading
11.1 _init_Revisited: Overloading _init_(Sort of).
11.2 Methods for Overloading Binary Operators.
11.3 Overloading the += Operator
11.4 Overloading the > and < Operators.
11.5 Overloading the _boolEan_ Operators: Precedence of _bool_over _len_. **[6 Hours]**
11.6 Destructors

UNIT-XII: Exception Handling
12.1 Importance and Mechanism: An exaple of Try/Catch; Manually Raising Exception.
12.2 Built In Exceptions in Python:
12.3 The Process: Exception Handling: Try/Except; Raising Exceptions.
12.4 Crafting User Defined Exceptions.
12.5 An Example of Exception Handling.

Recommended book:

H. Bhasin: Python Basics, MERCURY LEARNING AND INFORMATION Dulles, Virginia Boston, Massachusetts New Delhi
Chapter 1: 1.2, 1.4, 1.5. Chapter 2: 2.2 to 2.4. Chapter 3: 3.2 to 3.7;Chapter 4: 4.2 to 4.4.
Chapter 5: 5.2, to 5.8. Chapter 6: 6.2 to 6.6. Chapter 7: 7.1, to 7.6; Chapter 8: 8.1, to 8.4.
Chapter 9: 9.1, 9.2, 9.3, 9.4. Chapter 10: 10.1, to 10.8.; Chapter 11: 11.1to 11.5.
Chapter 12: 12.2, to 12.8.; Chapter 13: 13.2, to 13.6.

Reference Books:

1. Beginning-Python, Second Edition by Magnus Lie Hetland
2. The Complete Reference Python by Martin C. Brown
3. Head First Python by Patrick Barry
4. Learning Python, O'Reilly by Mark Lutz 5. Python in a Nutshell, O'Reilly by Alex Martelli

MTUTO 144: NUMBER THEORY [10 hours]

Unit I: Unique Factorization
1.1 : Unique Factorization in Z, Unique Factorization in k[x].
1.2 : Unique Factorization in a Principal Ideal Domain. [10 hours]
1.3 : The Rings Z[i] and Z[ω].

Unit II: Congruence
2.1: Congruence in Z., The congruence $ax \equiv b(m)$. [10 hours]
2.2: The Chinese Remainder Theorem. [10 hours]

Unit III: Quadratic Reciprocity
3.1: Quadratic Residues.
3.2: Quadratic Reciprocity [08 hours]

Unit IV: Some Functions of Number Theory
4.1: The Greatest Integer Function.
4..2: Arithmetic Functions.
4.3: The Mobius Inversion Formula.

Unit V: Algebraic Numbers
5.1: Algebraic Numbers.

5.2: Algebraic Number Fields. Algebraic Integers.
5.3: Quadratic Fields.,

Recommended Books:

1. Kenneth Ireland, Michael Rosen: A Classical Introduction to Modern Number Theory, Springer, 4th Indian Reprint, 2013.
   Unit I: Chapter 1: Arts 1 to 4., Unit II: Chapter 3: Arts 1 to 4.
2. Ivan Niven; Herbert Zuckerman; Hugh Montgomery: An Introduction to Theory of Numbers, John Wiley and Sons, 5th Edition.
   Unit III: Chapter 3: Arts 3.1 and 3.2, Unit IV: Chapter 4: Arts 4.1 to 4.3, Unit V: Chapter 9: Arts 9.1 to 9.6

Reference Books:

(1) S.G.Telang: Number Theory, Tata McGraw Hill.
(2) M.B.Nathanson: Methods in Number Theory, GTM , Springer 3rd Indian Reprint, 2009.

MTUTO 145 : ALGEBRAIC TOPOLOGY

Unit-I: The Fundamental Group **[25 Hours]**

1.1 Homotopy of Paths.
1.2 The Fundamental Group.
1.3 Covering Spaces.
1.4 The Fundamental Group of the Circle.
1.5 Retractions and Fixed Points.
1.6 The Fundamental Theorem of Algebra.
1.7 The Borsuk-Ulam Theorem.
1.8 Deformation Retracts and Homotopy Type.
1.9 The Fundamental Group of S^n.

Unit-II: The Seifert-van Kampen Theorem **[20 Hours]**

2.1 Direct Sums of Abelian Groups (only revision).
2.2 Free Products of Groups (only revision).
2.3 Free Groups
2.4 The Seifert-van KampenTheorem.
2.5 The Fundamental Group of a Wedge of Circles.
2.6 The Fundamental Groups of the Torus and the Dunce Cap.

Unit-III: Classification of Covering Spaces **[15 Hours]**

3.1 Equivalence of Covering Spaces.
3.2 The Universal Covering Spaces.
3.3 Covering Transformations.
3.4 Existence of Covering Spaces.

Recommended Book:

James R. Munkres, Topology, Second Edition, Pearson Prentice Hall.
Chapter 9: Sections: 51, 52, 53, 54, 55, 56, 57, 58, 59.
Chapter 11: Sections: 67, 68 (Only revision), 69, 70, 71, 73.
Chapter 13: Sections: 79, 80, 81, 82.

Reference Books:

1) **Allen Hatcher**, Algebraic Topology, Cambridge University Press, 2002.
2) **M.A. Armstrong**, Basic Topology, Springer International Edition, 2004.
3) **J. J. Rotman**, An Introduction to Algebraic Topology, Springer, 1988.
4) **E. H. Spanier,** Algebraic Topology, Springer, 1994.

MTUTO 146: REPRESENTATION THEORY OF FINITE GROUPS

Unit- I Basics of Group Theory and Linear Algebra [8 Hours]

1.1 Group actions, General linear group, basic definitions and examples of group actions and orbits under group actions,
1.2 General linear group [12 Hours]

Unit-II Group Representations:

2.1 Irreducible and Indecomposable representations,
2.2 Maschke's theorem and complete, reducibility, Schur's lemma [25 Hours]

Unit-III Character Theory and Orthogonality relations:

3.1 Orthogonality relations, characters and class functions,
3.2 The regular representation, permutation representation, representations of Abelian groups. [15 Hours]

Unit-IV Fourier Analysis on Finite Groups :

4.1 Periodic functions and Fourier transform,
4.2 Convolutions, Fourier Inversion,
4.3 Dual group.

Recommended Book :

Benjamin Steinberg, Representation Theory of Finite Groups
Unit-I 2.1 to 2.3; Unit-II 3.1, 3.2; Unit-III 4.1to 4.5; Unit-IV 5.1 to 5.3.

Reference Books:

1. J. P. Serre, Linear Representations of Groups
2. James Leibeck, Representation Theory Michael Artin, Algebra.

MTUTO 147: CODING THEORY

Unit-I Error detection: : [12 Hours]

1.1 Correction and decoding: Communication channels, Maximum likelihood decoding,
1.2 Hamming distance, Nearest neighbor / minimum distance decoding, Distance of a code.

Unit-II Linear codes: : [18 Hours]

2.1 Vector spaces over finite fields, Linear codes, Hamming weight, Bases of linear codes,
2.2 Generator matrix and parity check matrix, Equivalence of linear codes, Encoding with a linear code, Decoding of linear codes,
2.3 Cossets, Nearest neighbor decoding for linear codes, Syndrome decoding.

Unit-III : Bounds in Coding Theory : [16 Hours]

3.1 Main coding theory problem, lower bounds, sphere covering bounds, Gilbert Varshamov bound, Hamming Codes,
3.2 Hamming bound and Perfect codes Singleton bound and MDS codes [10 Hours]

Unit-IV Cyclic codes:

4 .1 Definitions, Generator polynomials,

4.2 Generator and parity check matrices,

4.3 Decoding of cyclic codes, Burst-error-correcting codes.

Unit-IV Some special cyclic codes: [04 Hours]

5.1 BCH codes, Definitions, Parameters of BCH codes.

Recommended Book:

San Ling and Chaoing xing, Coding Theory- A First Course (Cambridge University Press, 2004)

(Sections 2.1, to 2.5); (Sections 3.1. to 3.4 and Sections 4.1, to 4.8); (Sections 5.1, to 5.4) , (7.1, to 7.4); (8.1, 8.1.1 and 8.1.2)

Reference Books:

1) San Ling and Chaoing xing, Coding Theory- A First Course
2) Raymod Hill, A First Course in Coding Theory (Oxford)
3) Lid and Pilz, Applied Abstract Algebra Second Edition

MTUTO 148: PROBABILITY AND STATISTICS

Unit I: Introduction to Probability **[5 lectures]**

1.1 Sample space, events, probability of an event, additive rules, conditional probability,

1.2 Multiplicative rule, Bayes' rule.

Unit II: Random Variable **[16 lectures]**

2.1 Concept of a random variable, discrete probability distribution, continuous probability distribution, joint probability distribution,

2.2 Independent random variables, Chebyshev's theorem, Mean of a random variables, Variance and Covariance, Mean and Covariance of linear combinations of random variables, Functions of random variables, transformations of variables,

2.3 Moments and Moment Generating Functions, definition of Expectation, theorems on Expectation and its related problems, Variance in terms of Expectation and related problems.

2.4 Covariance in terms of Expectation and related problems,Variance of a Linear Combination.

Unit III: Some Discrete Probability Distributions **[12 lectures]**

3.1 Binomial and Multinomial distributions, Hypergeometric distribution, Negative binomial distribution, Geometric distribution.

3.2 Poisson distribution and Poisson process.

Unit IV: Some Continuous Probability Distributions **[13 lectures]**

4.1 Continuous Uniform distribution, Normal distribution, area under the normal curve, applications of the Normal distribution, normal approximation to the binomial distribution,

4.2 Gamma distribution, Exponential distribution, Chi-squared distribution.

Unit V: Linear Regression and Correlation **[14 lectures]**

5.1 Simple Linear Regression, lines of Regression, Least Squares and Fitted Model,

5.2 properties of Least Squares Estimators, Regression Coefficients, choice of regression model, data plot and transformations,

5.3 Karl Pearson's Coefficient of Correlation, Properties and Problems, Spearmen's Rank Correlation Coefficient, Method of Concurrent Deviations.

Recommended Book:

1) Probability and Statistics for Engineers and Scientists, by R. Walpole, R.H. Myers, S.L. Myers, and K. Ye (Seventh Edition, Pearson India).

Chapters: 2, 3, 4, 5, 6.1 – 6.8, 7.3, 11.

Reference Books:

1) Introduction to Probability and Statistics for Engineers and Scientists, by Sheldon M. Ross (Fourth Edition).
2) A first course in Probability, by Sheldon M. Ross (Nineth Edition).
3) Mathematical Statistics, by Parimal Mukhopadhyay.
4) Statistics for the Life Sciences, by M. Samules, J. Witmer and A. Schaffner (Fifth Edition, Pearson India)
5) Probability and Statistics for Engineers, by Richard Gupta, C B Gupta.

MTUTO 149:

Syllabus of MTUTO 149 is as per given by **Swayam /NPTEL / E- Pathashala etc**

Kopargaon Taluka Education Society's

K.J. Somaiya College of Arts, Commerce & Science, Kopargaon

Department of BBA_CA

List of Courses addresses crosscutting issues as per new syllabus (CBCS- 2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	BBA_CA	CA_101	Business Communication Skills	Professional Ethics
2	BBA_CA	CA_102	Principles of Management	Professional Ethics
	BBA_CA	CA_103	C Language	Professional Ethics
	BBA_CA	CA_104	Database Management System	Professional Ethics
	BBA_CA	CA_105	Statistics	Professional Ethics
	BBA_CA	CA_106	Computer Laboratory Based on 103 &104	Professional Ethics
	BBA_CA	CA_107	Add-On (PPA)	Professional Ethics
	BBA_CA	CA_201	Organization Behavior & Human Resource Management	Professional Ethics
	BBA_CA	CA_202	Financial Accounting	Professional Ethics
0	BBA_CA	CA_203	Business Mathematics	Professional Ethics
	BBA_CA	CA_204	Relational database	Professional Ethics
2	BBA_CA	CA_205	Web Technology HTML-JS-CSS	Professional Ethics
	BBA_CA	CA_206	Computer Laboratory Based on 204 & 205	Professional Ethics
	BBA_CA	CA_207	Add-On (Advance C)	Professional Ethics
	BBA_CA	CA_301	Digital Marketing	Professional Ethics
	BBA_CA	CA_302	Data Structure	Professional Ethics
	BBA_CA	CA_303	Software Engineering	Professional Ethics
18	BBA_CA	CA_304	PHP	Professional Ethics
19	BBA_CA	CA_305	Big data	Professional Ethics
20	BBA_CA	CA_306	Computer Laboratory Based on 302 , 304 and 305	Professional Ethics
21	BBA_CA	CA_307	Environment Awareness	Professional Ethics
22	BBA_CA	CA_401	Networking	Professional Ethics
23	BBA_CA	CA_402	Object Oriented Concepts Through CPP	Professional Ethics
24	BBA_CA	CA_403	Operating System	Professional Ethics
25	BBA_CA	CA_404	Advance PHP	Professional Ethics
26	BBA_CA	CA_405	Project	Professional Ethics
27	BBA_CA	CA_406	Computer Laboratory Based on 402,404	Professional Ethics
28	BBA_CA	CA_407	ADD-On	Professional Ethics

29	BBA_CA	CA_501	Cyber Security	Professional Ethics
30	BBA_CA	CA_502	OOSE	Professional Ethics
31	BBA_CA	CA_503	Core Java	Professional Ethics
32	BBA_CA	CA_504	Python	Professional Ethics
33	BBA_CA	CA_505	Project	Professional Ethics
34	BBA_CA	CA_506	Computer Laboratory Based on 503 and 504	Professional Ethics
35	BBA_CA	CA_507	Add on Course-IOT	Professional Ethics
36	BBA_CA	CA_601	Recent Trends in Information Technology(Tutorial/Assignment)	Professional Ethics
37	BBA_CA	CA_602	Software Testing	Professional Ethics
38	BBA_CA	CA_603	Advanced Java	Professional Ethics
39	BBA_CA	CA_604	Android Programming	Professional Ethics
40	BBA_CA	CA_605	Project	Professional Ethics
41	BBA_CA	CA_606	Computer Laboratory Based on 603 and 604	Professional Ethics
42	BBA_CA	CA_607	Add on Course-Soft Skills Training	Professional Ethics

List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
	BBA_CA	Cyber Security	CC.006	2018-19	Professional Ethics

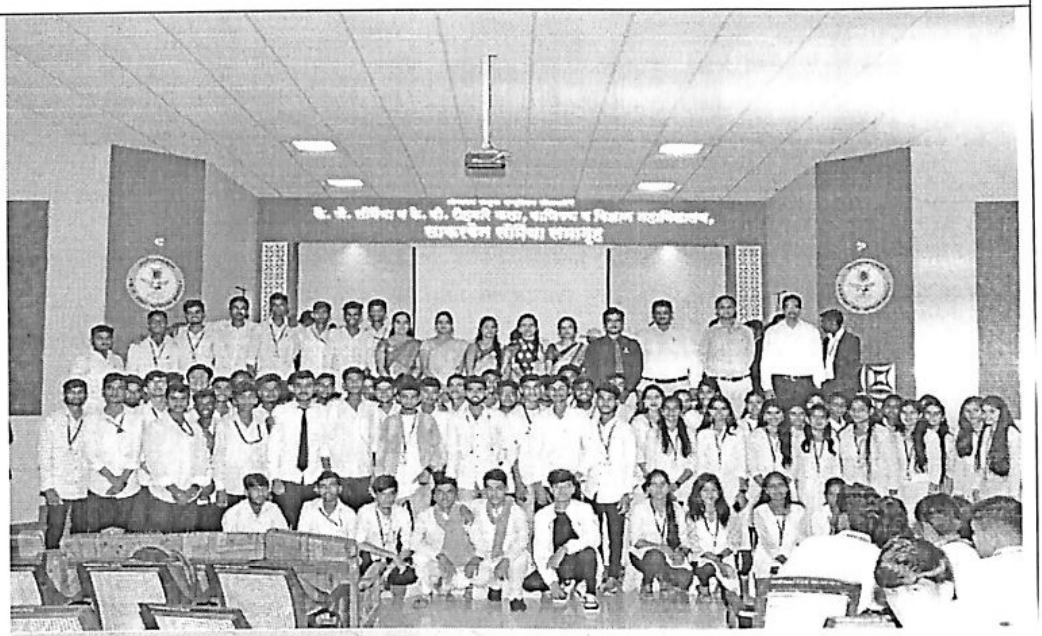
H.O.D

HOD
Dept.of BBA_CA
omaiya College,Kopargaon

IQAC coordinator

Principal

Principal
K.J.Somaiya College of Arts
Commerce & Science,Kopargaon

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1	Department of BBA-CA celebrated the 'fresher Party' -2022. On this occasion Dr. B. S. Yadav sir delivered Speech to student.	Professional Ethics, Human Values	 

2	poster presentation competition was organized on 11nd Apr. 2023	Professional Ethics, Human Values, Environment and Sustainability	

13. Titles of Papers and Scheme of Study for B.B.A. (C.A.) Programme

CC-Core Course, EC-Elective Course, PR-Practical, PJ-Project, AECC-Ability Enhancement Compulsory Courses, SEC-Skill Enhancement Courses.

SEMESTER- I

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-101	Business Communication	CC	3	
CA-102	Principles of Management	CC	3	
CA-103	C Language	CC	3	
CA-104	Database Management System	CC	3	
CA-105	Statistics	CC	3	
CA-106	Computer Laboratory Based on 103 &104 (2 credits each)	PR		4
107	Add-On (PPA) (30 Hours)	SEC	2	

SEMESTER- II

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-201	Organization Behavior & Human Resource Management	CC	3	
CA-202	Financial Accounting	CC	3	
CA-203	Business Mathematics	CC	3	
CA-204	Relational database	CC	3	
CA-205	Web Technology HTML-JS-CSS	CC	3	
CA-206	Computer Laboratory Based on 204 & 205(2 credits each)	PR		4
207	Add-On (Advance C) (30 Hours)	SEC	2	

SEMESTER- III

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-301	Digital Marketing	CC	3	
CA-302	Data Structure	CC	3	
CA-303	Software Engineering	CC	3	
CA-304	Angular JS	EC	3	
OR				
CA-304	PHP	EC	3	
CA-305	Big data	EC	3	
OR				
CA-305	Block chain	EC	3	
CA-306	Computer Laboratory Based on 302 , 304 and 305 (2 credits each)	PR		2+2+2 = 6
307 AECC	Environment Awareness	AECC	2	

SEMESTER- IV

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-401	Networking	CC	3	
CA-402	Object Oriented Concepts Through CPP	CC	3	
CA-403	Operating System	CC	3	
CA-404	**NODE JS**	**EC**	**3**	
OR				
CA-404	**Advance PHP**	**EC**	**3**	
CA-405	Project	EC		4
CA-406	Computer Laboratory Based on 402,404 (2 credits each)	PR		4
4	ADD-On (30 Hours)	SEC	2	

SEMESTER- V

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-501	Cyber Security	CC	3	
CA-502	OOSE	CC	3	
CA-503	Core Java	CC	3	
CA-504	Mongo DB	EC	3	
OR				
CA-504	Python	EC	3	
CA-505	Project	PJ		4
CA-506	Computer Laboratory Based on 503 and 504(2 credits each)	PR		4
5	Add on Course-IOT(30 Hours)		2	

SEMESTER- VI

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-601	Recent Trends in Information Technology(Tutorial/Assignment)	CCT	3+1	
CA-602	Software Testing	CC	3	
CA-603	Advanced Java	CC	3	
CA-604	Android Programming	EC	3	
OR				
CA-604	Dot Net framework	EC	3	
CA-605	Project	PJ		4
CA-606	Computer Laboratory Based on 603 and 604(2 credits each)	PR		4
6	Add on Course-Soft Skills Training		2	

14. Acknowledgement: The focus of BBA CA Programme (CBCS-2019 Pattern) has always been raising the academic standards, excellence and holistic development of students. Hon. Prof.

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-301	Digital Marketing	CC	3	
CA-302	Data Structure	CC	3	
CA-303	Software Engineering	CC	3	
CA-304	Angular JS	EC	3	
OR				
CA-304	PHP	EC	3	
CA-305	Big data	EC	3	
OR				
CA-305	Block chain	EC	3	
CA-306	Computer Laboratory Based on 302 , 304 and 305 (2 credits each)	PR		2+2+2 = 6
307 AECC	Environment Awareness	AECC	2	

SEMESTER- IV

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-401	Networking	CC	3	
CA-402	Object Oriented Concepts Through CPP	CC	3	
CA-403	Operating System	CC	3	
CA-404	**NODE JS**	**EC**	**3**	
OR				
CA-404	**Advance PHP**	**EC**	**3**	
CA-405	Project	EC		4
CA-406	Computer Laboratory Based on 402,404 (2 credits each)	PR		4
4	ADD-On (30 Hours)	SEC	2	

SEMESTER- V

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-501	Cyber Security	CC	3	
CA-502	OOSE	CC	3	
CA-503	Core Java	CC	3	
CA-504	Mongo DB	EC	3	
OR				
CA-504	Python	EC	3	
CA-505	Project	PJ		4
CA-506	Computer Laboratory Based on 503 and 504(2 credits each)	PR		4
5	Add on Course-IOT(30 Hours)		2	

SEMESTER- VI

Subject Code	Subject Name	Course	Credits	
			Th	Pr
CA-601	Recent Trends in Information Technology(Tutorial/Assignment)	CCT	3+1	
CA-602	Software Testing	CC	3	
CA-603	Advanced Java	CC	3	
CA-604	Android Programming	EC	3	
OR				
CA-604	Dot Net framework	EC	3	
CA-605	Project	PJ		4
CA-606	Computer Laboratory Based on 603 and 604(2 credits each)	PR		4
6	Add on Course-Soft Skills Training		2	

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Savitribai Phule Pune University, Pune

B.B.A. (Computer Application)

(Under faculty of Commerce & Management)

(To be implemented from Academic year 2019-20)

Business Communication Skills
Course Code: -- 101
Credit 3

Depth of the syllabus - Reasonable knowledge of the communication

Program objectives

1 To understand what is the role of communication in personal and business world
2. To understand system and communication and their utility
3. To develop proficiency in how to write business letters and other communications in required b

Unit No.	Contents	Lectures
1	**1.Concept of Communication and Introduction to Communication** 1.1 Role of Communication in social and economic system 1.2Need for effective communication 1.3 Meaning and definition 1.4Principles of effective communication 1.5Barriers to communication and over comings	12
2	**Methods and types of Communication** 2.1 Written communication, 2.2 Forms of written communication. 2.3 Qualities ,difficulties in written communication , 2.4 Constraints in developing effective written communication 2.5 Merits and Limitations of written communication 2.6 Listening Written communication, 2.7 Forms of written communication. 2.8 Qualities, difficulties in written communication , 2.9 Constraints in developing effective written communication	12
3.	**Business Correspondence** 3.1 Concept , 3.2 Need and functions of Business .Correspondence , 3.3 Types of Business letters , 3.4 Layout Drafting of business , 3.5 Sales Letter , 3.6 Orders sales circulars and business promotion letters 3.7 written methods& types of communication	12
4.	**Analysis of different Media of Communication** 4.1 Fax communication ,	12

	4.2 Voice mail , 4.3 e-mails , 4.4 Tele conferencing , 4.5 Communication through social media	

References

Sr. No.	Title of the Book	Author/s	Publication
1	Business Communication	Meenakshi Raman , Prakash Singh	Oxford
2	Business Communication	HomaiPradhan , N.S. Pradhan	Himalaya Publishing House
3	Business Communication	R.K. Madhukar	Vikas Publishing House
4	Business Communication and personality Development	BiswajitDas .ipswwtaSatpathy	Excel Books
5	Business Communication – Concepts , Cases and applications	P.D Chaturvedi , MukeshChaturvedi	Dorling Kindersley
6	Business Communication – Connecting at work	HorySankarMukerjee	Oxford
7	Business Communication Today	Courtland L. Bovee , John V. Thill , AbhaChatterjee	Pearson
8	Hand Book of internal Communication	Eileen Scholes	Infinity Books

Principles of Management
Course Code 102
Credit -3

Depth of the course- Reasonable working knowledge

Program Objectives

- To understand basic concept regarding org. Business Administration
- To examining how various management principles
- To develop managerial skills among the students

Unit No.	Contents	Lectures
1	**Nature of management** Meaning , importance , functions ,types Management as an art ,science and social system Universality of concept of management and organization	**12**
2	**Evolution of management thoughts** Concept of managerial thoughts Contribution of Taylor, Mayo and Fayol and Drucker and Indian Management Ethos	**12**
3.	**Major managerial Functions** Planning , need types ,methods , advantages ,merits Forecasting. need types ,methods , advantages ,merits Decision making types process and techniques Directions nature and principles and Motivation –nature, principles and theories Organizing –concept delegation of authorities decentralization concepts and importance	**12**
4.	**Recent trends in Management** Management of change , Mgt of crises ,TQM ,stress management (Principles ,concepts merits)	**12**

References

Sr. No.	Title of the Book	Author/s	Publication
1	Management Concepts and Strategies	J.S. Chandan	Vikas Publishing House Pvt. Ltd.
2	Principles of Management	Harold Koontz , Heinz Weihrich , A. RamachandraArysri	McGraw hill companies
3	Management A Global and Entrepreneurial Perspective	Heinz Weihrich , Mark V. Cannice , Harold Koontz	McGraw hill companies
4	Management – 2008 Edition	Robert Kreitner , MamataMohapatra	Biztantra – Management For Flat World
5	Introduction to Management	John R. Schermerhorn	Wiley India Pvt. Ltd.
6	Principles of Management	P.C. Tripathi , P.N. reddy	McGraw hill companies
7	Management Text and Cases	R. SatyaRaju , A. Parthasarthy	PHI learning Pvt. Ltd
7	Management (Multi-Dimensional Approach)	H. R. Appannaiah , G. Dinakar , H.A. Bhaskara	Himalaya Publishing House

Subject : C-Programming
Course Code-103
Credit-3

Unit No.	Topics	No. of Lectures
1	**Introduction to C language** 1.1 History 1.2 Basic structure of C Programming 1.3 Language fundamentals 1.3.1 Character set, tokens 1.3.2 Keywords and identifiers 1.3.3 Variables and data types 1.4 Operators 1.4.1 Types of operators 1.4.2 Precedence and associativity 1.4.3 Expression	3
2	**Managing I/O operations** 2.1 Console based I/O and related built-in I/O functions 2.1.1 printf(), scanf() 2.1.2 getch(), getchar() 2.2 Formatted input and formatted output	2
3	**Decision Making and looping** 3.1 Introduction 3.2 Decision making structure 3.2.1 If statement 3.2.2 If-else statement 3.2.3 Nested if-else statement 3.2.4 Conditional operator 3.2.5 Switch statement 3.3 Loop control structures 3.3.1 while loop 3.3.2 Do-while loop 3.3.3 For loop 3.3.4 Nested for loop 3.4 Jump statements 3.4.1 break 3.4.2 continue 3.4.3 goto 3.4.4 exit	9
4	**Programs through conditional and looping statements** Addition / Multiplication of integers Determining if a number is +ve / -ve / even / odd Maximum of 2 numbers, 3 numbers Sum of first n numbers, given n numbers Integer division, Digit reversing, Table generation for n, ab Factorial, sine series, cosine series, nCr , Pascal Triangle Prime number, Factors of a number	5

	Other problems such as Perfect number, GCD of 2 numbers etc (Write algorithms and draw flowcharts)	
5	**Arrays and Strings** 5.1 Introduction to one-dimensional Array 5.1.1 Definition 5.1.2 Declaration 5.1.3 Initialization 5.2 Accessing and displaying array elements 5.3 Finding smallest and largest number from array 5.4 Reversing array 5.5 Finding odd/even/prime number from array 5.4 Introduction to two-dimensional Array 5.4.1 Definition 5.4.2 Declaration 5.4.3 Initialization 5.5 Accessing and displaying array elements 5.6 Matrices: Addition, Multiplication, Transpose, Symmetry, upper/lower triangular 5.7 Introductions to Strings 5.7.1 Definition 5.7.2 Declaration 5.7.3 Initialization 5.8 Standard library functions 5.9 Implementations without standard library functions.	12
6	**Functions** 6.1 Introduction 6.1.1 Purpose of function 6.1.2 Function definition 6.1.3 Function declaration 6.1.4 Function call 6.2 Types of functions 6.3 Call by value and call by reference 6.4 Storage classes	9
7	**7 Introduction to pointer** 7.1 Definition 7.2 Declaration 7.3 Initialization 7.4 Indirection operator and address of operator 7.5 Pointer arithmetic 7.6 Dynamic memory allocation 7.7 Functions and pointers	4
8	8 Structures 8.1 Introduction to structure 8.2 Definition 8.3 Declaration 8.4 Accessing members 8.5 structure operations 8.6 nested structure	4

Reference Book :-

1) Let us C –YashwantKanetkar, BPB publication.
2) Ansi C- Balagurusamy
3) The complete Reference- HerbeltSchildt

Subject Name -: Database Management Systems
Course Code: 104
Credit-3

Sr. No.	Chapter No.	Name of Chapter and Contents	No. of Lect.
1	1	File Structure and Organization 1.1 Introduction 1.2 Logical and Physical Files 1.2.1 File 1.2.2 File Structure 1.2.3 Logical and Physical Files Definitions 1.3 Basic File Operations 1.3.1 Opening Files 1.3.2 Closing Files 1.3.3 Reading and Writing 1.3.4 Seeking 1.4 File Organization 1.4.1 Field and Record structure in file 1.4.2 Record Types 1.4.3 Types of file organization 1.4.3.1 Sequential 1.4.3.2 Indexed 1.4.3.3 Hashed 1.5 Indexing 1.5.1 What is an Index? 1.5.2 When to use Indexes? 1.5.3 Types of Index 1.5.3.1 Dense Index 1.5.3.2 Sparse Index	6

2	2	Database Management System 2.1 Introduction 2.2 Basic Concept and Definitions 2.2.1 Data and Information 2.2.2 Data Vs Information 2.2.3 Data Dictionary 2.2.4 Data Item or Field 2.2.5 Record 2.3 Definition of DBMS 2.4 Applications of DBMS 2.5 File processing system Vs DBMS 2.6 Advantages and Disadvantages of DBMS 2.7 Users of DBMS 2.7.1 Database Designers 2.7.2 Application programmer 2.7.3 Sophisticated Users 2.7.4 End Users 2.8 Views of Data 2.9 Data Models	14
		2.9.1 Object Based Logical Model a. Object Oriented Data Model b. Entity Relationship Data Model 2.9.2 Record Base Logical Model a. Relational Model b. Network Model c. Hierarchical Model 2.10 Entity Relationship Diagram(ERD) 2.11 Extended features of ERD 2.12 Overall System structure	

3	3	**Relational Model** 3.1 Introduction 3.2 Terms a. Relation b. Tuple c. Attribute d. Cordinality e. Degree of relationship set f. Domain 3.3 Keys 3.3.1 Super Key 3.3.2 Candidate Key 3.3.3 Primary Key 3.3.4 Foreign Key 3.4 Relational Algebra Operations a. Select b. Project c. Union d. Difference e. Intersection f. Cartesian Product g. Natural Join	8
4	4	**SQL (Structured Query Language)** 4.1 Introduction 4.2 History Of SQL 4.3 Basic Structure 4.4 DDL Commands 4.5 DML Commands 4.6 Simple Queries 4.7 Nested Queries 4.8 Aggregate Functions	12
5	5	**Relational Database Design** 5.1 Introduction 5.2 Anomalies of un normalized database 5.3 Normalization 5.4 Normal Form 5.4.1 1 NF 5.4.2 2 NF 5.4.3 3 NF 5.4.3.4 BCNF	8

Business Statistics
Course code 105
Credit 3

Depth Reasonable working knowledge
Objective of the program
1. To understand role and importance of statistics in various business situations
2. To develop skills related with basic statistical technique
3. Develop right understanding regarding regression, correlation and data interpretation

Unit No.	Contents	Lectures
1	**Concept of statistics.** Role of statistics. In informatics business science Tabulation, Data condensations and tabulation, Data Condensation and graphical Methods :Raw data , attributes and variables , classification , frequency distribution ,cumulative frequency distributions. Graphs - Histogram, Frequency polygon. Diagrams - Multiple bar , Pie ,Subdivided bar.	12
2	**Measures of central tendency and dispersion** Criteria for good measures of central tendency, Arithmetic mean, Median and Mode for grouped and ungrouped data, combined mean.	12
3.	**Measures of Dispersion :** Concept of dispersion , Absolute and relative measure of dispersion, Range, Variance, Standard deviation, Coefficient of variation, Quartile Deviation , Coefficient of Quartile deviation.	12
4	**Correlation and Regression(for ungrouped data)** Concept of correlation, positive & negative correlation, Karl Pearson's Coefficient of correlation, meaning of regression, Two regression equations, Regression coefficients and properties.	12

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Organizational Behavior & Human Resource Management
Course code 201
Credit 3

Depth of the course- Basic working knowledge

Program Objectives:

i) To understand basic concept of HRM & OB
ii) To make aware students about traditional & modern methods of procurement & development in organization.
iii) To know the major trends in HRM & OB

Unit No.	Unit Title	Contents	Purpose and Skills to be developed
1	**Introduction to Organizational Behavior**	Definition, concept, scope, Models of OB, Major trends in OB:-Total Quality management, Cultural diversity, Organizational change, Stress Management: Sources of Stress, Effects of Stress & Stress Management, Work life Balance and Quality of Work Life	To understand the basic concept of OB & To develop knowledge about major trends & ability to handle cultural diversity Stress, change and to maintain work life balance.
2	**Introduction to HRM**	**Introduction to HRM**- Definition, Concepts, scope, importance Functions ,Objectives & limitations, , Role of HR Manager , Areas in which Human Resource Manager can be of assistance	To understand the basic concept of HRM & developing knowledge & ability of the student about HRM.
3	**Procurement**	**HRP**-Concept, Definition, Merits & Demerits, process , influencing factors of HRP **Recruitment**-Concept, Definition, sources of recruitment and their utility in identifying vacancies, methods, E-recruitment, **Selection-** Concepts, definition, process, Types of interviews and frequently asked interview questions from the candidate at each step and how to answer them, E- selection	To understand process & importance of HR procurement and to develop the skills among students regarding awareness of new trends of Recruitment Selection and interview preparation
4	**Training & Development**	**Training & Development-** Concept, definition, importance, Methods, E-Training, Recent trends in Training	To know the training & performance appraisal methods & To develop evaluation skill.

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Financial Accounting
Course code 202
Credit 3

Depth of the syllabus: Reasonable working knowledge

Program objectives

i) To develop right understanding regarding role and importance of monetary and financial transactions in business
ii) To cultivate right approach towards classifications of different transactions and their implications
Iii) To develop proficiency preparation of basic financial as to how to write basis accounting statement - Trading and P&L

Unit No.	Unit Title	Contents	Purpose and Skills to be developed
1	**Financial Accounting-**	definition and Scope, objectives, Accounting concepts, principles and conventions	To understand role and importance of accounting in Business and how accounting concept can be implemented in business Computation ability in business ability to distinguished between various accounting concepts and practices
2	**Accounting Transactions and Final Accounts**	Voucher system; Accounting Process, Journals, Ledger, Cash Book , subsidiary books ,Trial Balance preparation of Final Accounts of Sole Proprietorship(Trading and Profit & Loss Account and Balance Sheet	To understand how to record different financial transactions and their financial implications Ability to write different accounting tractions and prepare basic financial tractions
3.	**Bank Reconciliation Statements**	Meaning, importance and preparation of Bank Reconciliation Statement	To understand the kind of accounting relationship between customer and bank Ability to write necessary set of entries in books of accounts and in cash book and compare them with bank statement to understand their implications and effect

Evaluation Method

Internal Evaluation	External Evaluation
-	-
One project Report : 5 Marks **One assignment : 5 marks** **One Case Study Solution Report : 5 marks** **Internal Examination : 15 marks**	**25% MCQ** **Short notes 35%** **Long answers 40%**
30	**70**

Teaching Methodology

Teaching Hours	Innovative methods to be used	Project	Expected Outcome
10	Lecture ,Interactive teaching & Ice breaking session	Role play on HR Manager	To develop group cohesiveness.
10	Lab activity of Searching links about E-recruitment and E- selection.	Project report	Up gradation of knowledge of new trends in Recruitment and Selection.
12	Guest lecture	Assignment	Up gradation of skill.
13	Case Study , Video clips on Cultural Diversity and Stress management	Case study report	To develop decision making skill.

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Financial Accounting
Course code 202
Credit 3

Depth of the syllabus: Reasonable working knowledge

Program objectives

i) To develop right understanding regarding role and importance of monetary and financial transactions in business
ii) To cultivate right approach towards classifications of different transactions and their implications
Iii) To develop proficiency preparation of basic financial as to how to write basis accounting statement - Trading and P&L

Unit No.	Unit Title	Contents	Purpose and Skills to be developed
1	**Financial Accounting-**	definition and Scope, objectives, Accounting concepts, principles and conventions	To understand role and importance of accounting in Business and how accounting concept can be implemented in business Computation ability in business ability to distinguished between various accounting concepts and practices
2	**Accounting Transactions and Final Accounts**	Voucher system; Accounting Process, Journals, Ledger, Cash Book , subsidiary books ,Trial Balance preparation of Final Accounts of Sole Proprietorship(Trading and Profit & Loss Account and Balance Sheet	To understand how to record different financial transactions and their financial implications Ability to write different accounting tractions and prepare basic financial tractions
3.	**Bank Reconciliation Statements**	Meaning, importance and preparation of Bank Reconciliation Statement	To understand the kind of accounting relationship between customer and bank Ability to write necessary set of entries in books of accounts and in cash book and compare them with bank statement to understand their implications and effect

	Computerized Accounting	Role of computers and Financial application, Accounting Software packages	Ability to understand growing importance of software and to know how to use software and to write books of accounts Ability to use software like tally for writing of accounts

Teaching Methodology

Teaching Hours	Innovative methods to be used	AV Applications	Project	Expected Outcome
10	Appling accounting concepts in real life business Ability to distinguish between accounting tractions and real life business	Role of accounting in business	Importance of accounting of business and nonprofit organizations	To learn about importance of acc. In business
15	Using practical situations for writing Transactions And applying accounting concepts different situations	Writing ledger and cash book	Developing model of Journals and model books of accounts Preparing flow chart of accordance of different tractions	Ability to distinguish between different tractions and its nature
11	Interpretation of bank passbook and its statement Comparative analysis-of bank pass book and statement and their interpretation	Lesson on How to write bank reconciliations. Statement from YouTube	Preparing BR. With imaginary data	Ability to prepare and interpret bank reconciliation statement
12	NIL	To Understand how various tractions are recorded while using software and what cautions are need to be taken while recording transactions.	Film on silent features of tally accounting As business software	Appling software basic financial statement and converting row financial data into well written financial data

7

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Business Mathematics
Course code 203
Credit 3

Course Depth: Fundamental Knowledge

Objectives:
i) To understand role and importance of Mathematics in various business situations and while developing softwares.
ii) To develop skills related with basic mathematical technique

Unit No.	Topic	No. of Lecture
1	**1. Ratio, Proportion and Percentage:** Ratio – Definition, Continued Ratio, Inverse Ration, Proportion, Continued Proportion, Direct Proportion, Inverse Proportion, Variation, Inverse Variation, Joint Variation, Percentage, computation of Percentage.	8
2	**2. Profit and Loss: -** Terms and Formulae, Trade discount, Cash discount, Problems involving cost price, selling price, Trade discount and cash discount. Introduction to Commission and brokerage, Problems on commission and brokerage	6

3	**3.Interest and Annuity: -** interest, Compound interest, Equated monthly Installments (EMI) by interest of reducing balance and flat interest methods and problems. Ordinary annuity, sinker fund, annuity due, present value and future value of annuity. **Shares and Mutual Funds:-** Shares, face value, market value, dividend, brokerage, equity shares, preferential shares, bonus shares, examples and problems, Concept of Mutual Funds, Change in Net Asset Value (NAV), Systematic Investment Plan (SIP), Examples and Problems.	Simple Concepts of	7 7	
4	**4.Matrices and Determinant: -** Matrices, Types of Matrices, Algebra of Matrices, Determinant, Adjoint of Matrix, Inverse of Matrix, System of Linear equations, Solution of System of Linear Equation by adjoint method (upto 3 variables only).	Definition of	10	
5	**5. Linear Programming Problem (LPP)** LPP, Formulation of LPP and solution of LPP by graphical method. **Transportation Problem (T.P.):-** Concept of Transportation Problem, Initial Basic Feasible Solution, North-West Corner Method (NWCM), Least Cost Method (LCM), Vogal's Approximation Method (VAM).	Concept of	5 5	-
	Total		**48**	

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Relational Data Base
Course code 204
Credit 3

Course Depth: Fundamental Knowledge

Objectives:

i) Enables students to understand relational database concepts and transaction management concepts in database system.
ii) Enables student to write PL/SQL- programs that use: procedure, function, package, cursor and trigger.

Unit No.	Unit Title	Contents	Purpose	Expected Outcome
1.	**Introduction To RDBMS**	Introduction to popular RDBMS product and their features	To understand concept of RDBMS & use in business	Understanding of various RDBMS products()
		Difference Between DBMS and RDBMS	To understand advantages of RDBMS over DBMS	Use of relational database
		Relationship among application programs and RDBMS	To understand interface between application programs and data	To get knowledge of Front End and Backend
2.	**PL-SQL**	Overview of PLSQL Data Types ,PLSQL Block	To understand various data types , operators , functions and control statements	Understanding of various programming aspects
		Exception Handling	To understand predefined and user defined exceptions	Learning of different exceptions
		Functions, Procedures	To understand concept of compact program writing by making use of functions and procedure	Writing of compact code (Small program writing)
		Cursor	To understand types of cursors and selective data retrieval	Understanding of exact data retrieval
		Trigger Package	To understand concept of stored	Writing of triggers and

Savitribai Phule Pune University
FY BBA- CA Semester II (CBCS) Pattern 2019
Web Technology (HTML-JSS-CSS)
Course code 205
Credit 3

Course Depth: Fundamental Knowledge

Objectives:

i) To know & understand concepts of internet programming.
ii) To understand how to develop web based applications using JavaScript.

Unit No	Topic	No. of Lecture
1	**1. Introduction** 1.1 Clients- Servers and Communication 1.2 Internet-Basic, Internet Protocols (HTTP, FTP, IP) 1.3 World Wide Web(WWW) 1.4 HTTP request message, HTTP response message	5
2	**2. Web Design** 2.1 Concepts of effective web design 2.2 Web design issues including Browser Bandwidth and Cache 2.3 Display resolution 2.4 Look and Feel of the Website 2.5 Page Layout and linking 2.6 User centric design 2.7 Sitemap 2.8 Planning and publishing website 2.9 Designing effective navigation	9

SPPU/BBA(CA) SYLLABUS SEMESTER-II CBCS/2019 PATTERN

4	**Concurrency Control & Recovery System**	Lock Based Protocol	To understand meaning Locks, Granting of Locks ,Two Phase Locking Protocol	To understand concept of shared and exclusive lock
		Timestamp Based Protocol	To understand Timestamp and timestamp ordering protocol	To learn how to prevent deadlock situation
		Deadlock Handling	To understand dead lock detection, prevention and recovery	Understand what deadlock is and how it can occur when giving mutually exclusive access to multiple resources
		Failure Classification	To understand transaction failure and system crash	To learn concepts related to hardware failures
		Recovery & Atomicity	To understand log based recovery and checkpoint	Data recovery with different techniques
		Recovery with concurrent transaction	To understand concept of transaction rollback	Restoring of data which is changed by mistake

3.	**Transaction Management**	Transaction Concept	To understand effect of transaction process on database	Understanding use of transaction and effect on database
		Transaction Properties	To understand properties like atomicity, consistency, isolation and durability	Application of properties (Case solving)
		Transaction States	To understand various states such as active, partially committed, Failed , aborted, committed	Understanding of various states
		Concurrent Execution	To understand concept of reduction in waiting time	
		Serializability	To understand Conflict Serializability and View Serializability	
			procedure and compiled data	packages(S ial application using all contents)

3	**3. HTML** 3.1 Introduction to HTML 3.2 Basic HTML Structure 3.3 Common HTML Tags 3.4 Physical and Logical HTML 3.5 Types of Images, client side and server-side Image mapping 3.6 List, Table, Frames 3.7 Embedding Audio, Video 3.8 HTML form and form elements 3.9 Introduction to HTML Front Page	12	
4	**4. Style sheets** 4.1 Need for CSS 4.2 Introduction to CSS 4.3 Basic syntax and structure 4.4 Using CSS- 4.4.1 background images, colors and properties, 4.4.2 manipulating texts, using fonts, borders and boxes, margins, padding lists, positioning using CSS 4.5 Overview and features of CSS2 and CSS3	10	
5	**5. JavaScript** 5.1 Introduction to Java Script 5.2 Identifier & operator, control structure, functions 5.3 Document object model(DOM), 5.4 DOM Objects (window, navigator, history, location) 5.5 Predefined functions, math & string functions 5.6 Array in Java scripts 5.7 Event handling in Java script	12	
	Total	48	

S.Y.B.B.A.(C.A.) Semester –III

Course Code: CA-301

Subject: Digital Marketing

Objectives:

1. The aim of this syllabus is to give knowledge about using digital marketing in and as business.

2. To make SWOT analysis, SEO optimization and use of various digital marketing tools.

Unit	Topic	No. of Lectures
1.	**E-Commerce** 1.1 Introduction 1.2 Understanding Internet Marketing 1.3 Search Engine Optimization 1.4 Search Engine Marketing 1.5 Email Marketing 1.6 Digital Display Marketing	4
2.	**Introduction to New Age Media (Digital) Marketing** 2.1 What is Digital Marketing 2.2 Digital vs. Real Marketing 2.3 Digital Marketing Channels 2.4 Types of Digital Marketing(Overview)-Internet Marketing ,Social Media Marketing, Mobile Marketing	4
3.	**Creating Initial Digital Marketing Plan** 3.1 Content management 3.2 SWOT analysis: Strengths, Weaknesses, Opportunities, andThreats 3.3 Target group analysis EXERCISE: Define a target group	4
4.	**Marketing using Web Sites** 4.1 Web design 4.2 Optimization of Web sites 4.3 MS Expression Web EXERCISE: Creating web sites, MS Expression	4
5.	**Search Engine Optimization** 5.1 SEO Optimization 5.2 Writing the SEO content EXERCISE: Writing the SEO content	4
6.	**Customer Relationship Management** 6.1 Introduction to CRM 6.2 CRM platform 6.3 CRM models EXERCISE: CRM strategy	4

7.	**Social Media Marketing** 7.1 Understanding Social Media Marketing 7.2 Social Networking (Facebook, Linkedin, Twitter, etc.) Social Media (Blogging, Video Sharing - Youtube, Photosharing – Instagram, Podcasts) 7.3 Web analytics - levels 7.4 Modes of Social Media Marketing- 7.4.1 **Creating a Facebook page** Visual identity of a Facebook page , Types of publications, Facebook Ads , Creating Facebook Ads , Ads Visibility 7.4.2 **Business opportunities and Instagram options** Optimization of Instagram profiles , Integrating Instagram with a Web Site and other social networks ,Keeping up with posts 7.4.3 **Business tools on LinkedIn** Creating campaigns on LinkedIn , Analyzing visitation on LinkedIn 7.4.4 **Creating business accounts on YouTube**YouTube ,Advertising , YouTube Analytics 7.4.5 **E-mail marketing** E-mail marketing plan , E-mail marketing campaign analysis , Keeping up with conversions 7.5 Digital Marketing tools: Google Ads, FaceBook Ads, Google Analytic, Zapier, Google Keyword Planner EXERCISE: Social Media Marketing plan. EXERCISE: Making a Facebook page and Google Ads	1 2 2 3 3 3 3 (20)
8.	**Digital Marketing Budgeting** 8.1 Resource planning 8.2 Cost estimating 8.3 Cost budgeting 8.4 Cost control	4
	Total	48

Reference Books:

1) Digital Marketing for Dummies By Ryan Deiss and Russ Hennesberry
2) Advertising and Promotion: An Integrated Marketing Communications Perspective, George Belch, San Diego University Michael Belch, San Diego University
3) Advertising Management: Rajeev Batra, John G. Myers, David A. Aaker
4) Belch: Advertising & Promotions (TMH)
5) The Social Media Bible: Tactics, Tools, & Strategies for Business Success by Lon Safko
6) Web Analytics 2.0 – AvinashKaushik

S.Y.B.B.A(C.A) Semester – III

Course Code: CA-302

Subject : Data Structure

Objectives:

1. To understand the concepts of ADTs
2. To learn linear data structures – lists, stacks, and queues
3. To understand sorting, searching and hashing algorithms
4. To apply Tree and Graph structures

Unit	Topic	No. of Lectures
1	**Basic Concept and Introduction to Data Structure** 1.1 Pointers and dynamic memory allocation 1.2 Algorithm-Definition and characteristics 1.3 Algorithm Analysis -Space Complexity -Time Complexity - Asymptotic Notation Introduction to Data structure 1.4 Types of Data structure 1.5 Abstract Data Types (ADT) Introduction to Arrays and Structure 1.6 Types of array and Representation of array 1.7 Polynomial - Polynomial Representation - Evaluation of Polynomial - Addition of Polynomial 1.8 Self Referential Structure	5
2	**Linear data structures** 2.1 Introduction to Arrays - array representation 2.2 Sorting algorithms with efficiency - Bubble sort, Insertion sort, Merge sort, Quick Sort, Selection Sort 2.3 Searching techniques –Linear Search, Binary search	6
3	**Linked List** 3.1 Introduction to Linked List 3.2 Implementation of Linked List – Static & Dynamic representation, 3.3 Types of Linked List - Singly Linked list(All type of operation) - Doubly Linked list (Create , Display) - Circularly Singly Linked list (Create, Display) - Circularly Doubly Linked list (Create, Display) 3.4 Generalized linked list – Concept and Representation	6
4	**Stacks** 4.1 Introduction 4.2 Representation- Static & Dynamic 4.3 Primitive Operations on stack 4.4 Application of Stack 4.5 Conversion of Infix, prefix, postfix , Evaluation of postfix and prefix	8

	4.6 Simulating recursion using stack	
5	**Queues** 5.1 Introduction 5.2 Representation - Static & Dynamic 5.3 Primitive Operations on Queue 5.4 Circular queue, priority queue 5.5 Concept of doubly ended queue	4
6	**Trees** 6.1 Concept & Terminologies 6.2 Binary tree, binary search tree 6.3 Representation – Static and Dynamic 6.4 Operations on BT and BST – create, Insert, delete, , counting leaf, non-leaf & total nodes , 6.5 Tree Traversals (preorder, inorder, postorder) 6.6 Application - Heap sort 6.7 Height balanced tree- AVL trees- Rotations, AVL tree examples.	12
7	**Graph** 7.1 Concept & terminologies 7.2 Graph Representation – Adjacency matrix, adjacency list, inverse Adjacency list, adjacency multilist, orthogonal list 7.3 Degree of Graph 7.4 Traversals – BFS and DFS 7.5 Applications – AOV network – topological sort, AOE network – criticalPath	7
	Total	48

Reference Books:

1. Fundamentals of Data Structures ---- By Horowitz Sahani (Galgotia)
2. Data Structures using C and C++ --- By YedidyahLangsam, Aaron M. Tenenbaum, Moshe J. Augenstein
3. Introduction to Data Structures using C---By Ashok Kamthane
4. Data Structures using C --- Bandopadhyay&Dey (Pearson)
5. Data Structures using C ---By Srivastava BPB Publication.

S.Y.B.B.A. (C.A.) Semester –III

Course Code: CA-303

Subject: Software Engineering

Objectives:

1. To understand System concepts.
2. To understand Software Engineering concepts.
3. To understand the applications of Software Engineering concepts and Design in Software development

Unit	Topic	No. of lectures
1	**Introduction to System Concepts** 1.1 Definition 1.2 Basic Components 1.3 Elements of the System 1.4 Types of System 1.5 System Characteristics	4
2	**Introduction to Software Engineering** 2.1 Definition of Software 2.2 Characteristics of Software 2.3 Definition of Software Engineering 2.4 Need for Software Engineering 2.5 Mc Call's Quality factors 2.6 The Software Process 2.7 Software Product and Process 2.8 V& V Model	6
3	**Software Development Life Cycle** 3.1 Introduction 3.2 Activities of SDLC 3.3 A Generic Process Model 3.4 SDLC 3.5 Waterfall Model 3.6 Incremental Process Models 3.7 Prototyping Model 3.8 Spiral Model	8
4	**Requirement Engineering** 4.1 Introduction 4.2 Requirement Elicitation 4.3Requirement Elaboration 4.4 Requirement Gathering 4.5 Feasibility study	8

	4.6 Fact Finding Techniques 4.7 SRS Format	
5	**Analysis And Design Tools** 5.1 Decision Tree and Decision Table 5.2 Data Flow Diagrams (DFD) (Up to 2nd level) 5.3 Data Dictionary 5.4 Elements of DD 5.5 Advantages and Disadvantages of DD 5.6 Input and Output Design 5.7 Structured Design Concepts 5.8 Structure Chart 5.9 Coupling and Cohesion 5.10 Compulsory Case Studies on above topics	12
6	**Software Testing** 6.1 Definition 6.2 Software testing Process 6.3 Unit Testing 6.4 Integration Testing 6.5 System Testing	6
7	**Software Maintenance and Software Re-Engineering** 7.1 Maintenance definition and types 7.2 Software reengineering 7.3 Reverse Engineering 7.4 Restructuring and forward Engineering.	4
	Total	48

Reference Books:

1. Software Engineering: A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010(Seventh Edition)

2. System Analysis, Design and Introduction to Software Engineering (SADSE) - S. Parthsarthy, B.W. Khalkar

3. Analysis and Design of Information Systems(Second Edition) - James A. Senn, McGraw Hill

4. System Analysis and Design- Elias Awad, Galgotia Publication, Second Edition

S.Y.B.B.A.(C.A.) Semester – III

Course Code: CA- 304 (Option)

Subject: Angular - JS

Objectives:

- By the end of this course, the students should be able to Understand Client Side MVC and SPA
- Explore AngularJS Component
- Develop an AngularJS Single Page Application
- Create and bind controllers with Javascript
- Apply filter in AngularJS application

Unit	Topics	No. of Lectures
1	**AngularJS Core Concepts:** 1.1 What is AngularJS? 1.2 Difference between Javasript and Angular JS 1.3 Advantages of Angular 1.4 AngularJS MVC Architecture 1.5 Introduction to SPA 1.6 Setting up the environment 1.7 First App using MVC architecture	8
2	**AngularJS Directives and Expressions:** 2.1 Understanding ng attributes ng-app, ng-init, ng-model, ng-controller, ng-bind, ng-repeat, ng-show, ng-readonly, ng-disabled, ng-if, ng-click 2.2 Expression and Data Binding 2.3 Working with directives	10
3	**AngularJS Modules, Controller, View and Scope:** 3.1 Angular Modules 3.2 Angular Controller 3.3 Angular View 3.4 Scope hierarchy	10
4	**Filter, Forms and Ajax Filters** 4.1 Built-in filters - upper case and lower case filters, date ,currency and number formatting ,orderBy, filter ,custom filter, 4.2 Angular JS Forms – Working with AngularJS forms, model binding,	12

	form controller ,Using CSS classes, form events , custom model update triggers ,custom validation, $http service , 4.3 Ajax implementation using $http	
5	**Dependency Injection, Services** 5.1 What is dependency injection? 5.2 Understanding services 5.3 Using built-in service 5.4 Creating custom service, 5.5 Injecting dependency in service	8
	Total	48

Reference Books:

1. Beginning Angular with Typescript (updated to Angular 5) by Greg Lim
2. Mastering Web Application Development with AngularJS by Pawel Kozlowski, Peter Bacon Darwin
3. https://www.tutorialsteacher.com/angularjs/angularjs-scope

S.Y.B.B.A.(C.A.) Semester – IV

Course Code: CA- 304(Option)

Subject: PHP

Objectives:

1. Understand how server-side programming works on the web.
2. Using PHP built-in functions and creating custom functions
3. Understanding POST and GET in form submission.
4. How to receive and process form submission data.
5. Read and process data in a MySQL database.

Unit	Topic	No. of Lectures
1	**PHP Basics** 1.1 Setting up a development environment 1.2 Variables, numbers and strings 1.3 Calculations with PHP 1.4 Using Arrays	6
2	**Control Structures and Loops** 2.1 Conditional Statements 2.2 Using Loops for Repetitive tasks 2.3 Combing Loops and Arrays	7
3	**Functions, Objects and Errors** 3.1 PHP's Built-in functions 3.2 Creating Custom functions 3.3 Passing Values by Reference 3.4 Understanding Objects	7
4	**Working with Forms** 4.1 Building a Form 4.2 Processing a Form's Data 4.3 Differences between POST and GET 4.4 Preserving User Input	7
5	**More with Forms** 5.1 Dealing with checkboxes and radiobuttons 5.2 Retrieving values from lists 5.3 Validating and restricting data 5.4 Sending Email	7
6	**Storing and Protecting Data** 6.1 Setting and Reading Cookies 6.2 Protecting Online Files 6.3 Understanding Session Variables	7
7	**MySQL Database Overview**	7

	7.1 phpMyAdmin Overview 7.2 Using a MySQL Database 7.3 Reading and Writing Data	
	Total	**48**

Reference Books:

1. Php: A Beginner's Guide 1st EditionMcGraw-Hill Osborne Media; 1 edition by VikramVaswani
2. Murach's PHP and MySQL (2nd Edition)by Joel Murach and Ray Harris
3. PHP: The Complete Reference Paperback – 1 Jul 2017by Steven Holzner (Author)

S.Y.B.B.A.(C.A.) Semester – III

Course Code: CA- 305(Option)

Course Title : Big Data

Objectives:

1. To enable learners to develop expert knowledge and analytical skills in current and developing areas of analysis statistics, and machine learning

2. To enable the learner to identify, develop and apply detailed analytical, creative, problem solving skills.

3. Provide the learner with a comprehensive platform for career development, innovation and further study.

Unit	Topic	No. of lectures
1	**INTRODUCTION TO BIG DATA** 1.1 Introduction to Big Data 1.2 Types of Digital Data 1.3 Big Data Analytics 1.4 Application of Big data	5
2	**INTRODUCTION TO DATA SCIENCE** 2.1 Basics of Data Analytics 2.2 Types of Analytics – 2.2.1 Descriptive, 2.2.2 Predictive, 2.2.3 Prescriptive 2.2.4 Statistical Inference 2.3 Populations and samples 2.3.1 Statistical modelling, 2.3.2 Probability 2.3.3 Distribution 2.3.4 Correlation 2.3.5 Regression	10
3	**INTRODUCTION TO MACHINE LEARNING** 3.1 Basics of Machine Leaning 3.2 Supervised Machine Learning 3.2.1 K- Nearest-Neighbours, 3.2.2 Naïve Bayes 3.2.3 Decision tree 3.2.4 Support Vector Machines	20

	3.3 Unsupervised Machine Learning 3.3.1 Cluster analysis 3.3.2 K means 3.3.3 EM Algorithm 3.3.4 Association Rule Mining 3.3.5 Apriori algorithms 3.4 Regression Analysis 3.4.1 Linear Regression 3.4.2 Nonlinear Regression	
4	**DATA ANALYTICS WITH R/ WEKA MACHINE LEARNING** 4.1 Introduction 4.2 Data Manipulation 4.3 Data Visualization 4.4 Data Analysis	**13**
	Total	**48**

Reference Books:

1. SeemaAcharya, SubhasiniChellappan, "Big Data Analytics" Wiley 2015.
2. Jay Liebowitz, "Big Data and Business Analytics" Auerbach Publications, CRC press (2013)
3. ArvindSathi, "BigDataAnalytics: Disruptive Technologies for Changing the Game", MC Press, 2012

S.Y.B.B.A.(C.A.) Semester – III

Course Code: CA-305 (Option)

Course Title : BlockChain

PREREQUISITES:

This course is highly technical in nature and would require the student to be comfortable with coding. To prepare for the class all students MUST:

- Understanding of basic programming language like Java, or Javascript.
- Understanding of PKI and Docker.

WHAT YOU'LL LEARN

- Understand what and why of Blockchain
- Explore the major components of Blockchain
- Learn about Bitcoin, Cryptocurrency, Ethereum
- Deploy and exercise example smart contracts
- Identify a use case for a Blockchain application
- Create your own Blockchain network application

COURSE OBJECTIVES

By the end of the course, students will be able to

1. Understand how blockchain systems (mainly Bitcoin and Ethereum) work,
2. To securely interact with them,
3. Design, build, and deploy smart contracts and distributed applications,
4. Integrate ideas from blockchain technology into their own projects.

Unit	Topic	No. of Lectures
1	**Introduction To Blockchain** 1.1 Digital Trust 1.2 Asset 1.3 Transactions 1.4 Distributed Ledger Technology 1.5 Types of network 1.6 Components of blockchain or DLT 1.7 Ledger 1.7.1. Blocks 1.7.2. Blockchain 1.8 PKI and Cryptography 1.8.1. Private keys 1.8.2. Public keys 1.8.3. Hashing 1.8.4. Digital Signature 1.9. Consensus	**12**

	1.9.1. Byzantine Fault 1.9.2. Proof of Work 1.9.3. Poof of Stake 1.10. Security 1.10.1.DDos 1.11 Cryptocurrency 1.12.Digital Token	
2.	**How Blockchain Works** 2.1 How Blockchain Works 2.2. Structure of Blockchain 2.3.Block 2.4. Hash 2.5. Blockchain 2.6. Distributed 2.7. Lifecycle of Blockchain 2.8. Smart Contract 2.9. Consensus Algorithm 2.10 Proof of Work 2.11 Proof of Stake 2.12 Practical Byzantine 2.13 Fault Tolerance 2.14 Actors of Blockchain 2.15 Blockchain developer 2.16 Blockchain operator 2.17 Blockchain regulator 2.18 Blockchain user 2.19 Membership service provider 2.20 Building A Small Blockchain Application	**12**
3.	**Introduction to Bitcoin** 3.1 Currency 3.2 Double Spending 3.3 Cryptocurrency 3.4 P2P Payment Gateway 3.5 Wallet 3.6 Mining	**8**
4.	**Ethereum** 4.1.Ethereum network 4.2. EVM 4.3.Transaction fee 4.4.Mist 4.5.Ether, gas 4.6.Solidity - Smart contracts 4.7.Truffle 4.8.Web3 4.9.Design and issue Cryptocurrency 4.10. Mining	**8**

	4.11. DApps 4.12. DAO	**8**
5	**Introduction To Hyperledger Fabric V1.1** 5.1. Introduction to Hyperledger 5.2 What is Hyperledger 5.3 Why Hyperledger 5.4 Where can Hyperledger be used 5.5 Hyperledger Architecture 5.6 Membership 5.7 Blockchain 5.8 Transaction 5.9 Chaincode 5.10 Hyperledger Fabric 5.11 Features of Hyperledger	**48**
	Total	

References:

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,
Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

	1.9.2. Proof of Work 1.9.3. Poof of Stake 1.10. Security 1.10.1.DDos 1.11 Cryptocurrency 1.12.Digital Token	
2.	**How Blockchain Works** 2.1 How Blockchain Works 2.2. Structure of Blockchain 2.3.Block 2.4. Hash 2.5. Blockchain 2.6. Distributed 2.7. Lifecycle of Blockchain 2.8. Smart Contract 2.9. Consensus Algorithm 2.10 Proof of Work 2.11 Proof of Stake 2.12 Practical Byzantine 2.13 Fault Tolerance 2.14 Actors of Blockchain 2.15 Blockchain developer 2.16 Blockchain operator 2.17 Blockchain regulator 2.18 Blockchain user 2.19 Membership service provider 2.20 Building A Small Blockchain Application	**12**
3.	**Introduction to Bitcoin** 3.1 Currency 3.2 Double Spending 3.3 Cryptocurrency 3.4 P2P Payment Gateway 3.5 Wallet 3.6 Mining	**8**
4.	**Ethereum** 4.1.Ethereum network 4.2. EVM 4.3.Transaction fee 4.4.Mist 4.5.Ether, gas 4.6.Solidity - Smart contracts 4.7.Truffle 4.8.Web3 4.9.Design and issue Cryptocurrency 4.10. Mining	**8**

	4.11. DApps 4.12. DAO	
5	**Introduction To Hyperledger Fabric V1.1** 5.1. Introduction to Hyperledger 5.2 What is Hyperledger 5.3 Why Hyperledger 5.4 Where can Hyperledger be used 5.5 Hyperledger Architecture 5.6 Membership 5.7 Blockchain 5.8 Transaction 5.9 Chaincode 5.10 Hyperledger Fabric 5.11 Features of Hyperledger	**8**
	Total	**48**

References:

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder,
Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, "ETHEREUM: A Secure Decentralized Transaction Ledger,"Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and TizianaCimoli, A survey of attacks on Ethereum smart contracts

SavitribaiPhule Pune University
Syllabus for BBA(CA) (CBCS 2019 Pattern)
Details for Skill Enhancement (Add-On) Courses

AECC - Course Title: - (M)Basic Course in Environmental Awareness
Credit -2 & Hours -30

Objectives:

1) To provide an opportunities to acquire the knowledge, values, attitudes, commitment, and skills needed to protect and improve the environment
2) To develop conscious towards a cleaner and better managed environment

Course content

1 Introduction - Environmental studies Definition, scope importance and need for public awareness. (Multidisciplinary nature of environmental studies)

2 Environmental Pollution -Definition, Causes, effects on human, water, soil, air (Mother Earth)

- Air pollution
- Water pollution
- Soil pollution
- Marine pollution
- Noise pollution
- Thermal pollution
- Nuclear hazards

3 Various Government initiatives for conservation of Environment. Controlling measures)

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes.
- Role of an individual in prevention of pollution. Pollution case studies.
- Disaster management: floods, earthquake, cyclone and landslides.

4 Field work Visit / Project Report preparation

•Visit to a local area to document environmental assets - river / forest / grassland / hill / mountain.

• Visit to a local polluted site-Urban/Rural/Industrial/Agricultural

• Effects on plants, insects, birds – As Elements of ecosystem

Evaluation of the course: Continuous evaluation of the student through oral, necessary writing assignments / Quiz and presentations.

Certification: A Course Completion Certificate will be provided by the college to every student who has passed in the continuous evaluation and the Grade as per his / her performance in the evaluation will appear on the Certificate.

OR – (Select Any One Course In Semester III – For BBA , BBA- IB , and BBA –CA)

SavitribaiPhule Pune University
Syllabus for BBA (CA) (CBCS 2019 Pattern)
Details for Skill Enhancement (Add-On) Courses

AECC - Course Title: - (N)Advance Course in Environmental Awareness
Credit -2 & Hours -30

Course Objectives

- Understand current concern about our impact on the environment.
- Recognize the things they do affect the environment.
- Promote green practices at home and at work.
- Describe what is being done and what we all can do to help prevent harm to the environment.

Course Contents

- **Environmental and Ecosystem Management:**

Concept and scope, Systems of approaches, Standards – International and National, Ecomark, Environmental accounting and auditing, Green funding and taxes, Trade and environmental management. Ecosystem analysis, Modelling, Monitoring and Planning, Ecotourism and Heritage management, Eco restoration,

- **Management of solid waste**

Different types of solid wastes, Methods of disposal and management of Municipal and thermal power plant generated solid wastes, Bio medical wastes and Hazordous wastes, Recycling of wastes, Power generation and waste minimization techniques.

Sanction and enforcement bodies of environmental laws in India.

Legal, administrative and constitutional provisions for environmental protection in India; Role of Supreme Court and Green Bench of High Court; Public awareness and Government measures; Role of Pressure Groups and NGOs; Concepts and Aspects of Public Interest Litigation (PIL); Public Interest Litigation in India on different Environmental Issues.

- **National and Regional Environmental Issues Resource and its conservation;**

Ecological refugees; Conservation strategies of the environment: Mines, riverine networks; forest, soil and wild life

Current Environmental Movements in India. Silent Valley, Chipko, Narmada dam, Appiko, TehriGarwal Dam, Uttara Kannada and Almatti dam movements.

- **Environmental Ethics and Global Imperatives.**

Concepts and aspects of Environmental ethics, Anthropocentrism and Eco-centrism; Deep ecology.Global environmental problems.Green house effect, global warming and climate change, ozone layer depletion, acid rain, deforestation and loss of biodiversity, unplannced urbanization.

Evaluation of the course: Continuous evaluation of the student through oral, necessary writing assignments/ Quiz and presentations.

Certification: A Course Completion Certificate will be provided by the college to every student who has passed in the continuous evaluation and the Grade as per his / her performance in the evaluation will appear on the Certificate.

S.Y.B.B.A.(C.A.) Semester –IV

Course Code: CA-401

Subject: Networking

Objectives:
1. To gain knowledge about Computer Networks concepts.
2. To know about working of networking models, addresses, transmission medias and connectivity devices.
3. To acquire information about network security and cryptography.

Unit	Topic	No. of Lectures
1	**Introduction to Computer Network** 1.1Basics of Computer Network 1.1.1Definition 1.1.2Goals 1.1.3Applications, 1.1.4Network Hardware –Broadcast, Point to Point 1.1.5Components of Data Communication 1.2 Network Topologies 1.2.1Mesh 1.2.2 Star, 1.2.3 Bus, 1.2.4Ring 1.3Types of Networks 1.3.1LAN,MAN,WAN, 1.3.2 Internetwork, 1.3.3 Wireless Network 1.4 Modes of Communication 1.4.1 Simplex, 1.4.2 Half Duplex, 1.4.3 Full Duplex 1.5. Server Based LANs & Peer-to-Peer LANs 1.6. Protocols and Standards 1.7. Network Software 1.7.1 Protocol Hierarchies,Layers, Peers,Interfaces 1.7.2 Design Issues of the Layers 1.7.3 Connection Oriented and Connectionless Service	10
2	**Network Models** 2.1 OSI Reference Model : Functions of each Layer 2.2 TCP/IP Reference Model,Comparison of OSI and TCP/IP	8

	Reference Model 2.3 TCP/IP Protocol Suite 2.4 Addressing 2.4.1Physical Addresses 2.4.2 Logical Addresses 2.4.3Port Addresses, 2.4.4 SpecificAddresses 2.5 IP Addressing 2.5.1 ClassfullAddressing 2.5.2 Classless Addressing	
3	**Transmission Media** 3.1Introduction, Types of Transmission Media 3.2 Guided Media: 3.2.1Twisted Pair Cable- Physical Structure,Categories,Connectors &Applications 3.2.2Coaxial Cable – Physical Structure, Standards, Connectors & Applications 3.2.3Fiber Optic Cable- Physical Structure,Propagation Modes,Connectors & Applications 3.3 Unguided Media: 3.3.1Electromagnetic Spectrum for Wireless Communication 3.3.2Propagation Modes Ground,Sky,Line-of-Sight 3.3.3Wireless Transmission:Radio Waves,Microwaves, Infrared	8
4	**Wired and Wireless LAN** 4.1 IEEE Standards 4.2 Standard Ethernet MAC Sublayer,Physical Layer 4.3 Fast Ethernet – Goals, MAC Sublayer,Topology, Implementation 4.4 Gigabit Ethernet – Goals, MAC Sublayer,Topology, Implementation 4.5 Ten-Gigabit Ethernet – Goals, MAC Sublayer, Physical Layer 4.6 Backbone Networks -Bus Backbone, Star Backbone 4.7 Virtual LANs Membership, IEEE standards advantages 4.8 Wireless LAN 4.8.1 IEEE 802.11 Architecture, 4.8.2 Bluetooth Architecture (Piconet, Scatternet)	8
5	**Network Devices** 5.1 Network Connectivity Devices 5.1.1 Active and Passive Hubs 5.1.2 Repeaters 5.1.3 Bridges- Types of Bridges 5.1.4 Switches 5.1.5 Router 5.1.6 Gateways	6

6	**Network Security** 6.1 Introduction 6.2 Need for Security 6.3 Security Services : 6.3.1 Message- -Confidentiality, Integrity, Authentication, Non repudiation. 6.3.2 Entity (User)- Authentication. 6.4 Types of Attack 6.5 Cryptography, PlainText,Cipher Text, Encryption,Decryption, Symmetric Key and Asymmetric Key Cryptography 6.6 SubstitutionTechniques, Caesar Cipher,and Transposition Cipher (Problems should be covered.) 6.7 Firewalls- Packet Filter firewall, Proxy firewall 6.8 Steganography,Copyright	8
	Total	48

Reference Books:

1. Computer Networks by Andrew Tanenbaum, Pearson Education.[4th Edition]
2. Data Communication and Networking by BehrouzForouzan, TATA McGraw Hill. .[4th Edition]

S.Y.B.B.A.(C.A.) Semester –IV

Course Code: CA-402

Subject: Object Oriented Concepts Through CPP

Objectives:

1. Acquire an understanding of basic object-oriented concepts and the issues involved in effective class design.
2. Enable students to write programs using C++ features like operator overloading, constructor and destructor, inheritance, polymorphism and exception handling.

Unit	Topic	No. of Lectures
1	**Introduction to C++** 1.1 Basic concepts, features, advantages and applications of OOP 1.2 Introduction, applications and features of C++ 1.3 Input and Output operator in C++ 1.4 Simple C++ program	2
2	**Beginning with C++** 2.1 Data type and Keywords 2.2 Declaration of variables, dynamic initialization of variables, reference variable 2.3 Operators: 2.3.1 Scope resolution operator 2.3.2 Memory management operators 2.4 Manipulators 2.5 Functions: 2.5.1 Function prototyping, call by reference and return by reference 2.5.2 Inline functions 2.6 Default arguments	6
3	**Classes and Objects** 3.1 Structure and class, Class, Object 3.2 Access specifiers, defining data member 3.3 Defining member functions inside and outside class definition. 3.4 Simple C++ program using class 3.5 Memory allocation for objects 3.6 Static data members and static member functions 3.7 Array of objects, objects as a function argument 3.8 Friend function and Friend class 3.9 Function returning objects	8
4	**Constructors and Destructors** 4.1 Constructors 4.2 Types of constructor : Default, Parameterized, Copy 4.3 Multiple constructors in a class 4.4 Constructors with default argument 4.5 Dynamic initialization of constructor 4.6 Dynamic constructor 4.7 Destructor	6
6	**Inheritance** 6.1 Introduction 6.2 Defining Base class and Derived class 6.3 Types of Inheritance 6.4 Virtual Base Class 6.5 Abstract class 6.6 Constructors in derived class	6
7	**Polymorphism** 7.1 Compile TimePolymorphism 7.1.1 Introduction, rules for overloading operators 7.1.2 Functionoverloading 7.1.3 Operator Overloading unary and binary 7.1.4 Operator Overloading using friendfunction 7.1.5 Overloading insertion and extractionoperators 7.1.6 String manipulation using operatoroverloading 7.2 RuntimePolymorphism 7.2.1 this Pointer, pointers to objects, pointer to derived classes 7.2.2 Virtual functions and pure virtualfunctions	8
8	**Managing console I/O operations** 8.1 C++ streams and C++ streamclasses 8.2 Unformatted I/O operations 8.3 Formatted console I/Ooperations 8.4 Output formatting usingmanipulators 8.5 User defined manipulators	3
9	**Working with Files** 9.1 Stream Classes for File operations 9.2 File operations - Opening, Closing andupdating 9.3 File updating with random access. 9.4 Error handling during Fileoperations 9.5 Command Line arguments	6
10	**Templates** 10.1 Introduction 10.2 ClassTemplate and class template with multiple parameters 10.3 FunctionTemplate and function template with multiple parameter 10.4 ExceptionHandlingIntroduction	3
	Total	48

Reference Books:

1) Object Oriented programming with C++ by EBalagurusamy
2) Object Oriented Programming with C++ by RobertLafore
3) The Complete Reference C++ by Herbert Schildt
4)

S.Y.B.B.A.(C.A.) Semester-IV

Subject: Operating System

Course Code:CA-403

Objectives:

1. To know the services provided by Operating System
2. To know the scheduling concept
3. To understand design issues related to memory management and various related algorithms.
4. To understand design issues related to File management and various related algorithms

Unit	Topic	No. of Lectures
1	**Introduction to Operating System** 1.1 What is operating system 1.2 Computer system architecture 1.3 Services provided by OS 1.4 Types of OS 1.5 Operating System Structure – - Simple structure -Layered approach -Micro kernels -Modules 1.6 Virtual Machines – Introduction, Benefits	3
2	**System Structure** 2.1 User operating system Interface 2.2 System Calls– -Process or job control -Device Management - File Management 2.3 System Program 2.4 Operating System Structure	3
3	**Process Management** 3.1 Process Concept – - The process - Process states - Process control block 3.2 Process Scheduling – - Scheduling queues - Schedulers -Context Switch 3.3 Operation on Process – - Process Creation -Process Termination 3.4 Interprocess Communication –	4

	- Shared memory system - Message passing systems.	
4	**CPU Scheduling** 4.1 What is scheduling 4.2 Scheduling Concepts – - CPU- I/O Burst Cycle - CPU Scheduler -Preemptive and Non-preemptive scheduling - Dispatcher 4.3 Scheduling criteria 4.4 Scheduling Algorithms – - FCFS - SJF (Preemptive& non-preemptive) - Priority Scheduling (Preemptive& Non- preemptive) - Round Robin Scheduling - Multilevel Queues - Multilevel Feedback queues	6
5	**Process Synchronization** 5.1 Introduction 5.2 Critical section problem 5.3 Semaphores – - Concept - Implementation - Deadlock & Starvation - Types of Semaphores 5.4 Classical Problems of synchronization – -Bounded buffer problem - Readers & writers problem - Dining Philosophers problem	6
6	**Deadlock** 6.1 Introduction 6.2 Deadlock Characterization 6.3 Necessary Condition 6.4 Deadlock Handling Technique– -Deadlock Prevention - Deadlock Avoidance – - Safe State - Resource allocation graph algorithm - Bankers algorithm - Deadlock Detection - Recovery from Deadlock – -Process Termination -Resource Preemption	7

7	**Memory Management** 7.1.Background – -Basic hardware - Address binding - Logical versus physical address space - Dynamic loading - Dynamic linking and shared libraries 7.2 Swapping 7.3 Contiguous Memory Allocation – - Memory mapping and protection -Memory allocation - Fragmentation 7.4 Paging – - Basic Method - Hardware support - Protection - Shared Pages 7.5 Segmentation – - Basic concept - Hardware 7.6 Virtual Memory Management – - Background - Demand paging - Performance of demand paging - Page replacement – - FIFO - OPT - LRU - Second chance page replacement - MFU - LFU	8
8	**File System** 8.1 Introduction & File concepts (file attributes, Operations on files) 8.2 Access methods – - Sequential access - Direct access 8.3 File structure – - Allocation methods - Contiguous allocation - Linked Allocation - Indexed Allocation 8.4 Free Space Management – - Bit Vector - Linked List - Grouping	7

	- Counting	4
9	**I/O System** 9.1 Introduction 9.2 I/O Hardware 9.3 Application of I/O Interface 9.4 Kernel I/O Subsystem 9.5 Disk Scheduling – - FCFS - Shortest Seek time first - SCAN - C- SCAN - C- Look	48
	Total	

Reference Books:

1. Operating System Concepts - Siberchatz, Galvin, Gagne (8th Edition).

2. Operating Systems : Principles and Design – Pabitra Pal Choudhary (PHI Learning Private Limited)

S.Y.B.B.A.(C.A.) Semester – IV

Course Code: CA- 404 (Option)

Course Title : Advance PHP

Objectives -:

1. To know & understand concepts of internet programming.
2. Understand how server-side programming works on the web.
3. Understanding How to use PHP Framework (Joomla / Druple)

Unit No	Topic	No. of Lectures
1	**Introduction to Object Oriented Programming in PHP** 1.1 Classes 1.2 Objects 1.3 Introspection 1.4 Serialization 1.5 Inheritance 1.6 Interfaces 1.7 Encapsulation	6
2	**Web Techniques** 2.1 Server information 2.2 Processing forms 2.3 Sticky forms 2.4 Setting response headers	4
3	**XML** 3.1 Introduction XML 3.2 XML document Structure 3.3 PHP and XML 3.4 XML parser 3.5 The document object model 3.6 The simple XML extension 3.7 Changing a value with simple XML	8
4	**Ajax with PHP** 4.1 Understanding java scripts for AJAX 4.2 AJAX web application model 4.3 AJAX –PHP framework 4.4 Performing AJAX validation 4.5 Handling XML data using php and AJAX 4.6 Connecting database using php and AJAX	6
5	**Introduction to Web Services** 5.1 Definition of web services 5.2 Basic operational model of web services, tools and technologies enabling web services 5.3 Benefits and challenges of using web services. 5.4 Web services Architecture and its characteristics 5.5 Core building blocks of web services 5.6 Standards and technologies available for implementing web services 5.7 Web services communication models 5.8 Basic steps of implementing web services.	10
6	**PHP Framework (Joomla / Druple)** **6.1 Introduction to Joomla/Druple** 6.1.1 Introduction 6.1.2 Joomla/Druple features 6.1.3 How joomla/Drupleworks ? 6.1.4 The platformComponents, Modules and Plugins **6.2 Administering Joomla/Druple** 6.2.1 Presentation Administration 6.2.2 Content Administration 6.2.3 System Administration **6.3 Working with Joomla/Druple** 6.3.1 Adding articles 6.3.2 Adding menus to point to content 6.3.3 Installing new templates 6.3.4 Creating templates 6.3.5 Adding a Module and Component 6.3.6 Modifying the existing templates 6.3.7 Creating templates with web editors 6.3.8 Creating real templates	14

Reference Books

- Php: A Beginner's Guide 1st EditionMcGraw-Hill Osborne Media; 1 edition by VikramVaswani
- Murach's PHP and MySQL (2nd Edition)by Joel Murach and Ray Harris
- PHP: The Complete Reference Paperback – 1 Jul 2017by Steven Holzner (Author)
- Building Web Services with Java, 2nd Edition, S. Graham and others, Pearson Edn., 2008.
- Java Web Services, D.A. Chappell & T. Jewell, O'Reilly,SPD.
- www.php.net.in
- www.W3schools.com

S.Y.B.B.A.(C.A.) Semester – IV

Course Code: CA- 404(Option)

Course Title : Node - JS

Objectives:

1. Understand the JavaScript and technical concepts behind Node JS
2. Structure a Node application in modules
3. Understand and use the Event Emitter
4. Understand Buffers, Streams, and Pipes
5. Build a Web Server in Node and understand how it really works
6. Connect to a SQL or Mongo database in Node

Pre-requisite / Target Audience:

1) Basic Knowledge of JavaScript and OOPS
2) Knowledge in async programming will be added advantage

Unit	Topics	No. of Lectures
1	**Introduction to Node JS** 1.1 Introduction 1.2 What is Node JS? 1.3 Advantages of Node JS 1.4 Traditional Web Server Model 1.5 Node.js Process Model 1.6 Install Node.js on Windows 1.7 Working in REPL	8
2	**Node JS Modules** 2.1Functions 2.2 Buffer 2.3 Module 2.4 Module Types 2.5 Core Modules 2.6 Local Modules 2.7 Module.Exports	10
3	**Node Package Manager** 3.1 What is NPM ? 3.2 Installing Packages Locally 3.3 Adding dependency in package.json 3.4 Installing packages globally 3.5 Updating packages	6
4	**Web server** 4.1 Creating web server 4.2 Handling http requests 4.3 Sending requests	6
5	**File System** 5.1 Fs.readFile 5.2 Writing a File 5.3 Writing a file asynchronously 5.4 Opening a file 5.5 Deleting a file 5.6 Other IO Operations	8
6	**Events** 6.1 EventEmitter class 6.2 Returning event emitter 6.3 Inhering events	4
7	**Database connectivity** 7.1 Connection string 7.2 Configuring 7.3 Working with select command 7.4 Updating records 7.5 Deleting records	6
	Total	48

Reference Books:

1) Node.js complete reference guid , velentinBojinov, David Herron, DiogeResende, packt Publishing ltd
2) Mastering Nod.js By SandroPasquali , packt Publishing
3) Smashing Node.js Javascript Everywhere , Guillermo Rauch, John wiley& Sons

Acknowledgement

The Syllabus Restructuring of BBA (CA) Programme (CBCS-2019 Pattern) is a manifestation of excellence in the faculty of Commerce and Management. Savitribai Phule Pune University's focus has always been in raising the academic standards and excellence in the field of education.

The BBA (CA) Programme predominantly endeavours for holistic development of students. It has emphasized on cultivating various skills and has also desired software technology acumen amongst the students.

This revision has been possible only with the help and support of different eminent personalities. The contribution of all the members as a team has enabled the robust revision of all the titles of the Programme. This synergy of the contributors is very crucial in fine tuning of the BBA(CA) Programme in its present form.

SPPU is grateful to Hon. Prof. Dr. Nitin Karmalkar, Vice Chancellor, Hon. Dr. N. S. Umarani, Pro-Vice Chancellor, who has always lent continuous support and encouraged everyone involved in this task of restructuring.

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Savitribai Phule Pune University
T.Y.B.B.A (C.A.) Semester –V
Course Code: CA-501
Subject Name: Cyber Security

Total Hours : 48 lectures **Total Credits: 03**

Prerequisites: -

- A course on Computer Networks.

Course Objectives:

- To understand the fundamentals of cyber security.
- To understand various categories of Cybercrime, Cyber-attacks on mobile, tools and techniques used in Cybercrime and case studies.
- To have an overview of the Cyber laws and concepts of Cyber forensics.

Course Outcome:-

- Have a good understanding of Cyber Security and the Tools.
- Identify the different types of Cyber Crimes.
- Have a good understanding of Cyber laws
- To develop Cyber forensics awareness.
- Identify attacks, security policies and credit card frauds in mobile and Wireless Computing Era.

Unit	Topic	No of lectures
1	**Chapter 1:- Introduction to Cyber Crime and Cyber Security** 1.1 Introduction 1.2 Cybercrime: Definition and Origin of the Word 1.3 Cybercrime and Information Security 1.4 Who are Cybercriminals? 1.5 Classifications of Cybercrimes: E-Mail Spoofing, Spamming, Cyber defamation, Internet Time Theft, Salami Attack/Salami Technique, Data Diddling,Forgery, Web Jacking, Newsgroup, Spam/Crimes Emanating from Usenet Newsgroup, Industrial Spying/Industrial Espionage, Hacking,OnlineFrauds,Computer Sabotage, Email Bombing/Mail Bombs, Computer Network Intrusions, Password Sniffing, Credit Card Frauds, Identity Theft 1.6 Definition of Cyber Security 1.7 Vulnerability, Threats and Harmful acts 1.8 CIA Triad 1.9 Cyber Security Policy and Domains of Cyber Security Policy	07
2	**Chapter 2 :- Cyber offenses and Cyberstalking** 2.1 Criminals Plan: Categories of Cybercrime Cyber Attacks: Reconnaissance, Passive Attack, Active Attacks, Scanning/Scrutinizing gathered Information, Attack (Gaining and Maintaining the System Access), Social Engineering, and Classification of Social Engineering. 2.2 Cyberstalking: Types of Stalkers, Cases Reported on Cyberstalking, Working of Stalking 2.3 Real-Life Incident of Cyber stalking 2.4 Cybercafe and Cybercrimes	10

	2.5 Botnets: The Fuel for Cybercrime, Botnet, Attack Vector 2.6 Cybercrime: Mobile and Wireless Devices – Proliferation - Trends in Mobility 2.7 Credit Card Frauds in Mobile and Wireless Computing Era 2.8 Security Challenges Posed by Mobile Devices 2.9 Authentication Service Security 2.10 Attacks on Mobile/Cell Phones	
3	**Chapter 3:- Tools and Methods Used in Cybercrime** 3.1 Introduction 3.2 Proxy Servers and Anonymizers 3.3 Phishing 3.4 Password Cracking 3.5 Keyloggers and Spywares 3.6 Virus and Worms 3.7 Trojan Horses and Backdoors 3.8 Steganography 3.9 DoS and DDoS Attacks 3.10 SQL Injection	05
4	**Chapter 4 :- Cybercrimes and Cyber security: The Legal Perspectives** 4.1 Introduction 4.2 Cybercrime and the Legal Landscape around the World 4.3 Why Do We Need Cyberlaws: The Indian Context 4.4 The Indian IT Act 4.5 Challenges to Indian Law and Cybercrime Scenario in India 4.6 Consequences of not Addressing the Weakness in Information Technology Act 4.7 Digital Signatures and the Indian IT Act 4.8 Amendments to the Indian IT Act 4.9 Cybercrime and Punishment 4.10 Cyberlaw, Technology and Students: Indian Scenario	07
5	**Chapter 5:- Cyber Forensics** 5.1 Introduction 5.2 Historical background of Cyber forensics 5.3 Digital Forensics Science 5.4 The Need for Computer Forensics 5.5 Cyber Forensics and Digital evidence 5.6 Forensics Analysis of Email 5.7 Digital Forensics Lifecycle 5.8 Challenges in Computer Forensics	06
6	**Chapter 6:- Cybersecurity: Organizational Implications** 6.1 Organizational Implications: Cost of cybercrimes and IPR issues 6.2 Web threats for organizations 6.3 Security and Privacy Implications from Cloud Computing 6.4 Social media marketing 6.5 Social computing and the associated challenges for organizations, Protecting people's privacy in the organization 6.6 Organizational guidelines for Internet usage and safe computing guidelines and computer usage policy 6.7 Incident handling	07

Savitribai Phule Pune University
T.Y.B.B.A.(C.A.) Semester –V
Course Code: CA-502
Subject: Object Oriented Software Engineering

Total Hours: 48 **Total Credits: 03**

Pre Requisite: Students shall have the Basic Knowledge of Software Engineering

OBJECTIVES:

1. To understand the fundamentals of object modeling
2. To understand and differentiate Unified Process from other approaches.
3. To design with static UML diagrams.
4. To design with the UML dynamic and implementation diagrams.
5. To improve the software design with design patterns.
6. To test the software against its requirements specification.

Outcomes:

1. Students will be able to give Design Specifications for Project.
2. Students will acquire Knowledge in Basic Modeling.
3. Students will acquire Project Management Skills.

Chapter	Course Content	No of lectures
1	**Introduction and basics of Software Modelling** 1.1 Software Life Cycle Models (Revision of SE) 1.2 System Concepts 1.3 Project Organization 1.4 Communication in Project Management 1.5 Risk management in Project Management	4
2	**SRS Documentation** 2.1 SRS Specification 2.2 Requirement Elicitation 2.3 Business Engineering	4
3	**Introduction to UML** 3.1 Concept of UML 3.2 Advantages of UML	2
4	**Object Oriented Concepts and Principles** 4.1 What is Object Orientation? - Introduction , Object , Classes and Instance , Polymorphism, Inheritance 4.2 Object Oriented System Development- Introduction, Function/Data Methods (With Visibility), Object Oriented Analysis, Object Oriented Construction 4.3 Identifying the Elements of an Object Model 4.4 Identifying Classes and Objects 4.5 Specifying the Attributes (With Visibility)	4

	4.6 Defining Operations 4.7 Finalizing the Object Definition	
5	**Structural Modeling** 5.1 Classes 5.2 Relationship 5.3 Common Mechanism 5.4 Class Diagram (Minimum three examples should be covered) 5.5 Advanced Classes 5.6 Advanced Relationship 5.7 Interface 5.8 Types and Roles 5.9 Packages 5.10 Object Diagram (Minimum three examples should be covered)	10
6	**Basic Behavioural Modeling** 6.1 Interactions 6.2 Use Cases and Use Case Diagram with stereo types (Minimum three examples should be covered) 6.3 Interaction Diagram (Minimum two examples should be covered) 6.4 Sequence Diagram (Minimum two examples should be covered) 6.5 Activity Diagram (Minimum two examples should be covered) 6.6 State Chart Diagram (Minimum two examples should be covered)	10
7	**Architectural Modelling** 7.1 Component 7.2 Components Diagram (Minimum two examples should be covered) 7.3 Deployment Diagram (Minimum two examples should be covered) 7.4 Collaboration Diagram (Minimum two examples should be covered)	6
8	**Object Oriented Analysis** 8.1 Iterative Development and the Rational Unified Process 8.2 Inception 8.3 Understanding Requirements 8.4 Use Case Model From Inception to Elaboration 8.5 Elaboration	4
9	**Object Oriented Design** 9.1 The Booch Method, The Coad and Yourdon Method and Jacobson Method and Raumbaugh Method 9.2 The Generic Components of the OO Design Model	4

Savitribai Phule Pune University
T.Y.B.B.A.(C.A.) Semester –V
Course Code: CA-503
Subject: Core Java

Total Credits: 03

Total Hours : 48

Prerequisite:

- Student should know basics of object oriented programming.

Course Objectives:

- To introduce the object oriented programming concepts.
- To understand object oriented programming concepts, and apply them in solving problems.
- To introduce the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes
- To introduce the implementation of packages and interfaces
- To introduce the concepts of exception handling and multithreading.
- To introduce the design of Graphical User Interface using applets and swing controls.

Course Outcomes:

- Able to solve real world problems using OOP techniques.
- Able to understand the use of abstract classes.
- Able to solve problems using java collection framework and I/o classes.
- Able to develop multithreaded applications with synchronization.
- Able to develop applets for web applications.
- Able to design GUI based applications

Unit No.	Topic	No. of Lectures	Reference Books
1	**Java Fundamentals** 1.1 Introduction to Java. 1.1 Features of Java 1.2 Basics of Java: - Data types, variable, expression, operators, constant. 1.3 Structure of Java Program. 1.4 Execution Process of java Program. 1.5 JDK Tools. 1.6 Command Line Arguments. 1.7 Array and String: 1.7.1 Single Array & Multidimensional Array 1.7.2 String, String Buffer 1.8 Built In Packages and Classes : 1.8.1 java.util:- Scanner, Date, Math etc. 1.8.2 java.lang	8	1,2
2	**Classes, Objects and Methods** 2.1 Class and Object 2.2 Object reference 2.3 Constructor: Constructor Overloading 2.4 Method: Method Overloading, Recursion, Passing and Returning object form Method 2.5 new operator, this and static keyword, finalize() method 2.6 Nested class, Inner class, and Anonymous inner class	8	1,2

3	**Inheritance, Package and Collection** 3.1 Overview of Inheritance 3.2 inheritance in constructor 3.3 Inheriting Data members and Methods, 3.4 Multilevel Inheritance – method overriding Handle multilevel constructors 3.5 Use of super and final keyword 3.6 Interface: 3.7 Creation and Implementation of an interface, Interface reference 3.8 Interface inheritance 3.9 Dynamic method dispatch 3.10 Abstract class 3.11 Comparison between Abstract Class and interface **3.12** Access control **3.13 Packages** 3.13.1 Packages Concept 3.13.2 Creating user defined packages 3.13.3 Java Built inpackages 3.13.4 Import statement, Static import 3.14 ***Collection*** 3.14.1 CollectionFramework. 3.14.2 Interfaces: Collection, List, Set 3.14.3 Navigation: Enumeration, Iterator, ListIterator 3.14.4 Classes: LinkedList, ArrayList, Vector, HashSet	10	
4	**File and Exception Handling** **Exception** 4.1 Exception and Error 4.2 Use of try, catch, throw, throws and finally 4.3 Built in Exception 4.4 Custom exception 4.5 Throwable Class. **File Handling** 4.6 Overview of Different Stream (Byte Stream, Character stream) 4.7 Readers and Writers class 4.8 File Class 4.9 File Input Stream , File Output Stream 4.10 Input Stream Reader and Output Stream Writer class 4.11 FileReader and FileWriter class 4.12 Buffered Reader class.	8	1,2,3
5	**Applet, AWT, Event and Swing Programming** **Applet** 5.1 Introduction 5.2 Typesapplet 5.3 Applet Lifecycle 5.3.1 Creatingapplet 5.3.2 Applet tag	14	1,2,3,4

Subject Code: 504
Subject: Python
Total Credits: 03

Total Hours :- 48

Prerequisites:

1. Experience with a high level language (C/C++, Java, MATLAB) is suggested.
2. Prior knowledge of a scriptinglanguage (Perl, UNIX/Linux shells) and Object-Oriented concepts is helpful but not mandatory.

Course Objectives:

1. To learn and understand Python programming basics and paradigm.
2. To learn and understand python looping, control statements and string manipulations.
3. Students should be made familiar with the concepts of GUI controls and designing GUI applications.
4. To learn and know the concepts of file handling, exception handling.

Course Outcomes: On completion of the course, student will be able

1. Define and demonstrate the use of built-in data structures "lists" and "dictionary".
2. Design and implement a program to solve a real world problem.
3. Design and implement GUI application and how to handle exceptions and files.

Unit	Details	Lectures
I	**Unit 1: Introduction to Python** 1.1 History, feature of Python, setting up path, working with python Interpreter, basic syntax, variable and data types, operators 1.2 **Conditional statements**-If, If-Else, nested if-else, Examples. 1.3 **Looping**-For,While,Nested loops, Examples 1.4 **Control Statements**-Break, Continue, Pass. 1.5 **String Manipulation**-Accessing String, Basic Operations, String Slices, Function and Methods, Examples. 1.6 **Lists**-Introduction, accessing list, operations, working with lists, function & methods. 1.7 **Tuple**-Introduction, Accessing tuples, operations working, function & methods, Examples. 1.8 **Dictionaries**-Introduction, Accessing values in dictionaries, working with dictionaries, properties, function, Examples. 1.9 **Functions**-Defining a function, calling a function, types of function, function arguments, anonymous function, global & local variable, Examples.	16
II	**Unit 2: Modules and Packages** **2.1Built in Modules** 2.1.1 Importing modules in python program 2.1.2 Working with Random Modules. 2.1.3 E.g. - built-ins, time, date time, calendar, sys, etc **2.2 User Defined functions** 2.2.1Structure of Python Modules **2.3 Packages** 2.3.1 Predefined Packages 2.3.2User defined Packages	6
III	**Unit 3: Classes ,Objects and Inheritance** **3.1 Classes and Objects** 3.1.1 Classes as User Defined Data Type 3.1.2 Objects as Instances of Classes 3.1.3 Creating Class and Objects 3.1.4 Creating Objects By Passing Values 3.1.5 Variables & Methods in a Class **3.2 Inheritance** 3.2.1 Single Inheritance 3.2.2 Multilevel Inheritance	8

3	**Inheritance, Package and Collection** 3.1 Overview of Inheritance 3.2 inheritance in constructor 3.3 Inheriting Data members and Methods, 3.4 Multilevel Inheritance – method overriding Handle multilevel constructors 3.5 Use of super and final keyword 3.6 Interface: 3.7 Creation and Implementation of an interface, Interface reference 3.8 Interface inheritance 3.9 Dynamic method dispatch 3.10 Abstract class 3.11 Comparison between Abstract Class and interface **3.12** Access control **3.13 Packages** 3.13.1 Packages Concept 3.13.2 Creating user defined packages 3.13.3 Java Built inpackages 3.13.4 Import statement, Static import 3.14 ***Collection*** 3.14.1 CollectionFramework. 3.14.2 Interfaces: Collection, List, Set 3.14.3 Navigation: Enumeration, Iterator, ListIterator 3.14.4 Classes: LinkedList, ArrayList, Vector, HashSet	10	
4	**File and Exception Handling** **Exception** 4.1 Exception and Error 4.2 Use of try, catch, throw, throws and finally 4.3 Built in Exception 4.4 Custom exception 4.5 Throwable Class. **File Handling** 4.6 Overview of Different Stream (Byte Stream, Character stream) 4.7 Readers and Writers class 4.8 File Class 4.9 File Input Stream , File Output Stream 4.10 Input Stream Reader and Output Stream Writer class 4.11 FileReader and FileWriter class 4.12 Buffered Reader class.	8	1,2,3
5	**Applet, AWT, Event and Swing Programming** **Applet** 5.1 Introduction 5.2 Typesapplet 5.3 Applet Lifecycle 5.3.1 Creatingapplet 5.3.2 Applet tag	14	1,2,3,4

Subject Code: 504
Subject: Python
Total Credits: 03

Total Hours :- 48

Prerequisites:

1. Experience with a high level language (C/C++, Java, MATLAB) is suggested.
2. Prior knowledge of a scriptinglanguage (Perl, UNIX/Linux shells) and Object-Oriented concepts is helpful but not mandatory.

Course Objectives:

1. To learn and understand Python programming basics and paradigm.
2. To learn and understand python looping, control statements and string manipulations.
3. Students should be made familiar with the concepts of GUI controls and designing GUI applications.
4. To learn and know the concepts of file handling, exception handling.

Course Outcomes: On completion of the course, student will be able

1. Define and demonstrate the use of built-in data structures "lists" and "dictionary".
2. Design and implement a program to solve a real world problem.
3. Design and implement GUI application and how to handle exceptions and files.

Unit	Details	Lectures
I	**Unit 1: Introduction to Python** 1.1 History, feature of Python, setting up path, working with python Interpreter, basic syntax, variable and data types, operators 1.2 **Conditional statements**-If, If-Else, nested if-else, Examples. 1.3 **Looping**-For,While,Nested loops, Examples 1.4 **Control Statements**-Break, Continue, Pass. 1.5 **String Manipulation**-Accessing String, Basic Operations, String Slices, Function and Methods, Examples. 1.6 **Lists**-Introduction, accessing list, operations, working with lists, function & methods. 1.7 **Tuple**-Introduction, Accessing tuples, operations working, function & methods, Examples. 1.8 **Dictionaries**-Introduction, Accessing values in dictionaries, working with dictionaries, properties, function, Examples. 1.9 **Functions**-Defining a function, calling a function, types of function, function arguments, anonymous function, global & local variable, Examples.	16
II	**Unit 2: Modules and Packages** **2.1Built in Modules** 2.1.1 Importing modules in python program 2.1.2 Working with Random Modules. 2.1.3 E.g. - built-ins, time, date time, calendar, sys, etc **2.2 User Defined functions** 2.2.1Structure of Python Modules **2.3 Packages** 2.3.1 Predefined Packages 2.3.2User defined Packages	6
III	**Unit 3: Classes ,Objects and Inheritance** **3.1 Classes and Objects** 3.1.1 Classes as User Defined Data Type 3.1.2 Objects as Instances of Classes 3.1.3 Creating Class and Objects 3.1.4 Creating Objects By Passing Values 3.1.5 Variables & Methods in a Class **3.2 Inheritance** 3.2.1 Single Inheritance 3.2.2 Multilevel Inheritance	8

	3.2.3 Multiple Inheritance 3.2.4 Hybrid Inheritance 3.2.5 Hierarchical Inheritance 3.2.6 IS-A Relationship and HAS-A Relationship	
IV	**Unit 4: Exception Handling** 4.1 Python Exception 4.2 Common Exception 4.3 Exception handling in Python (try-except-else) 4.4 The except statement with no exception 4.5 Multiple Exception 4.6 The try-finally clause 4.7 Custom Exception and assert statement	4
V	**Unit 5: GUI Programming** 5.1 Introduction 5.2 Tkinter programming 5.4 Tkinter widgets 5.5 Frame 5.6 Button 5.7 Label 5.8 Entry	10
VI	**Unit 6: Python Libraries** 6.1 Statistical Analysis- NumPy, SciPy, Pandas, StatsModels 6.2 Data Visualization- Matplotlib, Seaborn, Plotly 6.3 Data Modelling and Machine Learning- Scikit-learn, XGBoost, Eli5 6.4 Deep Learning- TensorFlow, Pytorch, Keras 6.5 Natural Language Processing (NLP)- NLTK, SpaCy, Gensim	4

Reference Books:

1.Mark Lutz, Programming Python, O`Reilly, 4th Edition, 2010
2.Dive into Python, Mike
3. Learning Python, 4th Edition by Mark Lutz
4. Programming Python, 4th Edition by Mark Lutz
5.Python Programming:An introduction to computer,John Zelle,3rd Edition.

TYBBA (CA) Sem VI Syllabus

Savitribai Phule Pune University
T.Y.B.B.A.(C.A.) Sem-VI (CBCS 2019 Pattern)

Subject Code: CA-601

Subject: Recent Trends in IT

Total Credits: 3+1=4

Total Hours: 48

Prerequisites:

1. Basic knowledge of related programming and database concepts.

2. Fundamentals of Mathematical logic & Data structures.

Course Objectives

1. To introduce upcoming trends in Information technology.
2. To study Eco friendly software development concepts.
3. To provide a strong foundation of fundamental concepts in Artificial Intelligence.
4. To evaluate the performance of various data mining task.
5. To understand Data analytics using Spark Programming.

Course Outcomes: On completion of the course, student will be able

1. To discuss the basic concepts AI.
2. To apply basic, intermediate and advanced techniques to mine the data.
3. To provide an overview of the concept of Spark programming.

Unit No.	Contents	No. of Lectures
1	**Introduction to recent trends** 1.1 Artificial Intelligence 1.2 Data Warehouse 1.3 Data Mining 1.4 Spark	02
2	**Artificial Intelligence** 2.1 Introduction& Concept of AI 2.2 Applications of AI 2.3 Artificial Intelligence, Intelligent Systems, Knowledge –based Systems, AI Techniques 2.4 Early work in AI & related fields. 2.5 Defining AI problems as a State Space Search 2.6 Search and Control Strategies 2.7 Problem Characteristics 2.8 AI Problem: Water Jug Problem, Tower of Hanoi, Missionaries & Cannibal Problem	08
3	**AI Search Techniques** 3.1 Blind Search Techniques: BFS, DFS, DLS, Iterative deepening Search, Bidirectional Search, and Uniform cost Search 3.2 Heuristic search techniques: Generate and test, Hill Climbing, Best First search, Constraint Satisfaction, Mean-End Analysis, A*, AO*	08
4	**Data Warehousing** 4.1 Introduction to Data warehouse 4.2 Structure of Data Warehouse 4.3 Advantages & uses of Data Warehouse 4.4 Architecture of Data Warehouse 4.5 Multidimensional data model 4.6 OLAP Vs. OLTP 4.7 OLAP Operations 4.8 Types of OLAP Servers: ROLAP versus MOLAP versus HOLAP	08
5	**Data Mining** 5.1 Introduction to Data Mining 5.2 Data mining Task 5.3 Data mining issues 5.4 Data Mining versus Knowledge Discovery in Databases 5.5 Data Mining Verification vs. Discovery 5.6 Data Pre-processing – Need, Data Cleaning, Data Integration & Transformation, Data Reduction 5.7 Accuracy Measures: Precision, recall, F-measure, confusion matrix, cross-validation, bootstrap 5.8 Data Mining Techniques 5.9 Frequent item-sets and Association rule mining: Apriori algorithm, FP tree algorithm 5.10 Graph Mining: Frequent sub-graph mining 5.11 Software for data mining : R, Weka, Sample applications of data mining 5.12 Introduction to Text Mining, Web Mining, Spatial Mining, Temporal Mining	12
6	**Spark** 6.1 Introduction to Apache Spark 6.2 Spark Installation 6.3 Apache Spark Architecture 6.4 Components of Spark 6.5 Spark RDDs 6.6 RDD Operations: Transformation & Actions 6.7 Spark SQL and Data Frames 6.8 Introduction to Kafka for Spark Streaming	10
	Total	48

Reference Books:

1. Artificial Intelligence by Elaine Rich, Kevin Knight - Tata McGraw Hill, 2nd Edition
2. Artificial Intelligence: A new Synthesis, Nilsson, Elsevier,ISBN 9788181471901
3. Data Mining Concepts and Techniques, by Jiawei Micheline Kamber, Morgan Kauf Mann Publishers.
4. Advanced Analytics with Spark by Sandy RyzaPublicatio O'REILLY
5. Apache Spark for Data Science Cookbook by Padma Priya Chitturi

Savitribai Phule Pune University

T.Y.B.B.A.(C.A.) Sem-VI (CBCS 2019 Pattern)
Subject Code: CA-602
Subject: Software Testing
Total Credits: 3

Total Hours: 48

Prerequisite:

1. Students shall have basic Knowledge of Software Engineering.
2. Students shall have basic Knowledge of OOSE.

Objectives:

1. To provide learner with knowledge in Software Testing techniques.
2. To understand how testing methods can be used as an effective tool in providing quality assurance for software.
3. To provide skills to design test case plan for testing software.

Outcomes:

1. Students will be introduced to testing tools.
2. Students will acquire Knowledge of Basic SQA.
3. Students will be able to design basic Test Cases.

Chapter	Course Content	No of lectures
1	**Introduction** 1.1 Introduction, Nature of errors, 1.2 Testing Objectives 1.3 Testing principles 1.4 Testing fundamentals, 1.5 Software reviews, Formal Technical reviews, 1.6 Inspection and walkthrough 1.7 Testing Life Cycle	10
2	**Approaches to Testing –Testing Methods** 2.1 White Box Testing and types of white box testing 2.2 Test Case Design 2.3 Black Box Testing and types of black box testing 2.4 Gray Box Testing	5
3	**Software Testing Strategies &Software metrics** 3.1 Software Testing Process 3.2 Unit Testing 3.3 Integration- Top-down ,Bottom up 3.4 System Testing 3.5 Acceptance Testing (alpha, Beta testing) 3.6 Validation and Verification 3.7 Big Bang Approach 3.8 Sandwich approach 3.9 Performance Testing 3.10 Regression Testing 3.11 Smoke Testing 3.13 Load Testing	10

4	**Software metrics** 4.1 Introduction 4.2 Basic Metrics –size-oriented metric, Function –oriented metric 4.3 Cyclometic Complexity Metrics Examples on Cyclometic Complexity	10
5	**Testing for Specialized Environments** 5.1 Testing GUI's 5.2 Testing of Client/Server Architectures 5.3 Testing Documentation and Help Facilities 5.4 Testing for Real-Time Systems	5
6	**Testing Tools& Software Quality Assurance (Introduction)** 6.1 JUnit, Apache JMeter, Win runner 6.2 Load runner, Rational Robot 6.3 Quality Concepts, Quality Movement, Background Issues, SQA activities 6.4 Formal approaches to SQA 6.5 Statistical Quality Assurance 6.6 Software Reliability 6.7 The ISO 9000 Quality Standards 6.8 SQA Plan 6.9 Six sigma 6.10 Informal Reviews	8
	Total	**48**

Reference Books:

Sr. No.	Title of the Book	Author's Name	Publication
1.	**Software Engineering – A Practitioner's approach**	**Roger S Pressman**	**7th Edition Tata McGraw-Hill**
2.	Effective Methods of Software Testing.	**William E Perry**	Wiley Publishing Inc
3.	**Software Testing Principles and Practices**	**Srinivasan Desikan, Gopalswamy Ramesh**	**Pearson Publication**
4.	**Total Quality Management**	**DaleH. Besterfield,**	**Prentice Hall, 2003**

T.Y.B.B.A.(C.A.) Sem-VI (CBCS 2019 Pattern)

Subject Code: CA-603

Subject: Advanced Java

Total Hours: 48 **Total Credits: 3**

Prerequisite: Students should know basic programming concepts.

1. To know the concept of Java Programming.
2. To understand how to use programming in day to day applications.

Outcomes:

3. To develop programming logic.

1. Students will know the concepts of JDBC Programming.
2. Students will know the concepts of Multithreading and Socket Programming.
3. Students will know the concepts of Spring and Hibernate.
4. Students will develop the project by using JSP and JDBC.
5. Students will develop applications in Spring and hibernate.

Sr. No	Topic	Number Of Lectures
1.	**JDBC** 1.1 Introduction 1.2 JDBC Architecture. 1.3 JDBC Process **1.4 Working with ResultSet Interface.**	**8**
2	**Multithreading:** 2.1 Introduction to Multithreading. 2.2 Thread creation: Thread Class, Runnable Interface. 2.3 Life cycle of Thread. 2.4 Thread Priority. 2.5 Execution of Thread Application. 2.6 Synchronization and Interthread communication.	**12**
3	**Networking:** 3.1 Overview of Networking. 3.2 Networking Basics: Port Number, Protocols and classes. 3.3 Sockets, Reading from and Writing to a Socket.	**5**

4	**Servlet and JSP** 4.1 Introduction to Servlet 4.2 Types of Servlet: Generic Servlet and Http Servlet 4.3 Life cycle of servlet 4.4 Session Tracking. 4.5 Servlet with database. **JSP** 4.6 Introduction to JSP. 4.7 JSP Life Cycle. 4.8 Components of JSP. 4.9 JSP with Database.	12
5	**Spring & Hibernate** **Spring:** 5.1 Introduction 5.2 Applications and Benefits of spring 5.3 Architecture and Environment Setup 5.4 Hello World Example 5.5 Core Spring- IoC Containers, Spring Bean Definition, Scope, Lifecycle **Hibernate** 5.6 Architecture and Environment 5.7 Configuration, Sessions, Persistent Class 5.8 Mapping Files, Mapping Types 5.9 Examples	11

T.Y.B.B.A.(C.A.) Sem-VI (CBCS 2019'Pattern)
Subject Code: CA-604
Subject: Android Programming
Total Credits: 3

Total Hours: 48
Pre-requisite:

1. Concepts of OOP's.
2. Basic Knowledge About JAVA Programming

Objective:

1. To understand the Android Operating System and develop applications using Google's Android open-source platform.
2. To understand the issues relating to Wireless applications.

Outcome:

1. Student will be able to write simple GUI applications, use built-in widgets and components, work with the database to store data locally, and much more.
2. Demonstrate their understanding of the fundamentals of Android operating systems
   Demonstrate their skills of using Android software development tools

Unit	Topic	No. of lectures
1	**INTRODUCTION TO Android Programming** 1.1 What is Android? 1.2 History and Versions 1.3 Android Architecture 1.4 Basic Building Blocks 1.5 Android API Levels 1.6 Application Structure 1.7 First Hello World Program	04
2	**ACTIVITY, INTENT AND LAYOUT** 2.1 Introduction to Activity 2.2 Activity life cycle 2.3 Introduction to Intent 2.4 Types of Intent(Implicit and Explicit Intent) 2.5 Layout Manager 2.5.1 View and View Group 2.5.2 Linear Layout 2.5.3 Relative Layout 2.5.4 Table Layout 2.5.5 Grid Layout 2.5.6 Constraint Layout 2.5.7 Frame Layout 2.5.8 Scroll Layout	07

3	**BASIC UI DESIGN** 3.1 Button(Push Button, Check Box, Radio Button, Toggle Button, Image Button) 3.2 Text Fields 3.3 Spinner 3.4 List View 3.5 Toast 3.6 Scroll View 3.6 ProgressBar View 3.7 Auto Complete Text View 3.8 Dialog Box 3.8.1 Alert Dialog. 3.8.2 DatePicker Dialog. 3.8.3 TimePicker Dialog. 3.8.4 Custom Dialog.	**10**
4	**ADAPTER AND MENU** 4.1 Base Adapter 4.2 Array Adapter 4.3 ListView using Adapter 4.4GridView using Adapter 4.5Photo Gallery using Adapter	**05**
	4.6 Using Menu with Views 4.6.1 Option Menu 4.5.2 Context Menu 4.5.3 Popup Menu	
5	**THREADS AND NOTIFICATION** 5.1 Worker thread 5.2 Handlers & Runnable 5.3 AsynTask (in detail) 5.4 Broadcast Receiver 5.5 Services 5.5.1Service life Cycle 5.5.2 Bounded Service 5.5.2 Unbounded Service 5.6 Notification 5.7 Alarm 5.8 Accessing Phone services(Call,SMS)	**06**
6	**CONTENT PROVIDER** 6.1 Content Providers 6.2 SQLite Programming 6.3 SQLiteOpenHelper 6.4 SQLiteDatabse 6.5 Cursor 6.6 Searching for content 6.7 Adding, changing, and removing content 6.8 Building and executing queries 6.9 Android JSON	**08**

K. J. Somaiya College, Kopargaon.
Department of Physics
List of Courses addresses crosscutting issues as per **New syllabus (CBCS- 2019 Pattern)**

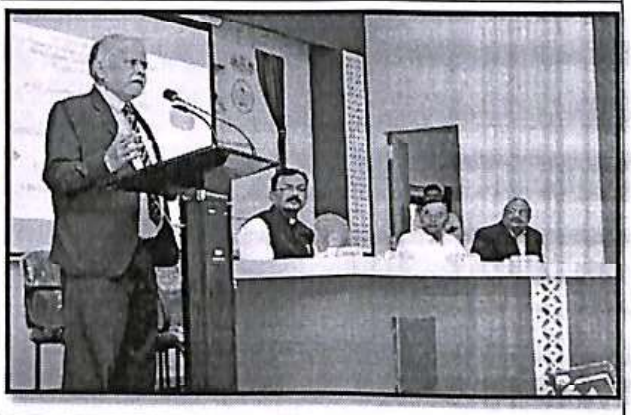
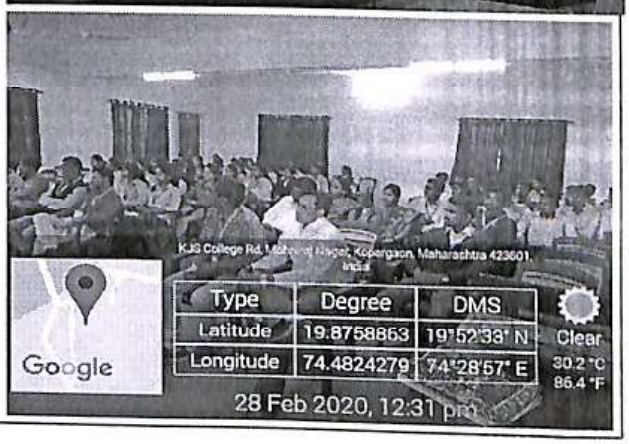
Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Environment and Sustainability)
1	B. Sc. Physics	PHY-111	Mechanics and Properties of Matter	Professional Ethics
2	B. Sc. Physics	PHY-112	Physics Principles and Applications	Professional Ethics
3	B. Sc. Physics	PHY-113	Physics Laboratory-1A	Professional Ethics
4	B. Sc. Physics	PHY-121	Heat and Thermodynamics	Professional Ethics
5	B. Sc. Physics	PHY-122	Electricity and Magnetism	Professional Ethics
6	B. Sc. Physics	PHY-123	Physics Laboratory-1B	Professional Ethics
7	B. Sc. Physics	PHY-231	Mathematical Methods in Physics-I	Professional Ethics
8	B. Sc. Physics	PHY-232	Electronics-I	Professional & Industrial Ethics
9	B. Sc. Physics	PHY-233	Physics Laboratory-2A	Professional Ethics
10	B. Sc. Physics	PHY-2310	Environment -I	Environment and Sustainability
11	B. Sc. Physics	PHY-241	Oscillations, Waves and Sound	Professional Ethics
12	B. Sc. Physics	PHY-242	Optics	Professional Ethics
13	B. Sc. Physics	PHY-243	Physics Laboratory-2B	Professional Ethics
14	B. Sc. Physics	PHY-2410	Environment -II	Environment and Sustainability
15	B. Sc. Physics	PHY-351	Mathematical Methods in Physics-II	Professional Ethics
16	B. Sc. Physics	PHY-352	Electrodynamics	Professional Ethics
17	B. Sc. Physics	PHY-353	Classical Mechanics	Professional Ethics
18	B. Sc. Physics	PHY-354	Atomic and Molecular Physics	Professional Ethics
19	B. Sc. Physics	PHY-355	Computational Physics	Professional Ethics
20	B. Sc. Physics	PHY-366(R)	Renewable Energy Sources-I	Environment and Sustainability
21	B. Sc. Physics	PHY-367	Physics Laboratory-3A	Professional Ethics
22	B. Sc. Physics	PHY-368	Physics Laboratory-3B	Professional & Industrial Ethics
23	B. Sc. Physics	PHY-369	Project-I	Professional & Industrial Ethics
24	B. Sc. Physics	PHY-3610(V)	Sensors and Transducer	Professional & Industrial Ethics
25	B. Sc. Physics	PHY-3611(AA)	Physics Workshop Skill	Professional & Industrial Ethics
26	B. Sc. Physics	PHY-361	Solid State Physics	Professional Ethics
27	B. Sc. Physics	PHY-362	Quantum Mechanics	Professional Ethics
28	B. Sc. Physics	PHY-363	Thermodynamics and Statistical Physics	Professional Ethics

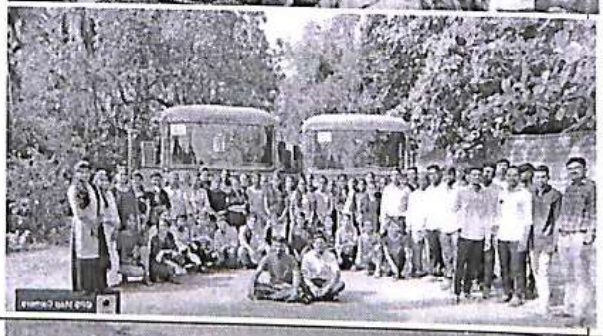
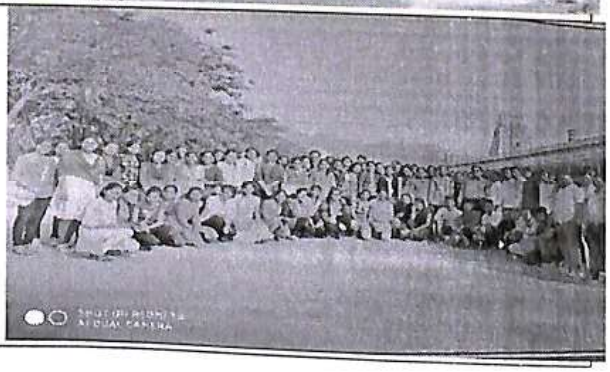
29	B. Sc. Physics	PHY-364	Nuclear Physics	Professional Ethics
30	B. Sc. Physics	PHY-365	Electronics-II	Professional & Industrial Ethics
31	B. Sc. Physics	PHY-356(D)	Laser	Professional & Industrial Ethics
32	B. Sc. Physics	PHY-357	Physics Laboratory-4A	Professional Ethics
33	B. Sc. Physics	PHY-358	Physics Laboratory-4B	Professional & Industrial Ethics
34	B. Sc. Physics	PHY-359	Project-II	Professional & Industrial Ethics
35	B. Sc. Physics	PHY-3510(J)	Solar PV System: Installation, Repairing and Maintenance	Professional Ethics
36	B. Sc. Physics	PHY-3511(K)	Radiation Physics	Professional Ethics
37	M. Sc. Physics	PHCT-111	Mathematical Methods in Physics	Professional Ethics
38	M. Sc. Physics	PHCT-112	Classical Mechanics	Professional Ethics
39	M. Sc. Physics	PHCT-113	Electronics	Professional Ethics
40	M. Sc. Physics	PHOT-114	Laser & Application	Professional & Industrial Ethics
41	M. Sc. Physics	PHOP-114	Laser & Application Practicals	Professional & Industrial Ethics
42	M. Sc. Physics	PHCP-115	Physics Laboratory – I (Electronics)	Professional & Industrial Ethics
43	M. Sc. Physics	PHCT-121	Electrodynamics	Professional Ethics
44	M. Sc. Physics	PHCT-122	Atoms and Molecules	Professional Ethics
45	M. Sc. Physics	PHCT-123	Quantum Mechanics	Professional Ethics
46	M. Sc. Physics	PHOT-124	Physics of Nano Materials	Professional Ethics
47	M. Sc. Physics	PHCP-125	Physics Laboratory - II	Professional Ethics
48	M. Sc. Physics	PHCT-231	Statistical Mechanics	Professional Ethics
49	M. Sc. Physics	PHCT-232	Solid State Physics	Professional Ethics
50	M. Sc. Physics	PHCT-233	Experimental Techniques in Physics - I	Professional & Industrial Ethics
51	M. Sc. Physics	PHOT-234	Energy Studies – I	Environment and Sustainability
52	M. Sc. Physics	PHCP-235	Physics Laboratory - III	Professional Ethics
53	M. Sc. Physics	PHCT-241	Nuclear Physics	Professional Ethics
54	M. Sc. Physics	PHCT-242	Experimental Techniques in Physics -II	Professional & Industrial Ethics
55	M. Sc. Physics	PHOT-243	Physics of Semiconductor Devices	Professional Ethics
56	M. Sc. Physics	PHOT-244	Energy Studies – II	Environment and Sustainability
57	M. Sc. Physics	PHCP-245	Project	Professional & Industrial Ethics

List of Add-on/Value Added/ **Certificate Courses:**

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Introducing	Addressed issue (Professional Ethics)
1	Physics	'C'-Programming Language	CC.009	2018-19	Professional Ethics

List Showing Curricular and Extra Curricular activities to address Crosscutting Issues (Similar/repeated activities are not listed).

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1.	Department of Physics Organized Two-Days National Conference on on **"Renewable Energy & Environment"** on **19th & 20th January 2018.**	Environment and Sustainability	
2.	Department of Physics celebrated the 'National Science Day' on 28th February 2020. On this occasion Dr. B. D. Gavhane delivered a lecture for science stream students on the topic 'Current innovations in science and technology'	Professional Ethics, Human Values	 

3.	Guest lecture of Dr. V. D. Bharud, Department of Physics, M. J. College, Jalgaon on 15th Sep.2019 on the topic 'Carrier Guidance	Professional Ethics	
4.	Department of Physics Organized Workshop on on **"Intellectual Property Right"** on **26th February 2020**	Professional Ethics	
5.	Department of Physics Organized **One Day State Level Workshop on "Green Power and its Applications". Monday, 6th June2022.**	Professional, Environment and Sustainability	
6.	Department of Physics organized two days educational tour at Konkan Darshan: Aakvira Devi-Karle-Leni- Diveaagar-Janjira Fort on 5-6th May 2022. Thirty two students of department participated in this tour.	Professional Ethics, Gender, Human Values, Environment and Sustainability	 
7.	Department of Physics organized two days educational tour at Panchgani-Mahabaleshwar on 27-28th Jan. 2020. Thirty nine students of department participated in this tour.	Professional Ethics, Gender, Human Values, Environment and Sustainability	

Title of the Course: B.Sc. (Physics)

Preamble:

The curriculum for the B. Sc. (Physics) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific - Physics), along with Ability Enhancement (Compulsory and Skill based) Courses. Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula from first year to the third year (comprised of six semesters) shall motivate the student for pursuing higher studies in Physics and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Physics.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials, review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments.
- To create foundation for research and development in Physics.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- To train studentsin skills related to research, education, industry, and market.
- To help students to build-up a progressive and successful career in Physics.

SEMISTER-I

Course code and title: PHY-111 Mechanics and Properties of Matter

Lectures: 36 **(Credits-02)**

1. Motion: **(9 Lectures)**

Introduction to motion, Types of motion, Displacement, Velocity, Acceleration, Inertia, Newton's laws of motion with their explanations, Various types of forces in nature, Frames of reference (Inertial and Non inertial), Laws of motion and it's real life applications, Problems.

2. Work and Energy: **(7 Lectures)**

Kinetic energy, Work Energy Theorem, Work done with constant force, Work done with varying force (spring force), Conservative and Non conservative forces, Potential energy, Law of energy conservation, Gravitational potential energy, Problems.

3. Fluid Mechanics: **(8 Lectures)**

Concept of viscous force and viscosity, Coefficient of viscosity, Steady and Turbulent flow, Reynolds number, Equation of continuity, Bernoulli's Principle, Applications of Bernoulli's Principle (Ventury Meter, PitotTube), Applications of viscous fluids, Problems.

4. Properties of Matter: **(12 Lectures)**

Surface tension, Angle of contact, Factors affecting surface tension, Jaeger's method for determination of surface tension, Applications of surface tension.

Stress and Strain, Hook's law and Coefficient of elasticity, Young's modulus, Bulk modulus, Modulus of rigidity, Work done during longitudinal strain, Volume strain, Shearing strain, Poisson's ratio, Relation between three elastic moduli, (Y, η, K), Applications of elasticity, Problems.

Reference Books

1. Physics: Resnick, Halliday& Walker 9/e, Wiley.
2. University Physics : Sears and Zeemansky, XIth/XIIth Edition, Pearson Education.
3. Mechanics: D. S. Mathur, S. Chand and Company, New Delhi.
4. Elements of Properties of Matter : D. S. Mathur, S. Chand, New Delhi.
5. Concepts of Physics: H. C. Verma, BharatiBhavan Publisher.
6. Problems in Physics: P. K. Srivastava, Wiley Eastern Ltd.
7. Applied Fluid Mechanics: Mott Robert, Pearson Benjamin Cummir VI Edition. Pearson Education/Prentice Hall International, New Delhi.
8. Fundamentals of Mechanics: J C Upadhyaya, Himalaya Publishing House.
9. Mechanics: D. S. Mathur, Revised by P. S. Hemne, S. Chand and Company, New Delhi.
10.

Course code and title: PHY-112 Physics Principles and Applications

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1. To understand the general structure of atom, spectrum of hydrogen atom.
2. To understand the atomic excitation and LASER principles.
3. To understand the bonding mechanism and its different types.
4. To demonstrate an understanding of electromagnetic waves and its spectrum.
5. Understand the types and sources of electromagnetic waves and applications.
6. To demonstrate quantitative problem solving skills in all the topics covered.

1. Physics of Atoms **(08-Lectures)**

1.1 Introduction to Atom
1.2 Atomic Models:
- 1.2.1 Thomson's Atomic Model
- 1.2.2 Rutherford's Atomic Model
- 1.2.3 Bohr's Atomic Model

1.3 Atomic Spectra:
- 1.3.1 Emission line Spectrum
- 1.3.2 Absorption line spectrum
- 1.3.3 Uses of Atomic Spectra

1.4 Classical planetary model of Hydrogen Atom
1.5 The Bohr Theory of the Hydrogen Atom
1.6 The Hydrogen Spectrum
1.7 Frank-Hertz experiment
Problems

2. LASERS and Its Applications **(07-Lectures)**

2.1 Introduction to LASERS
2.2 Basic Principle of Lasers: Three Processes
2.3 Characteristics of Lasers: brief explanation
2.4 Boltzmann Distribution Law
2.5 Population Inversion and Pumping
2.6 Types of Lasers:
- 2.5.1 He-Ne Laser
- 2.5.2 Ruby Laser

2.7 Applications of Lasers
Problems

3. Physics of Molecules **(08-Lectures)**

3.1 Introduction to Bonding Mechanisms
3.2 Forces between Atoms
3.3 Types of Bonding:
- 3.3.1 Ionic Bonds
- 3.3.2 Covalent Bonds
- 3.3.3 van der Waal's Bonds
- 3.3.4 Hydrogen Bond
- 3.3.5 Metallic Bond

3.4 Rotation energy levels of a diatomic molecule
3.5 Vibration energy levels of a diatomic molecule
Problems

Course code and title: PHY-113 Physics Laboratory 1A

Practical: 10 (Credits-1.5)

Section I- Mechanics and Properties of Matter

Sr. No	Title of the experiment
1	Study and use of various measuring Instruments. 1. Vernier caliper 2. Micrometer Screw Gauge 3. Travelling Microscope
2	Study of Modulus of Rigidity of wire using Torsional Oscillations
3	Determination of coefficient of Viscosity by Poiseuille's method
4	Determination of "Y" and "η" by flat spiral spring
5	Determination of "Y" by bending method.
6	Study of surface tension by Jaeger's method
7	Study of Poisson's ratio of rubber using rubber tube /rubber chord
8	Study of surface tension of liquid using Fergusson Method

Section II-Physics Principles and Applications

Sr. No	Title of the experiment
1	Study of Spectrometer and determination of angle of prism
2	Study of Spectrometer calibration and determination of refractive indices of different colors
3	Study of divergence of LASER beam
4	Study of total internal reflection using LASER
5	Determination of Plank's constant
6	Determination of wavelength of LASER light by plane diffraction grating
7	Study of I-V characteristics of solar cell

Note: Any four experiments from each section be conducted during the semester, with a total of 10 experiments.

SEMISTER-II

Course code and title: PHY-121 Heat and Thermodynamics

Lectures: 36 **(Credits-02)**

1. Fundamentals of Thermodynamics **(10 Lectures)**

Concept of thermodynamic state, Equation of state, Van der Waal's equation of state, Thermal equilibrium, Zeroth law of thermodynamics, Thermodynamic processes: Adiabatic, Isothermal, Isobaric and Isochoric changes, Indicator diagram, Work done during isothermal change, Adiabatic relations, Work done during adiabatic change, Internal energy, Internal energy as state function, First law of thermodynamics, Reversible and Irreversible changes, Problems.

2. Applied Thermodynamics: **(9 Lectures)**

Conversion of heat into work and it's converse, Second law of thermodynamics, Concept of entropy, Temperature - entropy diagram, T-dS equations, Clausius - Clapeyron latent heat equations, Problems.

3. Heat Transfer Mechanisms **(9 Lectures)**

Carnot's cycle and Carnot's heat engine and its efficiency, Heat Engines: Otto cycle & its efficiency, Diesel cycle & its efficiency, Refrigerators: General principle and coefficient of performance of refrigerator, Simple structure of Vapour compression refrigerator, Air Conditioning: Principle and it's applications, Problems.

4. Thermometry: **(8 Lectures)**

Concept of heat & temperature, Principle of thermometry, Temperature scales & inter-conversions, Principle, Construction and Working: (Liquid thermometers, Liquid filled thermometers, Gas filled thermometers, Bimetallic thermometers, Platinum resistance thermometer, Thermocouple), Problems.

Reference Books:

1. Concept of Physics: H. C. Verma, BharatiBhavan Publisher.
2. Heat and Thermodynamics: Brijlal, N. Subrahmanyam, S. Chand and Company Ltd.
3. Heat and Thermodynamics: Mark W. Zemansky, Richard H. Dittman, 7th Edition, Mc-Graw Hill International Edition.
4. Thermodynamics and Statistical Physics: J. K. Sharma, K. K. Sarkar, Himalaya Publishing House.
5. Thermal Physics (Heat and Thermodynamics): A. B. Gupta, H. P. Roy books and Allied (P) Ltd. Calcutta.
6. Instrumentation:Devices & Systems, Rangan, Mani, and Sarma.

Course code and title: PHY-122 Electricity and Magnetism

Lectures: 36 **(Credits-02)**

Learning Outcomes:

On successful completion of this course students will be able to do the following:

1) To understand the concept of the electric force, electric field and electric potential for stationary charges.
2) Able to calculate electrostatic field and potential of charge distributions using Coulomb's law and Gauss's law.
3) To understand the dielectric phenomenon and effect of electric field on dielectric.
4) To Study magnetic field for steady currents using Biot-Savart and Ampere's Circuital laws.
5) To study magnetic materials and its properties.
6) Demonstrate quantitative problem solving skills in all the topics covered.

1. Electrostatics **(08-Lectures)**

1.1 Revision of Coulomb's law:
- 1.1.1 Statement
- 1.1.2 Variation of forces with distances

1.2 Superposition principle:
- 1.2.1 Statement
- 1.2.2 Explanation with illustration

1.3 Energy of system of charges
1.4 Concept of electric field
- 1.4.1 Due to point charge
- 1.4.2 Due to group charges

1.5 Concept of electric flex
1.6 Gauss's law in electrostatics
Problems

2. Dielectrics **(08-Lectures)**

2.1 Introduction to dielectric materials
2.2 Electric Dipole
- 2.2.1 Electric dipole
- 2.2.2 Dipole moment

2.3 Electric potential and intensity at any point due to dipole
2.4 Torque on a dipole placed in an electric field
2.5 Polar and non-polar molecules
2.6 Electric polarization of dielectric material
2.7 Gauss' law in dielectric
2.8 Electric vectors and its relation
Problems

3. Magnetization **(07-Lectures)**

3.1 Introduction to Magnetization
3.2 Magnetic materials
3.3 Types of Magnetic Materials
- 3.3.1 Diamagnetic materials
- 3.3.2 Paramgnetic materials
- 3.3.3 Ferromagnetic materials
- 3.3.4 Antiferromagnetic materials

Course code and title: PHY-123 Physics Laboratory 1B

Practical: 08 **(Credits-1.5)**

Section I- Heat and Thermodynamics

Sr No	Title of the experiment
1	Interpretation of Isothermal and Adiabatic curve on P-V diagram and theoretical study of Carnot's cycle by drawing graphs of Isothermal and Adiabatic curves
2	Study of temperature coefficient of Thermistor.
3	Study of Thermocouple and determination of inversion temperature
4	Study of thermal conductivity by Lee's method
5	Study of specific heat of Graphite
6	Study of Solar constant
7	Determination of calorific values of different fuels

Section II- Electricity and Magnetism

Sr No	Title of the experiment
1	Study of charging and discharging of capacitor
2	Study of LR circuit
3	Study of LCR circuit
4	Study of Kirchhoff's Laws
5	Study of Diode characteristics
6	Study of Voltmeter, Ammeter and Multimeter (AC, DC, ranges and least count)
7	Determination of frequency of AC mains
8	Comparison of capacitor using DeSauty's method

Note: Any four experiments from each section be conducted during the semester.

Savitribai Phule Pune University

(Formerly University of Pune)

Second Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

S.Y.B.Sc. (Physics)

Choice Based Credit System

To be implemented from Academic Year 2021-2022

S.Y.B.Sc. (Physics) (Sem-III)
PHY-231: Mathematical Methods in Physics-I

Lectures: 36 **(Credits-02)**

Learning Outcomes: After the completion of this course students will be able to

1. Understand the complex algebra useful in physics courses.
2. Understand the concept of partial differentiation.
3. Understand the role of partial differential equations in physics.
4. Understand vector algebra useful in mathematics and physics.
5. Understand the concept of singular points of differential equations.

1. Complex Numbers: **(9L)**

1.1 Introduction to complex numbers
1.2 Rectangular, polar and exponential forms of complex numbers
1.3 Argand diagram
1.4 Algebra of complex numbers using Argand diagram
1.5 De-Moivre's Theorem (Statement only)
1.6 Power, root and log of complex numbers
1.7 Trigonometric, hyperbolic and exponential functions
1.8 Applications of complex numbers to determine velocity and acceleration in curved motion.
1.9 Problems.

2. Partial Differentiation: **(9L)**

2.1 Definition of partial differentiation
2.2 Successive differentiation
2.3 Total differentiation
2.4 Exact differential
2.5 Chain rule
2.6 Theorems of differentiation
2.7 Change of variables from Cartesian to polar co-ordinates
2.8 Conditions for maxima and minima (without proof)
2.9 Problems.

3. Vector Algebra and Analysis: **(12L)**

3.1 Introduction to scalars and vectors, dot product and cross product of two vectors and their physical significance. (Revision)
3.2 Scalar triple product and its geometrical interpretation
3.3 Vector triple product and its proof
3.4 Scalar and vector fields
3.5 Differentiation of vectors with respect to scalar
3.6 Vector differential operator and Laplacian operator
3.7 Gradient of scalar field and its physical significance
3.8 Divergence of scalar field and its physical significance
3.9 Curl of vector field and its physical significance.

S.Y.B.Sc. (Physics) (Sem-III)
PHY-232(A): Electronics-I

Lectures: 36 **(Credits-02)**

N.B: This course is for students **who have not taken Electronic Science as one of the subjects at F.Y.B. Sc.**

Learning outcomes: On successful completion of this course the students will be able to

- Apply different theorems and laws to electrical circuits.
- Understand the relations in electricity.
- Understand the parameters, characteristics and working of transistors.
- Understand the functions of operational amplifiers.
- Design circuits using transistors and applications of operational amplifiers.
- Understand the Boolean algebra and logic circuits.

1. Network Theorem: **(6L)**

1.1 Krichhoff's Law
1.2 Voltage and current Divider Circuit
1.3 Thevenin's Theorem
1.4 Norton's Theorem
1.5 Superposition Theorem
1.6 Maximum Power transfer theorem (With proof)
1.7 Problems

2. Study of Transistor: **(12L)**

2.1 Bi-junction Transistor:

1. Revision of bipolar Junction Transistor, Types, Symbol and basic action.
2. Configuration (Common Base, Common Emitter and Common Collector)
3. Current Gain Factors (α and β) and their relations
4. Input, Output and transfer Characteristic of CE Configuration
5. Biasing method and Voltage Divider
6. DC Load line (CE), Operating Point (Q- point)
7. Transistor as a switch
8. Problems

2.2 Unijunction Transistor:

1. Symbol, Types, Construction, Working Principle, I-V characteristics, Specifications and Parameters of Unijunction Transistor (UJT)
2. UJT as a relaxation Oscillator.

3. Operational Amplifiers and Application **(12 L)**

3.1 Operational Amplifiers:

1. Introduction
2. Ideal and practical Characteristics
3. Operational Amplifier: IC741- Block Diagram and Pin diagram
4. Concept of Virtual Ground
5. Inverting and Non-inverting operational amplifiers with concept of gain

6. Operational amplifier as an adder and subtractor
7. Problems

3.2 Oscillators:

1. Concept of Positive and negative feed back
2. Barkhausein Criteria for an oscillator
3. Construction, working and application of phase shift oscillator using IC741
4. Problems

4. Number System and Logic Gates **(6 L)**

1. Number System: Binary, Binary coded Decimal (BCD), Octal, Hexadecimal
2. Addition and Subtraction of binary numbers and binary fractions using one's and two's complement
3. Basic Logic gates (OR, AND, NOT)
4. Derived gates: NOR, NAND, EXOR, EXNOR, with symbols and truth table
5. Boolean Algebra
6. De Morgan's theorem and its verification
7. Problems

Reference Books:

1. Electronic Principles-Malvino, 7th Edition, Tata Mc-Graw Hills publication.
2. Principles of Electronics-V.K. Mehta, S. Chand publication.
3. Op-amp and Linear Integrated Circuit-Ramakant Gaikwad, Prentice Hall of India publication.
4. Integrated Circuit-Botkar, Khanna Publication, New Delhi.
5. Digital Principles and Application-Malvino and Leech, Tata Mc-Graw Hills publication.

S.Y.B.Sc. (Physics) (Sem-III)
PHY-233: Physics Laboratory-2A

Lectures: 36 **(Credits-02)**

Learning Outcome: After completing this practical course students will be able to

- Use various instruments and equipment.
- Design experiments to test a hypothesis and/or determine the value of an unknown quantity.
- Investigate the theoretical background of an experiment.
- Setup experimental equipment to implement an experimental approach.
- Analyze the data, plot appropriate graphs and reach conclusions from data analysis.
- Work in a group to plan, implement and report on a project/experiment.
- Keep a well-maintained and instructive laboratory logbook.

Section-I: Electronics-I/Instrumentation

1. Circuit Theorems (Thevenin's, Norton's and Maximum Power Transfer Theorems)
2. Transistor Characteristics(Input and Output characteristics of CE Configuration)
3. Single Stage Transistor Amplifier
4. Study f Rectifiers (Half, Full Wave and Bridge) with different filters
5. I-V Characteristics of UJT/ UJT as Relaxation Oscillator
6. Zener as a Regulator (Line and Load Regulation)
7. Op-amp as inverting and non-inverting amplifier
8. Study of Wein Bridge / Phase Shift Oscillator using 741
9. Op-amp as an adder and subtractor
10. Study of logic gates and verification of de Morgan's theorems
11. To measure displacement using potentiometer/variable inductor/ variable capacitor
12. Use of CRO(AC/DC Voltage measurement, Frequency measurement)
13. To measure force using load cell
14. To measure pressure using elastic diaphragm(In Variable Capacitor / Bourdon Tube)
15. To measure magnetic field using Hall Probe for a system of ring magnets

Section-II: Use of Computer

1. Plotting of various trigonometric functions using spread sheet/any graphic software viz. Microsoft Excel, Origin: sinx, cosx, tanx,ex, e-x, logx, lnx, xn
2. Plotting of conic sections using spreadsheet /any graphic software viz. Microsoft Excel, Origin: circle, ellipse, parabola, hyperbola
3. Inverse, determinant of matrix, solution of linear equations using Microsoft Excel or Origin software

Additional Activities (Any two)

1. Plotting of any **two** graphs using spreadsheets (of data obtained from various experiments performed by the student)
2. Any **two** computer aided demonstrations (Using computer simulations or animations)

S.Y.B.Sc. (Physics) (Sem-IV)
PHY-241: Oscillations, Waves and Sound

Lectures: 36 **(Credits-02)**

Learning Outcomes: On completion of this course, the learner will be able:

- To study underlying principles of oscillations and its scope in development.
- To understand and solve the equations / graphical representations of motion for simple harmonic, damped, forced oscillators and waves.
- To explain oscillations in terms of energy exchange with various practical applications.
- To solve numerical problems related to undamped, damped, forced oscillations and superposition of oscillations.
- To study characteristics of sound, decibel scales and applications.

1. Undamped Free Oscillations: **(7L)**

1.1 Different types of equilibria (static, dynamic, stable, unstable, and metastable equilibrium) – definitions only with examples.

1.2 Definitions of linear Simple Harmonic Motion (S.H.M) and angular S.H.M.

1.3 Differential equation for linear S.H.M. and its solution.

1.4 Composition of two perpendicular linear S.H.Ms. for frequency ratio 1:1 and 2:1 (analytical method).

1.5 Lissajous figures, their demonstration (optical and electrical method) and applications.

1.6 Problems.

2. Damped Oscillations: **(7L)**

2.1 Introduction

2.2 Differential equation for damped harmonic oscillator and its solution, discussion of different cases.

2.3 Logarithmic decrement.

2.4 Average energy of damped harmonic oscillator.

2.5 Quality factor.

2.6 Application: LCR series circuit.

2.7 Problems.

3. Forced Oscillations: **(8L)**

3.1 Introduction.

3.2 Differential equation for forced oscillations and its solution.

3.3 Resonance: mechanical, acoustic and electrical.

3.4 Velocity and Amplitude resonance.

3.5 Sharpness of resonance and half width.

3.6 Average energy of forced oscillator.

3.7 Quality factor of forced oscillator.

3.8 Relation between quality factor and bandwidth.

3.9 Application of forced oscillations- LCR series circuit.

3.10 Problems.

4. Wave Motion: **(6L)**

4.1 Introduction.
4.2 Equation for longitudinal waves and its solution (one dimension only).
4.3 Equation for transverse waves and its solution (one dimension only).
4.4 Energy density and intensity of a wave.
4.5 Qualitative discussion of seismic waves and gravitational waves.
4.6 Problems.

5. Sound and Doppler Effect: **(8L)**

5.1 Definition of sound Intensity, Loudness, Pitch, Quality and timbre.
5.2 Reverberation time and reverberation of hall.
5.3 Sabine's formula (without derivation).
5.4 Doppler Effect in sound, Expression for apparent frequency in different cases.
5.5 Asymmetric nature of Doppler Effect in sound.
5.6 Doppler Effect in light, Symmetric nature of Doppler Effect in light.
5.7 Applications: Radar, Speed of distant star, Rotational speed of binary star, Red Shift and Width of spectral line.
5.8 Problems.

Reference Books:

1. Waves and Oscillations - Stephenson.
2. The Physics of Waves and Oscillations - N. K. Bajaj, Tata McGraw- Hill, publication.
3. Fundamentals of Vibrations and Waves - S. P. Puri, Tata McGraw-Hill publication.
4. A Text Book of Sound - Subramanyam and Brijlal, Vikas Prakashan.
5. Sound - Mee, Heinmann Edition, London.
6. Waves and Oscillations - R.N. Chaudhari, New Age International (p) ltd.
7. A Textbook on Oscillations, Waves and Acoustics - M. Ghosh, and D. Bhattacharya, S. Chand and Company Ltd.

S.Y.B.Sc. (Physics) (Sem-IV)
PHY-242: Optics

Lectures: 36 **(Credits-02)**

Learning Outcomes: On successful completion of this course the students will be able to

- Acquire the basic concept of wave optics.
- Describe how light can constructively and destructively interfere.
- Explain why a light beam spread out after passing through an aperture
- Summarize the polarization characteristics of electromagnetic wave
- Understand the operation of many modern optical devices that utilize wave optics
- Understand optical phenomenon such polarization, diffraction and interference in terms of the wave model
- Analyze simple example of interference and diffraction.

1. Geometrical optics and Lens aberrations: **(12L)**

(a) Geometrical optics:

1.1 Introduction to lenses and sign conventions.
1.2 Thin lenses: Lens equation for single convex lens
1.3 Lens maker equation
1.4 Concept of magnification, deviation and power of a thin lens
1.5 Equivalent focal length of two thin lens system
1.6 Concept of cardinal points
1.7 Problems

(b) Lens Aberrations:

1.8 Introduction to Aberration
1.9 Types of aberration: Monochromatic and Chromatic Aberration (Only discussion)

2. Optical Instruments: **(6L)**

2.1 Introduction to optical instruments
2.2 Types of optical instruments: Simple Microscope, Compound Microscope and Astronomical telescope (only construction and working)
2.3 Eyepiece: Ramsden's eye piece (Expression), Huygens eye piece and Gauss's eyepiece (only qualitative discussion)
2.4 Problems.

3. Interference and Diffraction: **(12L)**

(a) Interference:

3.1 Introduction to interference
3.2 Types of Interference (only discussion)
3.3 Phase change on reflection (Stokes treatment).
3.4 Interference due to reflected light
3.5 Interference due to transmitted light.
3.6 Newton's ring (to calculate wavelength)

3.7 Problems

(b) Diffraction:

3.8 Introduction to diffraction

3.9 Types of diffraction (only discussion)

3.10 Fraunhoffer's diffraction due to single slit and double slit (only qualitative discussion)

3.11 Plane transmission grating and grating equation (only principal maxima)

3.12 Rayleigh criterion for resolution (only qualitative discussion)

3.13 Problems

4. Polarization: **(6L)**

4.1 Introduction to polarization

4.2 Brewster's law

4.3 Malus's Law

4.4 Polarization by double refraction

4.5 Nicol Prism

4.6 Application of polarization

4.7 Problems

Reference Books:

1. Optics - A.R. Ganesan, 4th edition, Pearson Education.
2. A Textbook of Optics - N. Subhramanyam, Brijlal, M.N. Avadhanulu, S. Chand Publication.
3. Physical Optics - A.K. Ghatak, McMillan, New Delhi
4. Fundamental of Optics - F.A. Jenkins, H.E.White, Mc Graw-Hilll International edition
5. Principles of Optics - D.S. Mathur, Gopal Press, Kanpur.

S.Y.B.Sc. (Physics) (Sem-IV)
PHY-243: Physics Laboratory-2B

Lectures: 36 **(Credits-02)**

Learning Outcome: After completing this practical course students will be able to

- Use various instruments and equipment.
- Design experiments to test a hypothesis and/or determine the value of an unknown quantity.
- Investigate the theoretical background of an experiment.
- Setup experimental equipment to implement an experimental approach.
- Analyze the data, plot appropriate graphs and reach conclusions from data analysis.
- Work in a group to plan, implement and report on a project/experiment.
- Keep a well-maintained and instructive laboratory logbook.

Section I: Oscillations, Waves and Sound

1. Logarithmic decrement (in air and water).
2. Study of coupled oscillators comprising two simple pendulum (Mechanical) and determination of coupling coefficient.
3. 'g' by bar pendulum.
4. Study of musical scales using a signal generator and musical instruments.
5. Measurement of coefficient of absorption of sound for different materials (cork, thermocol, mica, paper etc.).
6. Study of Lissajous's figures and determination of unknown frequency.
7. Determination of speed of sound by Quincke's method interferometer.
8. Directional characteristics of Microphone.
9. Velocity of sound by Phase shift method.
10. To determine the frequency of an electrically maintained tuning fork by stroboscopic method.
11. To determine the velocity of sound in air at room temperature with Kundt's Tube.

Section II: Optics

1. Newton's Ring: Determination of wavelength of monochromatic light source (λ).
2. Dispersive power of glass prism.
3. Total internal reflection using LASER beam and glass prism.
4. Diffraction at the edge of a razor blade.
5. Optical activity of sugar solution using Polarimeter.
6. Goniometer to determine cardinal points and focal length.
7. To determine temperature of sodium flame.
8. Double refracting prism.
9. Determination of Cauchy's constant.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Physics

(Faculty of Science & Technology)

T.Y.B.Sc. (Physics)

Choice Based Credit System

To be implemented from Academic Year 2021-2022

Savitribai Phule Pune University, Pune

Revised syllabus for T.Y.B.Sc. (Physics) (CBCS Pattern-2021-22)

To be implemented from Academic Year 2021-22

Salient Features of Revised Syllabi in Physics

As far as possible to promote:

1) Physics Education through Master Texts:
It helps in understanding the theoretical and mathematical development of the subject and to create interest in the subject.

2) Physics Education through Experimentation:
It helps in general to improve scientific attitude. So emphasis is given on the development of experimental skills, data analysis, calculations, and also on the limitations of the experimental method and data and, results obtained.

3) Physics Education through Problem Solving: It helps in understanding the concepts of physics. It underline the strength of equations, formulae, graphs, mathematical tools to tackle the problems. So accordingly, we have introduced compulsory problem part in the question paper.

4) Physics Education through History and Philosophy:
It helps in understanding the conceptual development of the subject and thereby increase the interest in the subject. A topic on this is introduced in the Physics Course.

5) Physics Education through Awareness of Misconceptions:
It improves the scientific awareness among the students. A discussion on different subjects are encouraged.

6) Physics Education through Proto-research:
It creates interest in the subject and improves technological aspect. Accordingly, mini projects, hands-on activities, projects, models and demonstrations etc. is included in the syllabi.

7) Physics Education through Qualitative Overview:
It creates interest in the subject to continue to work in the field of science in general and physics in particular. Accordingly future directions and frontiers of the subject are included in the syllabi.

8) Structure of Question paper:
Existing structure shall continue.

9) ATKT Rules:
Existing rules shall apply.

10) **Structure of the Course:**

Semester	Course Type	Course Code	Course Name	Credit
V	Discipline Specific Elective Course	PHY-351	Mathematical Methods in Physics-II	2
		PHY-352	Electrodynamics	2
		PHY-353	Classical Mechanics	2
		PHY-354	Atomic and Molecular Physics	2
		PHY-355	Computational Physics	2
		PHY-356: Elective-I (Select any One)		2
		PHY-356(**A**)	Astronomy and Astrophysics-I	
		PHY-356(**B**)	Elements of Materials Science	
		PHY-356(**C**)	Biophysics	
		PHY-356(**D**)	Renewable Energy Sources-I	
		PHY-356(**E**)	Applied Optics	
		PHY-356(**F**)	C# programming	
		PHY-357	Physics Laboratory-3A	2
		PHY-358	Physics Laboratory-3B	2
		PHY-359	Project-I	2
	Skill Enhancement Course	**PHY-3510: Skill Enhancement Course-I (Select any One)**		2
		PHY-3510(**G**)	Python Programming	
		PHY-3510(**H**)	Energy studies	
		PHY-3510(**I**)	Introduction to Arduino	
		PHY-3510(**J**)	Sensors and Transducer	
		PHY- 3511: Skill Enhancement Course-II (Select any One)		2
		PHY-3511(**K**)	Physics Workshop Skill	
		PHY-3511(**L**)	Biomedical Instrumentation	
		PHY-3511(**M**)	Non-destructive Testing Techniques	
		PHY- 3511(**N**)	Acoustics Applications	
VI	Discipline Specific Elective Course	PHY-361	Solid State Physics	2
		PHY-362	Quantum Mechanics	2
		PHY-363	Thermodynamics and Statistical Physics	2
		PHY-364	Nuclear Physics	2
		PHY-365	**(A)** Electronics-II **OR** **(B)** Advanced Electronics	2

		PHY-366: Elective-II (Select any One)		2
		PHY-366(**O**)	Medical Electronics	
		PHY-366(**P**)	Physics of Nanomaterials	
		PHY-366(**Q**)	Microcontrollers	
		PHY-366(**R**)	Lasers	
		PHY-366(**S**)	Astronomy and Astrophysics-II	
		PHY-366(**T**)	Renewable Energy Sources-II	
		PHY-367	Physics Laboratory-4A	2
		PHY-368	Physics Laboratory-4B	2
		PHY-369	Project-II	2
	Skill Enhancement Course	**PHY-3610: Skill Enhancement Course-III (Select any One)**		2
		PHY-3610(**U**)	Scientific Data Analysis using Python	
		PHY-3610(**V**)	Solar PV System: Installation, Repairing and Maintenance	
		PHY-3610(**W**)	Applications of Internet of things (IOT)	
		PHY-3610(**X**)	Calibration Techniques	
		PHY- 3611: Skill Enhancement Course-IV (Select any One)		2
		PHY- 3611(**Y**)	Microcontrollers	
		PHY- 3611(**Z**)	Instrumentation for Agriculture	
		PHY- 3611(**AA**)	Radiation Physics	
		PHY- 3611(**AB**)	Photography	

T.Y.B.Sc. (Physics) (Sem-V)
PHY-351: Mathematical Methods in Physics-II

Lectures: 36 **(Credits-02)**

1: Curvilinear Co-ordinates **(10L)**

Review of Cartesian, spherical and cylindrical co-ordinate, transformation equation, General Curvilinear co-ordinate system: Co-ordinate surface, co-ordinate lines, length, surfaces and volume elements in curvilinear co-ordinate system.

Orthogonal curvilinear co-ordinate system, expressions for gradient, divergence, Laplacian, and curl, special case for gradient, divergence and curl in Cartesian, spherical polar and cylindrical co-ordinate system, Problems.

2: The Special Theory of Relativity **(10L)**

Introduction and applications, Newtonian relativity, Galilean transformation equation, Michelson-Morley experiment, Postulates of special theory of relativity, Lorentz transformations, Kinematic effects of Lorentz transformation, Length contraction, Proper time, Problems.

3: Partial Differential Equations **(8L)**

Introduction and applications of Partial differential equations (PDE), General methods for solving second order PDE, Method of separation of variables in Cartesian, Spherical polar and cylindrical co-ordinate system (two dimensional Laplace's equation, one dimensional Wave equation), Singular points ($x = x_0$), Solution of differential equation-Statement of Fuch's theorem, Frobenius method of series solution.

4: Special Functions **(8L)**

Introduction, generating function for Legendre Polynomials: $P_n(x)$, Properties of Legendre Polynomials, Generating function for Hermite Polynomials: $H_n(x)$, Properties of Hermite Polynomials, Bessel function of first kind: $J_n(x)$, Properties of Bessel function of first kind, Applications of Special Functions in Physics, Problems.

Reference books:

1. Mathematical methods for physicists, Arfken and Weber, Acadmic press Newyork, 7th Edition.
2. Mathematical physics, Rajput, Pragati prakashan-1997.
3. Mathematical methods in the physical sciences – Marry L. Boas, John Willy & Sons publication, 3rd Edition-2005.
4. Introduction to special relativity, Robert Resnick, John Wiley & Sons, Inc.-1968.
5. Mathematical physics, B. D. Gupta, Vikas publishing house Pvt. Ltd., 4th edition-2010.
6. Mathematical physics, H. K. Dass, Dr. Rama Varma, S. Chand & Company Pvt. Ltd.,7th Edition-2014
7. The Special Theory of Relativity: A Mathematical Approach-Farook Rahaman, Springer Publication -2014.

T.Y.B.Sc. (Physics) (Sem-V)
PHY-352: Electrodynamics

Lectures: 36 **(Credits-02)**

1: Electrostatics **(12 L)**

a. Revision of Coulomb's law, Gauss law, Electric field, Electrostatic Potential.
b. Potential energy of system of charges.
c. Statement of Poisson's and Laplace's equation, Boundary Value problems in electrostatics- Solution of Laplace equation in Cartesian system, Boundary conditions.
d. Polarization **P**, Electric displacement **D**, Electric susceptibility and dielectric constant, bound volume and surface charge densities.
e. Electric field at an exterior and interior point of dielectric.

2: Magnetostatics **(12 L)**

a. Concepts of magnetic induction, magnetic flux and magnetic field.
b. Magnetic induction due to straight current carrying conductor, magnetization of matter, relationship between **B, H** and **M.**
c. Boundary conditions at the interface of two magnetic media (Normal and tangential components).
d. Biot-Savart's law, Ampere's force law, Magnetic force between two current carrying loops, Ampere's circuital law.
e. Equation of continuity, Magnetic vector potential **A,** Magnetic susceptibility and permeability.

3: Electrodynamics **(12 L)**

a. Day to day applications of Electrodynamics.
b. Concept of electromagnetic induction, Faradays law of induction, Lenz's law, displacement current, generalization of Amperes' law.
c. Maxwell's equations (Differential and Integral form) and their physical significance.
d. Polarization, reflection and refraction of electromagnetic waves through media.
e. Wave equation and plane waves in free space.
f. Poynting theorem and Poynting vector.

Reference Books:

1. Introduction to Electrodynamics; D. J. Griffith; Cambridge India; Fourth edition (2020)
2. Classical Electrodynamics; J. D. Jackson; Wiley; Third edition (2007)
3. Introduction to Electrodynamics; A. Z. Capri, Panat P. V.; Alpha science international ltd; Illustrated edition(2002)
4. Foundations of electromagnetic theory; Reitz, Milford and Christy; Pearson education India; Fourth edition (2010)
5. Electrodynamics; Gupta, Kumar, Singh; Pragati Prakashan; Ninteenth edition (2011)
6. Electromagnetic field and waves; Paul-Lorrain, D. R. Corson; W.H. Freeman & co. Ltd; Second edition (1970)
7. Electricity and magnetism; Murugeshan; S. Chand; (2020)
8. Electromagnetic theory and electrodynamics; Satya Prakash; Kedar Nath Ram Nath; (2020)

T.Y.B.Sc. (Physics) (Sem-V)
PHY-353: Classical Mechanics

Lectures: 36 (Credits-02)

1: Motion of Particles (8L)

a. Charged Particles: Motion of a charged particle in constant electric, magnetic and electromagnetic field,
b. System of particles: Concept of Centre of mass, Conservation of linear momentum, angular momentum, energy of system of particles.(statements only)
c. Day to day applications of Classical mechanics,
d. Problems

2: Central force Field (8L)

a. Central force Field: Definition and Properties of central force field. Reduction of two body problem to an equivalent one body problem
b. Motion in central force field,
c. Kepler's laws of planetary motion and their proof
d. Artificial satellite and its orbit
e. Problems.

3: Scattering of particles (10L)

a. Elastic and inelastic scattering: Definition and properties,
b. Elastic scattering - Laboratory and center of mass system.
c. Scattering: Scattering angles in laboratory and center of mass system.
d. Differential cross-section, impact Parameter, total cross-section in brief.
e. Problems

4: Langrangian and Hamiltonian formulation (10L)

a. Limitations of Newton's Law of Motion,
b. Constraints and Their Classification, Example of Constrains, degrees of freedom, generalized coordinate, configuration space,
c. Principle of Virtual work done,
d. D'Almeberts Principle of virtual work,
e. Langrangian equation from D' Alembert's principle, cyclic coordinates,
f. Phase space, Hamiltonian's equations
g. Problems

Reference books:

1. **Classical Mechanics**, J.C. Upadhyaya, Himalaya publishing Houses, 2nd Edition of 2005.
2. **Introduction to Classical Mechanics,** R. G. Takawale, P. S. Puranik, Tata McGraw Hill publishing Company Ltd., New Delhi.
3. **Classical Mechanics,** NC Rana and PS Joag, Tata McGraw Hill Education Private Limited, New Delhi, 1991.
4. **Classical Mechanics** by P.V.Panat.
5. **Classical Mechanics,** Herbert Goldstein, Narosa Publishing House.

T.Y.B.Sc. (Physics) (Sem-V)

PHY-354: Atomic and Molecular Physics

(Credits-02)

Lectures: 36

1: Atomic structure **(6 L)**

1. Revision of various atomic models
2. Vector atom model (Concepts of space quantization and electron spin)
3. Pauli Exclusion Principle and electron configuration, Quantum states, Spectral notations of quantum states.
4. Problems

2: One and Two Valence electron systems **(12 L)**

1. Spin-Orbit Interaction (Single valence electron atom), Energy levels of Na-atom, Selection rules, Spectra of sodium atom, Sodium doublet.
2. Spectral terms of two electron atoms, terms for equivalent electrons, LS and JJ-coupling schemes.
3. Singlet-Triplet separations for interaction energy of LS coupling, Lande's interval rule, Spectra of Helium atom.
4. Problems

3: Zeeman Effect **(4 L)**

1. Zeeman Effect
2. Experimental arrangement
3. Normal and anomalous Zeeman Effect
4. Stark effect (Qualitative discussion)
5. Applications of Zeeman effects
6. Problems

4: Molecular spectroscopy **(8 L)**

1. Introduction of molecular spectra and its types
2. Rotational energy levels, Rotational spectra of rigid diatomic molecule
3. Vibrational energy levels
4. Rotational and Vibrational spectra
5. Electronic spectra of molecules
6. Applications of UV-Vis spectroscopy
7. Problems

5: Raman spectroscopy **(6 L)**

1. History of Raman effect, Molecular polarizability
2. Classical theory and Quantum theory of Raman Effect
3. Characteristics Raman Lines and Applications of Raman spectroscopy
4. Problems

Reference books:

1) R. Murugeshan, Er. K. Sivaprasath, Modern Physics, S. Chand, 2014, Revised edition
2) Robert Eiseberg, Robert Resnik, Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles, Wiley, 2016, 2nd edition
3) G. Aruldhas, Molecular structure and Spectroscopy, PHI, 2015, 2nd edition
4) Colin Banwell, Elaine McCash, Fundamentals of Molecular Spectroscopy, TMH, 4th ed
5) Arthur Baiser, Concepts of Modern Physics , McGraw Hill International, 4th edition
6) White H. E, Introduction to Atomic spectra, McGraw Hill International

T.Y.B.Sc. (Physics) (Sem-V)
PHY-355: Computational Physics

(Credits-02)

Lectures: 36

1: Concepts of Programming and Introduction to C-programming: (14 L)

a) Definition and Properties of algorithms, Algorithm development, Flow charts- symbols and simple flowcharts.
b) Introduction and Structure of C-program, 'C' Character set, key words, Constants and variables, Variable names, Data types, qualifiers and their declarations, Symbolic Constants.
c) Input/output functions: scanf( ), printf( ), getchar(), putchar(), gets(), puts().
d) Operators and Expressions: Arithmetic Operators, Relational Operators, Logical Operators, Assignment Operators, Conditional Operator.
e) Control statements: if, if else, while, do while, for loop, nested control structures (nested if, nested loops), break, continue, switch- case statement, goto statement.
f) Use of Library functions: e.g. mathematical, trigonometric, graphics.

2: Arrays, Pointers and user defined function in C-Language (8 L)

a) Arrays: 1-D, 2-D: Arranging numbers in descending and ascending order, Sum of matrices, multiplication of matrices.
b) Concept of pointers with suitable illustrative examples.
c) User defined functions: Definitions and declaration of function, function prototype, passing arguments (Call by value, Call by reference). Simple illustrative examples.

(3 L)

3: Graphics in C-Language:

Concepts of graphics in C, Some simple graphic commands- Point, Line, Circle, Arc, Ellipse, Bar with suitable illustrative examples. **(11 L)**

4: Computational Physics:

Numerical Methods to solve the Physics Problems

a) **Iterative methods:** Bisection method and Newton-Raphson Method– Algorithm, Flowchart and writing C- program for finding the roots of the equation, problems
b) **Integration:** Trapezoidal rule, Simpson's $1/3^{rd}$ rule – Algorithm, Flowchart and C-program, problems

Reference Books:

1. Programming in C- (Schaum's series), Gottfreid, TMH
2. Programming in C- Balgurusami, Prentice Hall publications
3. Let us C- Yashwant Kanetkar, BPB publications
4. Programming with C- K.R. Venugopal, S. R. Prasad, TMH.
5. Introductory methods of numerical analysis-S. Sastry, Prentice Hall
6. Computer oriented numerical methods – V. Rajaraman.

T.Y.B.Sc. (Physics) (Sem-V)

PHY-356 Elective-I (D): Renewable Energy Sources-I

(Credits-02)

Lectures: 36

1: An Introduction to Energy Sources: **(10L)**

1. Energy: Definition, Classifications of energy sources
2. Conventional and non-conventional energy sources.
3. Sun: The source of energy (Structure, Characteristics and Composition)
4. Solar Constant
5. Electromagnetic Energy Spectrum.
6. Solar radiations outside earth atmosphere.
7. Solar radiation at the earth surface.
8. Problems.

Ref.1- page no. 1 to 11 and 15 to 37

Ref.3- 3.1, 3.2, 3.3, 3.4, 3.5

2: Photothermal Applications: **(10L)**

1. Photothermal devices: Solar Insolation, Selective Coating, Glass Cover, Heat Conductor and Heat Insulation.
2. Solar water heating systems: Types, construction and working of Liquid Flat Plate Collector (FPC) and Evacuated Tube Collector (ETC)
3. Energy Balance Equation (without thermal Analysis).
4. Concentrating collectors: Flat plate collector with plane reflector, Cylindrical parabolic, Compound parabolic, Collector with fixed circular concentrators and moving receiver, paraboloid concentrator.
5. Comparative study between flat plate collector and solar concentrators.
6. Solar distillation, Solar dryer, Solar cooker (box type)

Ref. 1: 3.3, 3.3(A), 3.5, 3.7, 3.8, 5.2, 5.8, 5.11.

Ref. 2: 2.2.6

3: Photovoltaic systems: **(10L)**

1. Introduction to Photovoltaic effect and Photovoltaic Conversion.
2. Basic photovoltaic system for power generation
3. Basics of Solar Cell, PV modules, Arrays,
4. Solar Cell: I-V characteristics, Power output and conversion efficiency.
5. Factors affecting on photovoltaic efficiency. (Change in amount of input light, solar cell area, Change in angle, Change in operating Temperature etc.)
6. Types of solar cells: p-n junction solar cell, p-i-n diode solar cell, cadmium sulphide solar cell, Gallium arsenide solar cell, Indium phosphide solar cell, nano-crystalline solar cell.
7. Application of solar photovoltaic systems.

Ref.3 -15.1, 15.3, 15.4, 15.5, 15.7, 15.8, 15.10.

Ref.8 – 3.6.1, 3.6.2, 3.6.3, 3.6.4, 3.6.5

(06L)

4: Energy Storage:

1. Importance and Needs of Energy storage in Conventional and Nonconventional Energy Systems.
2. Various forms of Energy Storage
3. Electrical Energy: Super capacitors
4. Electrochemical Energy: Battery
5. Chemical Energy: Hydrogen Production and storage

Ref.4 - Ref.5 - Ref.6 - Ref.7 -

Reference books:

1. Non-conventional Energy sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc. Graw Hill Ltd, New Delhi.
3. Solar Energy Utilizations, G. D. RAI (5th edition), Khanna Publishers, Delhi.
4. Energy Storage: Fundamentals, Materials and Applications, by Huggins R. A., Springer
5. Chemical and Electrochemical Energy System by R. Narayan and B. Viswanathan, University Press.
6. Battery Systems Engineering by C. D. Rahn and C. Wang, Wiley Pub.
7. Electrochemical Energy Storage for Renewable sources and grid balancing by P. T. Moseley and J. Garche, Elsevier Science.
8. Solar Photovoltaic Technology and Systems by C S Solanki

List of Experiments: (Any 2)

1. To calculate the thermal efficiency of liquid flat plate collector.
2. To study the box type solar cooker.
3. To determine an instantaneous thermal efficiency of parabolic collector.
4. To calculate an efficiency and fill factor of PN junction solar cell.
5. To study I-V characteristic of various types of solar cells.

T.Y.B.Sc. (Physics) (Sem-V)
PHY-357: Physics Laboratory-3A

Lectures: 36 **(Credits-02)**

(General Laboratory, Electromagnetism, Atomic and Molecular Physics, and Optics)

(Any Eight)

GROUP-I: GENERAL PHYSICS (any FOUR)

1. Kater's pendulum
2. Moment of Inertia by Bifilar suspension
3. Young's modulus by Koeing method
4. Surface tension of mercury by ripple method
5. Surface tension liquid by Fergusson method
6. Surface tension of mercury by Quincke's method
7. 'Y' by vibration of wooden scale
8. Young's modulus by Newton's rings
9. Determination of wavelength of light by Michelson's interferometer
10. Study of damped oscillations of physical pendulum and finding log decrement

GROUP-II: ELECTROMAGNETISM (any TWO)

1. Study of forced oscillations by electromagnetically driven simple pendulum
2. Self-Inductance by Anderson's bridge
3. Core losses in transformers
4. Electromagnetic pendulum
5. Self-Inductance by Maxwell's bridge

GROUP-III: ATOMIC AND MOLECULAR PHYSICS AND OPTICS (any TWO)

1. Determination of Rydberg's constant
2. Zeeman Effect
3. Llyod's mirror
4. Determination of Resolving Power of grating
5. Determination of wavelength by Constant deviation spectrometer

Additional Activities (Any ONE)

- Demonstrations: Any 2 demonstrations equivalent to 2 experiments
- Study tour with report equivalent to 2 experiments
- Mini project equivalent to 2 experiments
- Computer aided demonstrations (simulations or animations)
  (Any 2 demonstrations equivalent to 2 experiments)

*Note: Students have to perform **ten** experiments or **one** additional activities in addition to **eight** experiments mentioned above. Total laboratory work with additional activities should be equivalent to **ten** experiments.*

T.Y.B.Sc. (Physics) (Sem-V)
PHY-358: Physics Laboratory-3B

Lectures: 36 **(Credits-02)**

GROUP-I: EXPERIMENTS USING CRO/INSTRUMENTATION (any TWO)

1. Charging and discharging of capacitor and RC time constant
2. Measurement of g using simple pendulum
3. Velocity of sound
4. Radiation detection
5. IV Characteristics of diode
6. Measuring a value of a capacitor using CRO.
7. Temperature controller using AD590
8. Study of IC 7490 as mod 2, mod 5, mod 7 and mod 10 counter.

GROUP-II: C-PROGRAMMING (any TWO)

1. Factorial of a number by simple and recursive method.
2. To find out the first 100 prime numbers
3. Matrix multiplication
4. Position time data using kinematic equations
5. Finding pressure using Van-der-Waals' equation of state

GROUP-III: COMPUTATIONAL PHYSICS (NUMERICAL BASED) (any TWO)

1. Roots of an algebraic equation (Bisection)
2. Roots of polynomial (Newton Raphson)
3. Numerical Integration by Trapezoidal rule
4. Numerical Integration by Simpson's 1/3 rule

GROUP-IV: PRACTICAL FROM OPTIONAL COURSE (Any TWO)

Additional Activities (Any ONE)

- Demonstrations: Any 2 demonstrations equivalent to 2 experiments
- Study tour with report equivalent to 2 experiments
- Mini project equivalent to 2 experiments
- Computer aided demonstrations (simulations or animations)
  (Any 2 demonstrations equivalent to 2 experiments)

Note: *Students have to perform* ***ten*** *experiments or* ***one*** *additional activities in addition to* ***eight*** *experiments mentioned above. Total laboratory work with additional activities should be equivalent to* ***ten*** *experiments.*

T.Y.B.Sc. (Physics) (Sem-V)
PHY-359: Physics Project-I

(Credits-02)

Lectures: 36

Guidelines:

It is expected that,

1. The student does work equivalent to about ten (10) laboratory experiments throughout the semester in the third year.
2. One bears in mind that the project work is a practical course and it is intended to develop a set of skills pertaining to the laboratory work apart from the cognition of students. Therefore, the guides should not permit projects that involve no contribution on part of student.
3. The project must have a clear and strong link with the principles of basic physics and/or their applications.
4. The theme chosen should be such that it promotes better understanding of physics concepts and brings out the creativity in the students.
5. The evaluation of the project work must give due credit to the amount of the project work actually done by a student, skills shown by the student, understanding of the physics concepts involved and the final presentation at the time of viva voce.
6. It is also recommended that a teacher will look after Four (4) projects at one time.
7. Practical examination will be conducted semester wise.
8. The student can perform an Experimental/Theoretical/Computational Project in Physics or interdisciplinary areas under the supervision of one or more guides.
9. The student can learn the basics of the topic chosen for project, to learn how to do literature survey and set up the basic experimental/theoretical and computational techniques needed for the project.
10. The department encourage to students for projects both in experimental and theoretical areas of Physics in collaboration with other institutes and industry.

The Project work shall consist of the following Criterions.

1. Project work is mandatory for all the T. Y .B. Sc. students.
2. All the T. Y. B. Sc. students will be have to complete the Project work prescribed by the Board of Studies in Physics of Savitribai Phule Pune University during the Vth Semester.
3. The Project work shall consist of the following Criterions.
   - It is expected that students must finalize the Title of Project, Aim and objective, Significance, Literature survey, Materials required, Method and Application etc.
   - Introduction to foundations of Project Work.
   - Introduction of Project Research Methodology.
   - Study of Data Collection Methods.
   - Project Problem Writing and Presentation Skills.

Evaluation weightage:

- Project-I: Semester End University Examination : 35 Marks
- Internal Examination: 15 Marks

T.Y.B.Sc. (Physics) (Sem-V)

PHY-3510 SEC (J): Smart Sensors and Transducer Technology

(Credits-02)

Lectures: 36

Course Objectives:

- To make students familiar with the constructions and working principle of different types of sensors and transducers.
- To make students aware about the measuring instruments and the methods of measurement and the use of different transducers.

Course Outcomes: At the end of the course, a student will be able to:

- Use concepts in common methods for converting a physical parameter into an electrical quantity
- Classify and explain with examples of transducers, including those for measurement of temperature, strain, motion, position and light
- Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc
- Predict correctly the expected performance of various sensors
- Locate different type of sensors used in real life applications and paraphrase their importance
- Set up testing strategies to evaluate performance characteristics of different types of sensors and transducers and develop professional skills in acquiring and applying the knowledge outside the classroom through design of a real-life instrumentation system.

[18 L]

Syllabus:

Unit-I: Mechanical and Electromechanical sensor:

Definition, principle of sensing & transduction, classification. Resistive (potentiometric type): Forms, material, resolution, accuracy, sensitivity. Strain gauge: Theory, type, materials, design consideration, sensitivity, gauge factor, variation with temperature, adhesive, rosettes. LVDT: Construction, material, output input relationship, I/O curve, discussion.

Unit-II: Capacitive sensors:

Variable distance-parallel plate type, variable area- parallel plate, serrated plate/teeth type and cylindrical type, variable dielectric constant type, calculation of sensitivity. Stretched diaphragm type: microphone, response characteristics..

Unit-III: Thermal sensors:

Material expansion type: solid, liquid, gas & vapor Resistance change type: RTD materials, tip sensitive & stem sensitive type. Thermo emf sensor: types, thermoelectric power, general consideration, Junction semiconductor type IC and PTAT type.

Unit-IV: Magnetic sensors:

Sensor based on Villari effect for assessment of force, torque, proximity, Wiedemann effect for yoke coil sensors, Thomson effect, Hall effect, and Hall drive, performance characteristics. Radiation sensors: LDR.

Activity: any-6 (At least one activity from each unit) **[18 L]**

Unit-I:

1) Linear displacement measurement using potentiometric sensor.
2) Displacement/pressure measurement using strain gauge sensor.
3) Linear displacement measurement using LVDT.

Unit-II:

1) Capacitive type transducer measure small displacement/force varying plate area/distance of plate/dielectric constant.
2) Displacement/pressure measurement using microphone.
3) Liquid pressure measurement using pressure sensor

Unit-III:

1) Measurement of temperature using RTD .
2) Measurement of temperature using Thermocouple transducer.
3) Silicon diode as temperature sensor

Unit-IV:

1) Magnetic sensor/Hall effect/proximity sensor based measurement magnetic susceptibility magnetisation
2) LDR based measurement light intensity etc.

Reference books:

1) R Sensor & transducers, D. Patranabis, 2nd edition, PHI
2) Instrument transducers, H.K.P. Neubert, Oxford University press.
3) Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill
4) Sensor & transducers, D. Patranabis, 2nd edition, PHI
5) Instrument transducers, H.K.P. Neubert, Oxford University press.
6) Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill

T.Y.B.Sc. (Physics) (Sem-V)

PHY-3511 SEC (K): Physics Workshop Skill

(Credits-02)

Lectures: 36

Objectives:

This course is to get exposure with various aspects of instruments and their usage through hands-on mode.

Course outcomes:-

After completion of this course students will able to handle and test various instruments.

Syllabus:

Unit-1. Basic of Measurement: **4L**

- Accuracy, precision, sensitivity, resolution, range etc.
- Errors in measurements and loading effects.
- Principle and working of digital meters. Comparison of analog & digital instruments. Characteristics of a digital meter.

Multimeter:

- Block diagram and working of a digital multimeter.
- Principles of measurement of dc voltage and dc current, ac voltage, ac current and resistance.
- Specifications of a multimeter and their significance.

Unit-2. Electronic Voltmeter: **4L**

- Principles of voltmeter, Construction (block diagram only).
- Specifications of an electronic Voltmeter and their significance.
- AC Milli Voltmeter: Type of AC Milli Voltmeters
- Block diagram ac Milli Voltmeter,
- Specifications and their significance.

Unit-3. Cathode Ray Oscilloscope: **5L**

- Block diagram of basic CRO.
- Construction of CRT, Electron gun, electrostatic focusing and acceleration (Explanation only-no mathematical treatment),
- Brief discussion on screen phosphor, visual persistence & chemical composition.
- Time base operation, synchronization. Front panel controls.
- Specifications of a CRO and their significance.
- Use of CRO for the measurement of voltage (dc and ac frequency, time period.
- Special featuresof dual trace oscilloscope.
- Introduction to digital oscilloscope, Block diagram and principle and working.

Unit-4. Signal Generators and Analysis Instruments: **2L**

- Block diagram, explanation and specificationsof low frequency signal generators.
- Pulse generator, and function generator.

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-361: Solid State Physics

Lectures: 36 **(Credits-02)**

1: The Crystalline Structures **(10 L)**

Lattice, Basis, Translational Vectors, Primitive Unit Cell, Symmetry Operations, Different types of lattices: 2D and 3D (Bravais lattices) Miller indices, Inter Planer Distances, SC, BCC and FCC structures, Packing Fraction, Crystal structures NaCl, diamond, CsCl, ZnS, HCP, Concept of Reciprocal Lattice and its properties, Problems

2: X ray Diffraction and Experimental Methods **(9 L)**

Bragg's Diffraction, Bragg's Law, Experimental X-ray diffraction Methods: The Laue Method, Bragg's Spectrometer, The Powder Crystal Method, Analysis of cubic structure by Powder Method, Ewald's Construction, Bragg's Diffraction condition in direct and reciprocal lattice, Problems

3: Free Electron and Band Theory of Metals **(9L)**

Assumptions of Classical and Somerfield Free Electron model, Energy levels and Density of States (One and Three Dimensions), Nearly free electron model, Fermi energy, Fermi level, Hall Effect, Mobility, Hall Angle

Band Theory of Solids: Origin of energy gap, Energy bands in Solids, Distinction between metal, semiconductor and insulator, Problems

4: Magnetism **(8L)**

Diamagnetism, Langevin theory of Diamagnetism, Paramagnetism, Langevin theory of Paramagnetism, Ferromagnetism, Antiferromagnetism, Ferromagnetic Domains, Hysteresis, Curie temperature, Neel temperature, **Superconductivity**, Day to day applications of Magnetism, Problems

Reference books:

1. Solid State Physics S.O.Pillai, 6th Edition, New Age International (P) Ltd, Publisher, (2010).
2. Solid State Physics – Kakani S.L. and Hemrajani C, 4th Edition, S. Chand Publication (2005).
3. Fundamentals of Solid State Physics – B.S.Saxena, R.C.Gupta and P.N.Saxena, Pragati Prakashan, Meerut , Uttar Pradesh
4. Introduction to Solid State Physics- Charles Kittel, John Wiley and Sons, 7th Edition.
5. Solid State Physics- A.J.Dekker, Macmillan India Ltd, (1998).
6. Solid State Physics- R.K. Puri, V.K. Babbar, S. Chand Publication.
7. Elementary Solid State Physics Principles and Applications, M Ali Omar, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc.(2006)
8. Problems and Solution in Solid State Physics-S.O. Pillai, New Age International (P) Ltd.
9. Solid State Physics, P.K. Palanisamy, Scitech Publications(India) Pvt Ltd, Chennei, 1st Edition (2004)
10. Solid State Physics: Essential Concepts, David W. Snoke, 2nd Edition, Cambridge University Press

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-362: Quantum Mechanics

Lectures: 36 (Credits-02)

1: Origin of Quantum Mechanics (08 L)

1. Historical Background: Black body radiation, photoelectric effects.
2. Matter waves - De Broglie hypothesis. Davisson and Germer experiment.
3. Wave particle duality
4. Concept of wave function, wave packet, phase velocity, group velocity and relation between them
5. Heisenberg's uncertainty principle with Electron diffraction experiment, different forms of uncertainty.
6. Different fields of applications of quantum mechanics
7. Problems

2: The Schrodinger equation (10 L)

1. Physical interpretation of wave function
2. Schrodinger time dependent equation.
3. Schrodinger time independent equation.(Steady state equation).
4. Requirements of wave function.
5. Probability current density, equation of continuity, and its physical significance.
6. An operator in Quantum mechanics, Eigen function and Eigen values.
7. Expectation value, Ehrenfest's theorem (Only statements)
8. Problems

3: Applications of Schrodinger Steady state equation (14 L)

1. Free particle.
2. Step potential.
3. Potential barrier. (Qualitative discussion). Barrier penetration and tunnelling effect.
4. Particle in infinitely deep potential well (one - dimension).
5. Schrodinger's equation in spherical polar co-ordinate system.
6. Rigid rotator (free axis).
7. Problems

4: Operators in Quantum Mechanics (4 L)

1. Hermitian operator.
2. Position, Momentum operator, angular momentum operator, and total energy operator (Hamiltonian).
3. Commutator brackets- Simultaneous Eigen functions.
4. Commutator Algebra
5. Commutator bracket using position, momentum and angular momentum operator
6. Concept of parity according to quantum mechanics, parity operator and its Eigen values.
7. Applications of Operators in Quantum Mechanics
8. Problems

T.Y.B.Sc. (Physics) (Sem-VI)

PHY-363: Thermodynamics and Statistical Physics

Lectures: 36 **(Credits-02)**

1: Transport phenomenon and Maxwell's relations: **(9L)**

Mean free path, Transport phenomenon, Viscosity, Thermal conductivity and diffusion. Thermodynamic functions: Internal Energy, Enthalpy, Helmholtz function, Gibb's function, Derivation of Maxwell Relations, Specific heat and latent heat equations, Joule Thomson effect (Throttling Process), Problems

2: Elementary Concepts of Statistics: **(9L)**

Probability, distribution functions, Random Walk and Binomial distribution, Simple random walk problem, Calculation of mean values, Probability distribution for large-scale N, Gaussian probability distributions, Problems

3: Statistical Distribution of System of Particles and Ensembles: **(12L)**

Specification of state of system, Statistical ensembles, Basic Postulates, Probability calculations, Behaviors of density of states, Thermal, Mechanical and general interactions

Micro canonical Ensemble (Isolated System), Canonical ensembles, simple application of canonical ensemble, Molecules in Ideal gas, Calculation of mean values in canonical ensemble. Problems.

4: Introduction to Quantum Statistics: **(6L)**

Quantum distribution function, Maxwell-Boltzmann's statistics, Bose-Einstein Statistics, Fermi-Dirac Statistics, Comparison of the distributions. Applications of Quantum Statistics, Problems.

Reference books:

1) Lokanathan, R.S. Gambhir, Statistical and Thermal physics
2) F. Reif, Fundamentals of statistical and thermal physics
3) A. Beiser, Perspectives of modern physics
4) B.B. Laud, Fundamental of Statistical Mechanics
5) R.B. Singh, A primer of Statistical Mechanics
6) Gupta, Kumar, Statistical Mechanics

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-364: Nuclear Physics

Lectures: 36 (Credits-02)

1: Nuclear Structure, Properties and Radioactivity: **(12 L)**

a) Basic Concept of Nucleus:

- Composition, charge, size, density of nucleus(Revision)
- Nuclear Angular momentum,
- Nuclear magnetic dipole moment
- Electric quadrupole moment, Parity & symmetry,
- Mass defect and Binding energy, packing fraction,
- Classification of nuclei,
- Stability of nuclei (N Vs Z Curve)
- Day to day applications of Nuclear Physics
- Problems.

b) Radioactivity:

- Radioactivity disintegration (concept of natural and artificial radioactivity, Properties of α, β, γ-rays, Laws of radioactive decay, half-life, mean life, Specific activity and its units (Revision)
- Successive disintegration and equilibriums and radioisotopes.
- Radiocarbon dating
- Application of radioactivity (Agricultural, Medical, Industrial, Archaeological).
- Problems

Ref.(1) Ch.(2,3), Ref.(3) Ch.(3, 6)

2: Particle Accelerator and Radiation Detectors: **(06 L)**

a) Particle Accelerators:

- Introduction and Classification
- Linear Accelerator (electron/proton LINAC)
- Cyclic Accelerator (Cyclotron)
- Particle Accelerators In India (Discussion only)

Ref.(1) Ch.(12)

b) Nuclear Detector:

- Classification of Nuclear Detectors
- Gas filled Detectors (G. M. counter)
- Solid state detectors (scintillation counter)
- Problems:

Ref.(2) Ch.(4), Ref.(3) Ch.(7, 15)

3: Nuclear forces and Nuclear Models: **(09 L)**

a) Nuclear Forces:

- Classification of Nuclear Forces

- Meson theory of nuclear forces,
- Properties Of nuclear forces, properties of deuteron system,
- Elementary particles,

b) Nuclear Models:

- Quarks model for elementary particles
- Shell Model: Assumptions, Evidences, and Spin and Parity limitations.
- Liquid drop model: Assumptions
- Semi-empirical B.E. formula
- Problems:

Ref.(1) Ch.(9, 17, 18), Ref.(3) Ch.(18)

4: Nuclear Reactions and Reactor Theory: **(09 L)**

a) Introduction to Nuclear reactions:

- Nuclear Reaction, Conservation laws (Revision)
- The Q-value equation, Exothermic and Endothermic reaction
- Compound nucleus
- Threshold energy
- Nuclear cross-section
- Nuclear fission , nuclear fusion stellar energy, chain reaction and critical mass,

b) Reactor Theory:

- Nuclear reactor and its basic components, homogeneous and heterogeneous reactors, power reactor, fast breeders
- Nuclear Reactors In India (Discussion only)
- Problems.

Ref.(1) Ch.(14, 15), Ref.(3) Ch.(11, 13, 14)

Reference books:

1. Dr. S. N. Ghoshal, Nuclear Physics, Revised Edition, S. Chand Publication, 2014
2. D. C. Tayal, Nuclear Physics, Revised Enlarged Edition, Himalaya Publishing House.
3. K.S. Krane, Introductory Nuclear Physics, Wiley, India, 1988
4. B. L. Cohen, Concepts of Nuclear Physics, Tata McGraw Hill
5. I. Kaplan, Nuclear Physics, 2nd Edition, Narosa, New Delhi, 1989
6. S.B. Patel, Nuclear Physics: An Introduction, New Age International, 1991

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-365 (A): Electronics-II

Lectures: 36 (Credits-02)

1: Semiconductor Devices: (9L)

a. LED and Photodiode, Optocoupler. (Working Principles) Problems. Ref. 1.
b. BJT: Transistor amplifier classifications - Class A, B, C and AB (working only), Differential amplifier (transistorized), Problems. Ref. 1.
c. Field Effect Transistor: JFET (Introduction, classification, principle, working and IV characteristics) MOSFETs (DE-MOSFET and E only MOSFET). Problems. Ref. 1

2: Applications of Semiconductor Devices: (9L)

a. Three Pin Regulators: Block diagram of 3-pin IC regulator, study of IC-78XX, 79XX. Dual Power Supply using IC-78XX, 79XX. Ref. 1
b. Switching Regulators (SMPS): Introduction, Block diagram, Advantages and Disadvantages. Ref. 4
c. Modulation and Demodulation : Concept of Carrier Wave, Need of Modulation and Demodulation, Methods of Modulation like AM, FM, PM (Concepts Only),
d. Concept of Modulation Index, Upper and Lower Side Band Frequencies in AM. Problems, Ref.3

3: Integrated Circuits: (9L)

a. Integrated Circuits: Introduction, Scale of Integration, Advantages and drawbacks of IC Ref.4
b. OP-AMP Applications as Integrator, Differentiator, Comparator. Ref. 1
c. Timer IC-555: Block diagram, Astable, monostable multivibrator (working and design). Problems, Ref. 1

4: Combinational and Sequential Circuits: (9L)

a. Combinational Circuits: Introduction to SOP and POS equation. Concept of Standard SOP and POS equation. Concept of K-map and their use in reduction of Boolean expressions, design of half adder, full adder, half subtract, Study of binary to gray and gray to binary code conversion. Problems. Ref. 2
b. Sequential Circuits: RS flip flop using NAND/NOR, clocked RS, D, JK and T-flip flops. Application of flip flops in Sequential Circuits as Counters and Registers. Asynchronous and Synchronous Counters. (3-bit Counter), Shift Registers and their types of operation -SISO, SIPO, PISO, PIPO (Concepts only). Ref. 2

Reference books:

1. Malvino, Electronic Principles (6th Ed.), Tata McGraw Hill, New Delhi
2. R. P. Jain, Modern Digital Electronics (3rd Ed.), Tata McGraw Hill, New Delhi
3. B. L. Theraja, Basic Electronics - Solid State, S. Chand and Company, New Delhi
4. K. R. Botkar, Integrated Circuits, Khanna Publishers, Delhi

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-366 Elective-II (R): Lasers

Lectures: 36 **(Credits-02)**

1: Introduction to Lasers: **(8 L)**

Brief history of Lasers, Interaction of radiation with matter, Energy levels, Population density, Boltzmann distribution, Stimulated Absorption, Spontaneous Emission and Stimulated Emission, Einstein's Coefficients, Einstein's relations.

Characteristics of Laser: Directionality, Mono-chromaticity, Coherence,

2: Laser Action: **(6 L)**

Population inversion, Condition for light amplification, Gain coefficient, Active medium, metastable states.

Pumping schemes: three level and four level

3: Laser Oscillator: **(6 L)**

Optical feedback, round trip gain, critical population inversion, Optical resonator, condition for steady state oscillations, cavity resonance frequencies.

4: Laser Output: **(3 L)**

Line-shape broadening: Lifetime broadening, Collision broadening

5: Types of Lasers: **(7 L)**

Solid State Lasers – Ruby Laser, Diode Laser, Gas Lasers – HeNe Laser, CO_2 Laser

6: Applications of Lasers: **(6 L)**

Industrial: welding, cutting, drilling

Nuclear Science: laser isotope separation, laser fusion,

Medical: eye surgery

Reference books:

1. An introduction to Lasers - Theory and applications, M.N. Avadhanulu, S. Chand and Co. New Delhi
2. Experiments with He-Ne Laser by Sirohi
3. Optical fibre and Laser - Principle and applications, Anuradha De, New Age International Publishers,

List of Experiments: (Any Two)

1. Determination of wavelength of He-Ne Laser by transmission grating
2. Determination of Angle of prism (Pin and drawing paper)
3. Study of Lissajous figures using diode Laser and mirrors
4. Beam divergence of a Diode Laser.
5. Determination of the diameter of a thin wire using a laser.
6. Measurement of wavelength of Laser beam using Michelson Interferometer.
7. To study the interference of light using optical fibers
8. Measurement of the focal length of a given convex lens using a laser.

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-367: Physics Laboratory-4A

Lectures: 36 **(Credits-02)**

(General Physics, Thermodynamics and Statistical Physics, Nuclear Physics and Quantum Mechanics)

(Any Eight)

GROUP-I: GENERAL PHYSICS (any FOUR)

1. Surface Tension of Mercury by method of Ripples.
2. Viscosity of Liquid by rotating cylinder method.
3. Coefficient of sound absorption
4. 'Y' by Cornu's Method
5. Hall Effect: To measure the Hall coefficient
6. Energy gap of a semiconductor
7. Study of XRD spectrum of any material.
8. Resistivity by Four probe method
9. Platinum resistance thermometer

GROUP-II: THERMODYNAMICS AND STATISTICAL PHYSICS (any TWO)

1. Determination of pressure coefficient of air by constant volume thermometer.
2. Verification of Stefan's fourth power law by bulb filament
3. Thermal conductivity by Forbes Method.
4. Thermal conductivity of rubber tube.
5. Thermal diffusivity of Brass.
6. Thermal and Electrical conductivity of Cu.

GROUP-III: NUCLEAR PHYSICS AND QUANTUM MECHANICS (any TWO)

1. Characteristics of G.M. tube
2. Inverse square law (γ-rays)
3. e/m by Thomson method
4. Determination of Planck's constant
5. Study of Gaussian distribution by G. M. tube.

Additional Activities (Any ONE)

- Demonstrations: Any 2 demonstrations equivalent to 2 experiments
- Study tour with report equivalent to 2 experiments
- Mini project equivalent to 2 experiments
- Computer aided demonstrations (simulations or animations)
  (Any 2 demonstrations equivalent to 2 experiments)

*Note: Students have to perform **ten** experiments or **one** additional activities in addition to **eight** experiments mentioned above. Total laboratory work with additional activities should be equivalent to **ten** experiments.*

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-368: Physics Laboratory-4B

Lectures: 36 **(Credits-02)**

(Electronics (Essential) or Advanced Electronics, acoustics and Lasers, Optional Courses)

(Any Eight)

GROUP-I: ELECTRONICS (ESSENTIAL) (any TWO)

(For the students not offering advance electronics in theory courses)

1. Characteristics of JFET
2. Design and built astable multivibrator using IC 555/IC 741
3. Half adder /Full adder
4. Integrator and differentiator using IC 741
5. IC 723 as regulated power supply

GROUP-I: ADVANCED ELECTRONICS (any TWO)

(For the students offering advance electronics in theory courses)

1. Instrumental amplifier using three op-amps
2. Temperature controller using PT 100 / thermocouple /thermistor temperature sensors
3. Object counter (two digit)
4. Schmitt trigger
5. Study of LVDT

GROUP-II: ACOUSTICS AND LASERS (any FOUR)

1. Frequency response of loudspeaker (twitter, woofer, mid-range)
2. Study of interference by Quinck's method
3. Use of Ultrasonic interferometer to measure velocity of sound in liquids
4. Transmission loss using expansion chamber muffler.
5. Study of diffraction using a transmission/reflection grating (metal ruler)
6. Study of the characteristics of a laser beam.
7. Determination of the diameter of a thin wire using a laser beam.
8. 'μ' By total internal reflection of light

GROUP-III: PRACTICAL FROM OPTIONAL COURSE (Any-2)

Additional Activities (Any ONE)

- Demonstrations: Any 2 demonstrations equivalent to 2 experiments
- Study tour with report equivalent to 2 experiments
- Mini project equivalent to 2 experiments
- Computer aided demonstrations (simulations or animations)

(Any 2 demonstrations equivalent to 2 experiments)

*Note: Students have to perform **ten** experiments or **one** additional activities in addition to **eight** experiments mentioned above. Total laboratory work with additional activities should be equivalent to **ten** experiments.*

5. Energy Audit Measurements and Instruments, and Preparation of Energy Audit Report (in brief).
6. Case studies of Energy Audit & Management (e.g. Industries & Green Buildings, Boilers, Furnaces, Refrigeration and Air conditioning, Cogeneration, Waste Heat recovery, Electric motors, Pumping systems, Fans and blowers, Cooling Towers,
   Industrial/Commercial Lighting system, BEE Star rated equipment) any one.

Ref- 4 to 12 - Use any book for reference

Reference books:

1. Non-conventional Energy Sources, G. D. RAI (4th edition), Khanna Publishers, Delhi.
2. Solar Energy, S.P. Sukhatme (second edition), Tata Mc Graw Hill Ltd, New Delhi.
3. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers, Delhi.
4. Energy Management: W.R.Murphy, G.Mckay (Butterworths).
5. Energy Management Principles: C.B.Smith (Pergamon Press).
6. Efficient Use of Energy: I.G.C.Dryden (Butterworth Scientific)
7. Energy Economics -A.V.Desai (Wieley Eastern)
8. Industrial Energy Conservation: D.A. Reay (Pergammon Press)
9. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley Inter science publication)
10. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington)
11. Hand book of Energy Audit by Sonal Desai (Publisher Tata McGraw Hill.)
12. Energy Management and Conservation Handbook, Frank Kreith and Yogi Goswami, (CRC Press)

List of Experiments: (Any Two)

1. Fuel value of wood/charcoal.
2. Study of sensible heat storage using liquid.
3. Selective and Non-selective coatings – Determination of Selectivity ratio.
4. To do energy audit of home/society/college/industry and prepare a detail audit report.
5. Study and analysis of home Electricity Bill
6. Study of Power consumption of conventional tube light vs LED fitting

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-369: Physics Project-II

(Credits-02)

Lectures: 36

Guidelines:

It is expected that,

1. The student does work equivalent to about 10 laboratory experiments throughout the semesters in the third year.
2. One bears in mind that the project work is a practical course and it is intended to develop a set of skills pertaining to the laboratory work apart from the cognition of students. Therefore, the guides should not permit projects that involve no contribution on part of student.
3. The project must have a clear and strong link with the principles of basic physics and/or their applications.
4. The theme chosen should be such that it promotes better understanding of physics concepts and brings out the creativity in the students.
5. The evaluation of the project work must give due credit to the amount of the project work actually done by a student, skills shown by the student, understanding of the physics concepts involved and the presentation of the final report at the time of viva voce.
6. The viva voce should be conducted at the time of evaluation of project work at least for twenty minutes per student. Extra care must be taken in the evaluation of projects done in a pair or group. Delegation of the work done by individuals must be sought from the students in such cases.
7. Any ready-made material used in the report (such as downloaded pages from the web) must be clearly referred to and acknowledged.
8. It is also recommended that a teacher will look after 4 projects at one time.
9. Any non-adherence to this norm should attract a penalty by way of deduction in the marks awarded to a student. It is recommended that the College will provide consumables/contingencies for every project, to the tune of Rs. 750 /- each. (*If the students paid extra fee other than laboratory fee then college will provide financial assistance for the Project work.)

The Project work shall consist of the following Criterions.

1) Working model (Experimental or Concept based simulation/Demonstration Related to Physics).
2) Understanding of the project.
3) Experimental Details.
4) Data collection and Data Analysis.
5) Innovation.
6) Outcomes/Result.
7) Conclusion.

Note: At the time of project practical examination, the candidate must submit the certified project report by the project in-charge and HOD. A candidate will be allowed to appear for the Project practical examination only if the candidate submits a project completion report duly certified by the project in-charge and Head of the department.

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-366 Elective-II (T): Renewable Energy Sources-II

Lectures: 36 **(Credits-02)**

1: Bioenergy and Biofuels:

Bioenergy: **(10L)**

1. Introduction to Bioenergy
2. Basic Routs: Biochemical, Thermochemical, Transesterification
3. Biochemical- Biogas generation/methanation
4. Biogas plant: Floating gas holder and fixed dome type biogas plant, construction and working
5. Factors affecting on bio-digestion (list of factors).
6. Thermochemical: Pyrolysis, Gasification, Carbonization
7. Transesterification:
8. Comparative study of floating gas holder and fixed dome type biogas plant.
9. Working of downdraft gasifier.
10. Various methods to obtain energy from biomass.

Biofuel:

1. Introduction to Biofuels
2. Production of Biofuels (Jatropa and Sugar cane bagasse)

Ref 1: 7.1, 7.2, 7.2.1, 7.2.2, 7.4, 7.5, 7.6, 7.7, 7.8, 7.11, 7.23, 7.24.1
Ref 2: 10.3 (page no 374 to 380)

2: Wind Energy

1. Introduction to wind energy.
2. Principles and components of wind energy conversion system. **(08L)**
3. Classification of wind machines: Horizontal axial machine and vertical axial machine.
4. Advantages and disadvantages of wind energy.
5. Wind data

Ref -1: 6.1, 6.2, 6.3, 6.5, 6.7, 6.8

3: Other Energy Sources:

1. Introduction to tidal and geothermal energy.
2. Tidal energy: methods of utilization of tidal energy. **(08L)**
3. Advantages and disadvantages of tidal power generation.
4. Geothermal energy: Geothermal sources and energy conversion.
5. Advantages and disadvantages of geothermal energy.
6. Introduction to Thermocell

Ref -1 (9.3), pages from 510-532),
Ref -1 (8), pages from 443, 470-476, 477) Ref -1 (11), pages from 609-657)

4: Energy Management:

1. Introduction to Energy Management (Definition, Principles etc) **(10L)**
2. Need of Energy Saving and Management
3. Different strategies of Energy Management
4. Role of Energy Managers and Auditors,

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-3610 SEC (V): Solar PV System: Installation, Repairing and Maintenance

Lectures: 36 **(Credits-02)**

Objectives:

1. In this skill oriented course, student will study basics of solar photovoltaic (PV) cells, modules, and system components.
2. Design and sizing of off-grid PV system for homes, apartments as well as commercial offices.
3. Understanding energy conversion from sunlight to electricity, and working with solar conversion equipment.
4. This Course will hands on experience needed to become self-employed.

Outcomes:

1. Learn basics of light conversion in electricity.
2. Hands on training will motivate to use Solar PV system.
3. Become entrepreneur / self-employed.
4. Analyzed of MSEB electricity bill and design and sizing of off-grid PV system
5. Participants will learn about solar PV module and batteries used in solar PV plant.

Syllabus:

Unit-1: Introduction **(6L)**

The Sun, Earth, and Renewable Energy, Photovoltaic Effect, Working of Solar cell, Types of solar cell, PV Modules and Arrays, Module Parameters, Sunshine and Shadow, tracking mechanism, aligning the Array.

Unit-2: Solar Radiations and Measurement **(6L)**

Introduction, Solar constant, Solar radiation at the earth surface, Need of solar radiation measurement, Instruments for the measurement of solar Radiation, Pyrheliometer, Pyranometer, Sunshine Recorder, Sun Meter or Lux Meter

Unit-3: Basics Solar PV Systems **(6L)**

Basics types of PV Systems on grid and off grid, DC to AC conversion, Building-integrated Photovoltaics, Engineering and Architecture, Balancing of PV system. System Components, Batteries, Charge controllers, Inverters, Hybrid systems, System sizing, Applications of off grid PV System. **(18L)**

Activity: any-6

1. Estimate the value of the Solar Constant.
2. Study of intensity variation on the performance of PV module.
3. Study of series and parallel combination of the PV modules.
4. Measurement of Solar radiation measurement using Sunmeter and Pyranometer.
5. Analysis of MSEB electricity bill.
6. Energy Farm/PV Plant visit report.
7. Study of intensity variation using Sun Meter or Lux Meter.
8. Study of I-V characteristics and working of solar cell.
9. Study of different types of solar cell.
10. Study of Hybrid systems.

Reference books:

1. Solar Energy, S.P. Sukhatme (second edition), Tata Mc.Graw Hill Ltd, New Delhi.
2. Solar Energy Utilisation, G. D. RAI (5th edition), Khanna Publishers,Delhi.
3. Electricity from Sunlight, An Introduction to Photovoltaics, Paul A. Lynn, John Wiley & Sons, Ltd.
4. Solar Electricity, 2nd edition, T. Markvart, John Wiley & Sons, Ltd.
5. Solar Photovoltaic Basics, White Sean, Taylor & Francis Ltd.

T.Y.B.Sc. (Physics) (Sem-VI)
PHY-3611 SEC (AA): Radiation Physics

Lectures: 36 **(Credits-02)**

Course Objectives:

1. Students should understand the mechanism of interaction of various types of radiations with matter.
2. Students should get acquainted with principles of Measurement radiation levels, design principles and and actual implementation of variety of radiation detectors.
3. Students should learn about standards regarding safety levels laid down by National and International agencies, methods adapted to maintain safety standards in various places and methods of shielding.
4. Students should study the applications of radiations in various fields.

Course outcomes:

1. Students can use the knowledge in the applications of Radiation Physics in the fields like radio carbon dating, medical diagnostic tools.
2. Students acquire skill in operating different types of radiation detectors to detect and measure radiation levels in different places.
3. Students can work as advisers in maintenance of radiation safety standards and following of strict protocols at various places like Hospitals, Industry, and Laboratories etc.
4. Students become able to employ their skills to develop applications of radio activity in the fields like agriculture, industry, hospitals etc.

Syllabus:

Unit No.	Title and Contents	Lectures
I	**Interaction of Radiation with Matter** Interaction of different types of radiation with matter-Ionizing & Nonionizing radiations, excitation, ionization, radioactive losses-Energy loss by collision, range energy relation, Bethe-Bloch formula collision stopping power, radiation stopping power, Straggling.	3
II	**Radiation Detectors** Characteristic curve of Gas-filled detectors. Ionization chamber, Proportional counter, Gas filled detectors (G. M. counter), Characteristics of organic and inorganic scintillation detectors, Scintillator detector, Semiconductor detector.	3
III	**Radiation units and Measurement of radiation exposure** Units for radiation exposure- Roentgen, Becquerel, Gray, Sievert, RAD, REM, KERMA. Radiation exposure, Absorbed Dose, Equivalent Dose, Effective Dose, Ambient and directional equivalent dose, Relative biological effective dose, Quality factor, Personal dosimeters, Film badge dosimeters, Thermo luminescent dosimeter.	3
IV	**Radiation Sources and Radiation Shielding** Natural & Artificial radioactive sources, Alpha, Beta, Gamma Sources, Basic concept of radiation shielding, linear and mass absorption coefficient, stopping power, materials for shielding of gamma and neutron, shielding interaction cross section.	3

Faculty of Science and Technology

M. Sc. (Physics)

Choice Based Credit System (CBCS)

To be implemented from Academic Year 2020-2021

Structure and Syllabus

SAVITRIBAI PHULE PUNE UNIVERSITY
GANESHKHIND, PUNE-411007

Proposed Structure of M. Sc. (Physics) Syllabus (C. B. C. S.)

1. Title of the Course: M. Sc. Physics

2. Preamble:

The curriculum for the M. Sc. (Physics) programme is designed to cater to the requirement of Choice Based Credit System following the University Grants Commission (UGC) guidelines. In the proposed structure, due consideration is given to Core and Elective Courses (Discipline specific - Physics), along with Ability Enhancement (Compulsory and Skill based) Courses. Furthermore, continuous assessment is an integral part of the CBCS, which will facilitate systematic and thorough learning towards better understanding of the subject. The systematic and planned curricula divided into two years (comprised of four semesters) shall motivate the student for pursuing higher studies in Physics and inculcate enough skills for becoming an entrepreneur.

Objectives:

- To foster scientific attitude, provide in-depth knowledge of scientific and technological concepts of Physics.
- To enrich knowledge through problem solving, minor/major projects, seminars, tutorials, review of research articles/papers, participation in scientific events, study visits, etc.
- To familiarize with recent scientific and technological developments.
- To create foundation for research and development in Physics.
- To help students to learn various experimental and computational tools thereby developing analytical abilities to address real world problems.
- To train students in skills related to research, education, industry and market.
- To help students to build-up a progressive and successful career in Physics.

Detailed Syllabi:

Course Code and Title: PHCT-111 Mathematical Methods in Physics

Module 1: Complex Analysis **Credit-1**

Complex number, Complex function (polynomial, Exponential, Trigonometric complex function, Logarithm), Limit and Continuity, differentiation, Analytical function, Cauchy-Riemann condition, Line integrals, Cauchy integral formula, Derivative of analytical functions, Power Series, Taylor's theorem, Laurent's theorem, Calculus of residues, Evaluation of real definite integrals

References: 1-5

Module 2: Vector Space and Matrix Algebra **Credit-1**

Revision on Vector space: Vectors (dependent and independent), Vector space, Hilbert space, Dimension of vector space, Matrix representation, Similarity transformation, Eigen values and Eigen vectors, Inner product, Orthogonality, Introduction only to Gramm-Schmidt orthogonalization procedure, Self adjoint and unitary transformation, Eigen values and Eigen vectors of Hermitian and Unitary transformation, Diagonalization

References: 6, 7

Module 3: Special Functions **Credit-1**

Bessel function, Legendre, Hermite, and Laguerre functions – Generating function, Recurrence relations and their differential equations, Orthogonality properties, Bessel's function of first kind, Spherical, Associated Legendre function, Spherical harmonics

References: 4, 5, 7

Module 4: Fourier Series and Integral Transforms **Credit-1**

Fourier series: Definition, Dirichlet's Condition, Convergence, Fourier Integral and Fourier transform, convolution theorem, Parseval's identity, Application to the solution of differential equations, Laplace transform and its properties, Fourier transform and Laplace transform of Dirac Delta function

References: 3, 4, 7

Reference Books:

1. Complex Variables and Application- J. W. Brown, R. V. Churchill - McGraw Hill
2. Complex Variables – Seymour Lipschutz
3. Mathematics for Physical Sciences – Mary Boas, John Wiley and Sons
4. Mathematical methods in Physics- B. D. Gupta
5. Mathematical methods in Physics- Satyaprakash
6. Linear algebra – Seymour Lipschutz, Schaum Outline Series McGraw Hill Edition
7. Mathematical Method for Physicists, Arfken and Weber, 6th Edition, Academic Press, N. Y.

Course Code and Title: PHCT-112 Classical Mechanics

Module 1: Analytical Dynamics (Lagrangian and Hamiltonian Dynamics, Canonical Transformations and Poisson Brackets) **Credit-2**

Variational principle and its applications to problems like shortest distance, brachistochrone, geodesics etc. Lagrangian and Hamiltonian equations of motion - derivation using Hamilton's principle of least action and their applications to various problems. Hamiltonian for a charged particle. Properties of kinetic energy function. Time-dependence of total energy (theorem on total energy). Symmetry and conservation laws (energy and momentum). Gauge function for Lagrangian. Invariance under Galilean transformation.

Canonical transformations and their applications. Canonical transformations of the free particle Hamiltonian. Liouville's theroem. Area conservation properties of canonical flows. Poisson Brackets. Jacobi-Poisson theorem on Poisson Brackets. Invariance of Poisson brackets under canonical transformations. Dirac's formulation of generalized Hamiltonian.

Module 2: Central Forces and Non-inertial Frames of Reference **Credit-1**

Lagragian formulation of motion under central forces. Kepler problem. Stability of orbits. Motion of satellites. Rotating frames of reference. Coriolis force, banking of rivers, Foucault's pendulum, and tides.

Module 3: Rigid Body Dynamics and Small Oscillations **Credit-1**

Moment of inertia tensor. Euler angles. Euler equation of motion for rigid body motion. Symmetric top. Small oscillations. System of couple oscillators. Normal modes and normal coordinates.

Reference Books:

1. Classical Mechanics by H. Goldstein, C. Poole and J. Safko
2. Classical Mechanics by N. C. Rana and P.S. Joag
3. Mechanics by L. D. Landau and E.M. Lifshitz
4. Classical Mechanics by J.R. Taylor
5. Classical Mechanics by P.V. Panat
6. Classical Mechanics by Y.R. Waghmare

Course Code and Title: PHCT-113 Electronics

Module 1: Semiconductor Devices and its Applications **Credit-1**

1.1 SCR: Construction, working, Characteristics and applications as half wave and full wave rectifier

1.2 DIAC and TRIAC: Construction, working, characteristics and applications as fan regulator

1.3 DC-DC converter and SMPS: Concept and applications

(Ref. 1: page nos. 166 to 194 and Ref. 2, 3)

Module 2: Special Function ICs and their Applications **Credit-1**

2.1 Operational Amplifier: Function generator using two OPAMPS with variable controls, Astable and Monostable multivibrators using OPAMPs, Precision rectifiers (Half wave and Full wave), Instrumentation amplifier

2.2 Timer IC 555: Applications as PAM, PWM, FM and FSK generator

2.3 Voltage Controlled Oscillator (IC566): Block diagram and working

2.4 Phase Locked Loop (IC565): Block diagram and working and applications as FM detector, FSK detector, Frequency multiplier and Frequency Translator (Ref. 4, 5, and 6)

Module 3: Digital Logic Circuits I: Combinational Logic **Credit-1**

Review ofBoolean identities and its use to minimize Boolean expressions.Use of Karanaugh Map to design 4-variable logic circuits like BCD to 7-segment decoder, Binary-to-Gray and Gray-to-Binary code converter.

Digital Logic Circuits II: Sequential Logic

4-bit serial, parallel and combinational counter.Study of IC 7490 with applications as MOD counters (01 to 99)Study of IC 7495 and its use as SISO, SIPO, PIPO and PISO.UP-DOWN counters, Ring counter and their applications. (Ref.: 7, 8, and 9)

Credit-1

Module 4: Data Converters

4.1 Digital to Analog converters: Binary weighted and R-2R ladder type with practical circuit (Using Input switches, Level amplifiers, Control gates and Buffer amplifier)

4.2 Analog to Digital converters: Single slope, Dual slope, Flash (Simultaneous) type, Counter ramp type, Continuous type and Successive approximation type (Ref.: 7, 8, and 9)

Reference Books:

1. Power Electronics Circuits, Devices and Applications, 3rd Edition by Muhammad H. Rashid, Pearsons Publications
2. Electronic Devices and Circuits: An Introduction by Allen Mottershed
3. Solid State Electronic Devices, 6th Edition, by Ben G. Streetman
4. Operational Amplifiers, 5th Edition by G.B. Clayton
5. Linear Integrated Circuits, 4th edition by Roy Choudhari
6. Design with OPAMPS and Analog Integrated Circuits by Sergio Franco
7. Digital Electronics by R.P. Jain
8. Digital Principles and Applications by Leach and Malvino
9. Digital Electronics: An Introduction to Theory and Practice by W.H. Gothmann

Course Code and Title: PHCP-115 Physics Laboratory-I (Electronics)

(4 Credits)

Student has to perform Any **12 Experiments**

1. Diode Pump Staircase generator using UJT
2. Foldback Power Supply
3. Crystal Oscillator & Digital Clock
4. Voltage Control Oscillator using IC-566
5. Function generator using IC -8038
6. Optocoupler using OPAMPs and IC MCT-2E
7. Constant current Source using OP-AMP
8. DAC (Digital to Analogue Converter) using R-2R and Binary ladder
9. Active filters using OP-AMP / IC- 8038(L-P, H-P. Notch type)
10. Study of Multiplexer and Demultiplexer
11. Precision rectifier
12. Design, built and test oscillator – LC oscillator
13. 8-bit ADC
14. PLL application using IC565
15. OPAMP : logarithmic amplifier
16. Voltage to Frequency / Frequency to voltage converter using OP-AMP
17. Study of errors in electrical measurement and results due to loading
18. To determine the transition capacitance of a varactor diode and use it as a variable capacitor (Pg. 28, Experiments in Electronics, S.V. Subramanian, McMillan India Limited, 1982)
19. Measurement of efficiency of a power amplifier (IC 810) and study of its frequency response.(Pg. 118, Experiments in Electronics, S.V. Subramanian, McMillan India Limited, 1982)
20. Study of noise performance of an amplifier (Pg. 449, Art of Electronics, Horowitz and Hill, Cambridge, University Press, Low Price Edition, 1995.)
21. Fourier analysis (Pg. 18, Experiments in Electronics, S.V. Subramanian, McMillan India Limited, 1982)

Reference Books:

1. Signetic Manual
2. Power Supplies: B.S. Sonde
3. Digital Principles: Malvino (6th Edition, Tata McGraw Hill Publication Co. Ltd. Delhi)
4. Operational Amplifier: G.B. Clayton
5. OP-AMPS and Linear Integrated Circuits: Ramakant Gaikwad
6. Data Converters: B.S. Sonde, Tata Mc-Graw Hill Pub. Co. Ltd. (1974)
7. Pulse, Digital and Switching Circuits: Miliman and Taub
8. Electronic Integrated Circuits and Systems: Franklin, C. Fitchen (Van No strand Reinhold Company)
9. Digital Principles and Applications: Leach and Malvino, Tata Mc-Graw Hill Pub. Co. Ltd. N. Delhi (5th Edition, 2002)

Course Code and Title: PHCT-121 Electrodynamics

Module 1: Multipole Expansions and Time Varying Fields 1 credit

Multipole expansions for a localized charge distribution in free space, linear quadrapole potential and field, static electric and magnetic fields in material media, boundary conditions, Time dependent fields, Faraday's law for stationary and moving media, Maxwell's displacement current, differential and integral forms of Maxwell's equations, Maxwell's equations for moving medium

(Ref: 1-4, 10)

Module 2: Energy, Force, Momentum Relations and Electromagnetic Wave Equations 1 credit

Energy relations in quasi-stationary current systems, Magnetic interaction between two current loops, Energy stored in electric and magnetic fields, Poynting's theorem, General expression for electromagnetic energy, Electromagnetic wave equations, Electromagnetic plane waves in stationary medium, Reflection and refraction of electromagnetic waves at plane boundaries (Oblique incidence), Electromagnetic waves in conducting medium, Skin effect and skin depth

(Ref: 1-6, 8, 10)

Module 3: Inhomogeneous Wave Equations 1 credit

Inhomogeneous wave equations, Lorentz's and Coulomb's gauges, Gauge transformations, Wave equations in terms of electromagnetic potentials, D'Alembertian operator, Hertz potential and its use in computation of radiation fields (Ref: 1, 2, 4, 5, 8, 10)

Module 4: Relativistic Mechanics and Covariance 1 credit

Experimental basis for special theory of relativity (Michelson – Morley experiment), Lorentz transformations, Relativistic velocity addition, Minkowski's space time diagram, Four vector potential, electromagnetic field tensor, Lorentz force on a charged particle. (Ref: 1-3, 6, 9, 10)

Reference Books:

1. Introduction to Electrodynamics, (3rd Edition) by David J. Griffith, Publication: Prentice-Hall of India, New Delhi
2. Introduction to Electrodynamics, by A.Z. Capri and P.V. Panat, Narosa Publishing House
3. Classical Electricity and Magnetism, by Panofsky and Phillips, Addison Wesley
4. Foundations of Electromagnetic Theory by Reitz and Milford, World Student Series Edition
5. Classical Electrodynamics, by J.D. Jackson, 3rd Edition John Wiley
6. Electromagnetic Theory and Electrodynamics, by Satya Prakash, Kedar Nath and Co. Meerut
7. Special Theory of Relativity, by Robert Resnick
8. Electromagnetics by B.B. Laud, Willey Eastern
9. Matrices and Tensors in Physics, A.W. Joshi, 3rd Edition, New Age International
10. Electrodynamics by Kumar Gupta and Singh

Course Code and Title: PHCT-122 Atoms and Molecules

1 credit

Module 1: Atoms

(a) Revision of Atomic models, Revision of Hydrogen atom, Revision of quantum numbers, exclusion principle, electron configuration, Hund's rule
(b) origin of spectral lines, selection rules, One electron spectra, Coupling schemes, two electron spectra, fine structure and hyperfine structure, The Hartree Theory, Results of Hartree theory, X-ray line
(c) Atoms in Electromagnetic field: Zeeman effect- Normal and Anomalous, Paschen- Back effect, Stark effect (weak field)

1 credit

Module 2: Molecules

Bonding mechanism in molecules, Molecular orbital methods, Valence band method, Molecular Spectra – Rotational and vibrational spectra for diatomic molecules, Electronics spectra of diatomic molecules, vibration course structure, vibrational analysis of band system, Frank – Condon principle, Dissociation energy and dissociation products, rotational fine structure of electronic vibration transitions, electronic angular momentum in diatomic molecules.

1 credit

Module 3: Spectroscopic Techniques

(a) Microwave Spectroscopy: microwave spectrometer, information derived from rotational spectra and analysis of microwave absorption by H2O
(b) Infrared spectroscopy: IR spectrophotometer and instrumentation, sample handling techniques, FTIR spectroscopy and analysis of HCl spectrum, Applications
(c) Raman spectroscopy: Theory of Raman scattering, Rotational Raman spectra, Mutual exclusion, Raman spectrometer, sample handling techniques, Fourier transform Raman spectrometer, Structure determination using IR and Raman spectroscopy (diamond), Applications

1 credit

Module 4: Resonance spectroscopy

(a)ESR- Principles of ESR, ESR spectrometer, total Hamiltonian, hyperfine structure.
(b)NMR-Magnetic properties of nucleus, resonance condition, NMR instrumentation, relaxation process, chemical shift, applications of NMR.

Reference Books:

1. Fundamentals of Molecular spectroscopy. Collin N. Banwell and Elaine M. McCash
2. Molecular structure and Spectroscopy G. Aruldhas
3. Quantum Physics – Robert Eiesberg and Robert Resnik

Course Code and Title: PHCT-123 Quantum Mechanics

Module 1: Revision and General Formalism — 1 Credit

Inadequacy of classical Physics, wave packets and uncertainity relations, Schrodinger wave equation and probability interpretation, Simple one dimensional problems wells, barriers and harmonic oscillator (One dimension)

Postulates of Quantum Mechanics

Representation of states and dynamical variables, observables, self adjoint operators, eigen functions and eigen values, degeneracy, Dirac delta function, Completeness and closure property, Physical interpretation of eigen values, eigen functions and expansion coefficients, eigen values and eigen functions of momentum operator.

Module 2: Representation of States – Dirac notation — 1 Credit

Hilbert space, Dirac's bra and ket notation, dynamical variables and linear operators, projection operators, unit operator, unitary operator, matrix representation of an operator, change of basis, unitary transformation. Eigen values and eigen functions of simple harmonic oscillator by operator method. **1 Credit**

Module 3: Angular Momentum

Eigen values and eigen functions of L^2 and Lz operators, ladder operators L_+ and L_-, Pauli theory of spins (Pauli's matrices), matrix representation of J in $|jm>$ basis. Addition of angular momenta, Computation of Clebsch-Gordon coefficients in simple cases ($J_1=1/2$, $J_2=1/2$) **1 Credit**

Module 4: Approximation Methods

Time-independent Perturbation theory: Non degenerate, Zeeman effect, Time dependent Perturbation theory: Transition amplitude 1st and 2nd order, Fermi's golden rule, Harmonic perturbation, Introduction to WKB approximation, Variational method

Basic principles and applications to particle in box, SHO

Reference Books:

1. A Text-book of Quantum Mechanics by P.M.Mathews and K.Venkatesan.
2. Quantum mechanics by A. Ghatak and S. Lokanathan
3. Quantum Mechanics by L.I. Schiff
4. Modern Quantum mechanics by J. J. Sakurai
5. Quantum Physics by R. Eisberg and R. Resnick
6. Introduction to Quantum Mechanics by by David J. Griffiths
7. Introductory Quantum mechanics by Granier, Springer Publication.
8. Introductory Quantum Mechanics, Li Boff, 4th Edition, Pearson Education Ltd
9. Quntum Mechanics Nouredine Zettili,, A John Wiley and Sons, Ltd., Publication
10. Shankar R. Principles of Quantum Mechanics, IInd Edition (Plenum, 1994)

Course Code and Title: PHCP-125 Physics Laboratory-II (General Lab)

(4 Credits)

Student has to perform any **12 Experiments**

1. **Photoconductivity:**
   a) To plot the current voltage characteristics of a CdS photoresistor at constant irradiance.
   b) To measure the photocurrent as a function of irradiance at constant voltage.
2. **Speed of Light** : To determine the speed of light using transit time of light pulse as a function of a reflecting mirror.
3. **Faraday Effect**: Rotation of The Polarization Plane Φ As A Function of The Magnetic Field and Rotati n of The Polarization Plane 2Φ As A Function Of The Magnetic Field
4. **Dielectric constant**:
   a) To Measure the charge Q on a plate capacitor as a function of the applied voltage E.
   b) To determine the capacitance C as a function of areas A of plates.
   c) To determine the capacitance C with different dielectrics between the plates.
   d) To determine the capacitance C as a function of the distance d between the plates
5. **Millikan Oil Drop Apparatus:** To measure the rise and fall times of the oil droplets at different voltages having different charges.
   a) To determine the radii of droplets. b) To determine the charge '**e**' on the droplets
6. **Michelson's Interferometer:** To determine the wavelength of He-Ne LASER by using Michelson's Interferometer apparatus.
7. **Specific Heat of Solids**: To determine the specific heat of copper, lead and glass at three different temperatures.
8. **Electron Spin Resonance**: To study the Electron Spin Resonance and to determine Lande's g-factor
9. **Frank-Hertz experiment**: To study the discrete energy levels using Frank-Hertz experiment
10. **G.M. counter:** Counting statistics, Characteristics of GM tube and determination of end point energy of β-ray source
11. **G.M. counter:** Determination of dead time of GM tube by Double source method
12. **Skin depth :** Skin depth in Al using electromagnetic radiation
13. **Gouy's Method:** Mea urement of magnetic susceptibility of MnSO4
14. **Thermionic emission:** To determine work function of Tungsten filament
15. **Hall effect:** To determine charge concentration, conductivity of Ge-semiconductor
16. **Four Probe method:** Temperature variation and Band gap of Ge-semiconductor
17. Ionic Conductivity of NaCl
18. Fabry-Parot Etalon
19. Zeeman Effect
20. Stefan's constant – Black Body Radiation
21. To study absorption spectra of Iodine molecule and to determine its dissociation Energy using spectrometer

Reference Books:

1. Solid State Laboratory Manual in Physics, Department of Physics, University of Pune, Pune-7 (1977)
2. Experimental Physics, Wersnop and Flint.
3. Molecular structure and Spectroscopy, G.Aruldas Prentice-hall of India Pvt. Ltd.New Delhi.
4. Practical Physics, D.R. Behekar, Dr.S. T. Seman, V.M.Gokhale,P.G.Kale (KitabMahal Publication)
5. Introduction to experimental Nuclear Physics, R.M. Singru, Wiley Eastern private Ltd. New Delhi.

Course Code and Title: PHCT-231 Statistical Mechanics

Module1: Probability theory, Statistical Description of thermodynamic system (1 Credit)

Brief discussion on probability distributions (F. Reif Chap-1), Thermodynamical laws and basic thermodynamic relations including Maxwell's equations. Specification of the state of the system, Macroscopic and Microscopic states, Phase space, Statistical ensemble, Postulate of equal a priori probability, Probability calculations, Behaviour of density of states, Liouville's theorem (Classical). Distribution of energy between systems in equilibrium, Sharpness of the probability distribution, Equilibrium between interacting systems.

Module 2: Classical Statistical Mechanics (1 Credit)

Micro-canonical ensemble, Canonical ensemble, Partition function, Applications of canonical ensembles to Paramagnetism, Molecule in an ideal gas, Law of atmosphere. System with specified mean energy, Calculation of mean values and fluctuations in a canonical ensemble in terms of energy, enthalpy and pressure. Connection with thermodynamics and Calculations of thermodynamic quantities, Grand-canonical ensemble, Physical interpretation of Chemical potential (μ) in the equilibrium state. Mean values and fluctuations in grand canonical ensemble. Thermodynamic functions in terms of the Grand partition function.

Module 3: Applications of Statistical Mechanics and Quantum Distribution Functions (1 Credit)

Classical partition functions and their properties, Calculations of thermodynamic quantities, Ideal monoatomic gas, Gibbs paradox, Equipartition theorem and its some applications. i) Mean kinetic energy of a molecule in a gas ii) Brownian motion iii) Harmonic Oscillator iv) Specific heat of solid (Einstein and Debye Specific heat) v) Maxwell velocity distribution, related distributions and mean values

Symmetry of wave functions, Quantum distribution functions, Boltzmann limit of Boson and Fermion gases, Evaluation of the partition function, Partition function for diatomic molecules, Equation of state for an ideal gas, quantum mechanical paramagnetic susceptibility

Module 4: Ideal Bose and Fermi Systems (1 Credit)

Bose-Einstein statistics: Partition function, thermodynamic behaviour, Ideal Bose gas: Photon gas - i) Radiation pressure ii) Radiation density iii) Emissivity iv) Equilibrium number of photons in the cavity; Einstein derivation of Planck's law, Specific heat of on gas and Bose Einstein Condensation.

Fermi-Dirac distribution function: Ideal Fermi system. Fermi energy, Mean energy of fermions at absolute zero, Fermi energy as a function of temperature, Electronic specific heat, White – Dwarfs (without derivation)

Reference Books

1. Fundamentals of Statistical and Thermal Physics, - F. Reif, McGraw Hill International Edition (1985)
2. Statistical and Thermal Physics: With Computer Applications- Harvey Gould and Jan Tobochnik (Princeton University Press; 6.1.2010 edition (July 21, 2010)(ISBN-10: 0691137447, ISBN-13: 978-0691137445)
3. Statistical Physics, Berkeley Physics Course, F. Reif, (Tata McGraw-Hill, 2008)

Course Code and Title: PHCT-232 Solid State Physics

Module 1: Crystal Structure and Band Theory of Solids — 1 Credit

Revision of crystal structures, structure of atomic form factor, Geometrical structure factor, Atomic scattering factor, calculations for SC, BCC, FCC, HCP and diamond structure

Revision of nearly free electron model, DC and AC electrical conductivity of metals, Bloch theorem (with proof), Kronig-Penney model, Motion of electron in 1-D according to band theory, Fermi sphere, Tight binding approximation, Band structure (in R space) of semiconductor crystal, Cyclotron resonance, Quantization of electronic orbit in a magnetic field

Module 2: Diamagnetism and Paramagnetism — 1 Credit

Classical theory of diamagnetism, Langevin theory of Paramagnetism, Quantum theory of Paramagnetism, Paramagnetic susceptibility of conduction electron, Magnetic properties of rare earth ions & iron group ions with graphical representation, Crystal field splitting, quenching of orbital angular momentum

Module 3: Ferromagnetism and Antiferromagnetism — 1 Credit

Wiess theory, Curie point, Exchange integral, saturation magnetization and its temperature dependence, Saturation magnetization at absolute zero, ferromagnetic domains, Anisotropy energy, Bloch wall. Antiferromagnetism- Neel temperature and Ferrimagnetism (Explanation only for both)

Module 4: Superconductivity Dielectric Properties of Solids — 1 Credit

Properties of Superconductors: Meissner effect, Heat capacity, Energy gap, Isotope effect; Type I and II superconductors; Thermodynamics of superconductivity; London equation and London penetration depth; BCS theory; Quantization in a superconductivity ring and Qualitative discussion of Josephson superconductor tunneling

Macroscopic and local electric field, Polarizability, Dielectric constant, Clausius– Mossotti relation, Piezoelectricity, Dielectric behavior in $BaTiO_3$

Reference Books:

1. Solid State Physics, N. W. Ashcroft and N. D. Mermin, (CBS Publishing Asia Ltd.)
2. Introduction to Solid State Physics, C. Kittel, (John Wiley and Sons)
3. Introductory Solid State Physics, H. P. Myers, (Viva Books Pvt. Ltd.)
4. Solid State Physics, H. Ibach and H. Luth, (Springer-Verlag)
5. Fundamentals of Solid State Physics, J. R. Christman, (John Wiley and Sons)
6. Solid State Physics, A. J. Dekkar, (Prentice Hall)
7. Solid State Physics, J.J. Quinn and K-Soo Yi (Springer)

Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce and Science, Kopargaon

DEPARTMENT OF MICROBIOLOGY

CROSSCUTTING ISSUE

Sr. No.	Programme Name	Course Code	Name of Course	Addressed Issue (Professional Ethics, Gender, Human Values, Environment and Sustainability
1.	**(FY)B.Sc. Microbiology**	MB 111	Introduction to Microbial World	Professional Ethics
2.	B.Sc. Microbiology	MB 112	Basic Techniques in Microbiology	Professional Ethics
3.	B.Sc. Microbiology	MB 113	Practical Course based on theory papers MB 111 and MB112	Professional Ethics
4.	B.Sc. Microbiology	MB 121	Bacterial Cell and Biochemistry	Professional Ethics
5.	B.Sc. Microbiology	MB 122	Microbial cultivation and growth	Professional Ethics
6.	B.Sc. Microbiology	MB 123	Practical Course based on theory papers MB121 and MB122	Professional Ethics
7.	**(SY)B.Sc. Microbiology**	MB 231	Medical Microbiology and Immunology	Professional Ethics
8.	B.Sc. Microbiology	MB 232	Bacterial Physiology and Fermentation Technology	Professional Ethics
9.	B.Sc. Microbiology	MB 233	Practical based on MB 231 and MB 232	Professional Ethics
10.	B.Sc. Microbiology	MB 241	Bacterial Genetics	Professional Ethics
11.	B.Sc. Microbiology	MB 242	Air, Water and Soil Microbiology	Professional Ethics
12.	B.Sc. Microbiology	MB 243	Practical based on MB 241 and	Professional Ethics

			MB 242	
13.	**(TY) B.Sc. Microbiology**	MB 351	Medical Microbiology-I	Professional Ethics
14.	B.Sc. Microbiology	MB 352	Immunology-I	Professional Ethics
15.	B.Sc. Microbiology	MB 353	Enzymology	Professional Ethics
16.	B.Sc. Microbiology	MB 354	Genetics	Professional Ethics
17.	B.Sc. Microbiology	MB 355	Fermentation Technology-I	Professional Ethics
18.	B.Sc. Microbiology	MB 356	Agricultural Microbiology	Professional Ethics
19.	B.Sc. Microbiology	MB 357	Practical course-I based on: MB 351 Medical Microbiology-I MB 352 Immunology I	Professional Ethics
20.	B.Sc. Microbiology	MB 358	Practical course-II based on MB 353 Enzymology MB 354 Genetics	Professional Ethics
21.	B.Sc. Microbiology	MB 359	Practical course-III based on: MB 355 Fermentation Technology-I MB 356Agricultural Microbiology	Professional Ethics
22.	B.Sc. Microbiology	MB 3510	Marine Microbiology	Professional Ethics
23.	B.Sc. Microbiology	MB 3511	Dairy Microbiology	Professional Ethics
24.	B.Sc. Microbiology	MB 361	Medical Microbiology II	Professional Ethics
25.	B.Sc. Microbiology	MB 362	Immunology II	Professional Ethics
26.	B.Sc. Microbiology	MB 363	Metabolism	Professional Ethics
27.	B.Sc. Microbiology	MB 364	Molecular Biology	Professional Ethics
28.	B.Sc. Microbiology	MB 365	Fermentation Technology I	Professional Ethics
29.	B.Sc. Microbiology	MB 366	Food Microbiology	Professional Ethics
30.	B.Sc. Microbiology	MB 367	Practical course-I. Based on: MB 361 Medical Microbiology	Professional Ethics

			II and MB 362 Immunology II	
31.	B.Sc. Microbiology	MB 368	Practical course-II. Based on: MB 363 Metabolism and MB 364 Molecular Biology	Professional Ethics
32.	B.Sc. Microbiology	MB 369	Practical course III. Based on: MB 365 Fermentation technology-II and MB 366 Food Microbiology	Professional Ethics
33.	B.Sc. Microbiology	MB 3610	Waste management	Professional Ethics
34.	B.Sc. Microbiology	MB 3611	Nano biotechnology	Professional Ethics
35.	**(M.Sc-I).Microbiology**	MBCT 111	Microbial Systematics	Professional Ethics
36.	M.Sc. Microbiology	MBCT 112	Quantitative Biology	Professional Ethics
37.	M.Sc. Microbiology	MBCT 113	Biochemistry and Metabolism	Professional Ethics
38.	M.Sc. Microbiology	MBCP 1	Biochemical Techniques (Practical based on compulsory theory credits)	Professional Ethics
39.	M.Sc. Microbiology	MBTE 11	Fungal Systematics and Extremophiles	Professional Ethics
40.	M.Sc. Microbiology	MBPE11	Practicals Based on Fungal Systematics and Extremophiles	Professional Ethics
41.	M.Sc. Microbiology	MBCT 121	Instrumentation and Molecular Biophysics	Professional Ethics
42.	M.Sc. Microbiology	MBCT 122	Molecular Biology	Professional Ethics
43.	M.Sc. Microbiology	MBCT 123	Enzymology, Bioenergetics and Metabolism	Professional Ethics
44.	M.Sc. Microbiology	MBCP 124	Molecular biology, Enzymology and Instrumentation Techniques	Professional Ethics

			(Practical basedon compulsory theory credits)	
45.	M.Sc. Microbiology	MBET 127	Nitrogen Metabolism, Respiration and Photosynthesis	Professional Ethics
46.	M.Sc. Microbiology	MBEP 127	Practicals Based on Nitrogen Metabolism, Respiration and Photosynthesis	Professional Ethics
47.	**(M.Sc-II). Microbiology**	MBCT 231	Immunology	Professional Ethics
48.	M.Sc. Microbiology	MBCT 232	Molecular Biology	Professional Ethics
49.	M.Sc. Microbiology	MBCT 233	Clinical Microbiology	Professional Ethics
50.	M.Sc. Microbiology	MBCP 234	Practicals based on Compulsory Theory Credits.	Professional Ethics
51.	M.Sc. Microbiology	MBET 236	Bioremediation and Biomass utilization	Professional Ethics
52.	M.Sc. Microbiology	MBEP 236	Practical based on Bioremediation and Biomass utilization	Professional Ethics
53.	M.Sc. Microbiology	MBCT 241	Pharmaceutical Microbiology	Professional Ethics
54.	M.Sc. Microbiology	MBCT 242	Microbial Technology	Professional Ethics
55.	M.Sc. Microbiology	MBCP 243	Dissertation	Professional Ethics
56.	M.Sc. Microbiology	MBTE 41	Quality Assurance and Validation in Pharmaceutical Industry and Development Of Anti infectives	Professional Ethics
57.	M.Sc. Microbiology	MBPE 41	Practicals based on Quality Assurance AndValidation In Pharmaceutical Industry And Development Of Anti infectives	Professional Ethics

58.	M.Sc. Microbiology	MBTE 43	Industrial Waste Water Treatment andIndustrial Production of Vaccines	Professional Ethics
59.	M.Sc. Microbiology	MBPE 43	Practicals based on Industrial Waste WaterTreatment and Industrial Production of Vaccines	Professional Ethics
60.	All PG Programmes		Democracy, Election and Governance	Human Values
61.	All PG Programmes		Human Rights - I	Human Values
62.	All PG Programmes		Cyber Security -I	Human Values
63.	All PG Programmes		Cyber secuirity -II	Human Values
64.	All PG Programmes		Cyber secuirity -III	Human Values
65.	All PG Programmes		Cyber secuirity -IV	Human Values
66.	All PG Programmes		Skill Development –I	Human Values
67.	All PG Programmes		Skill Development –II	Human Values
68.	All PG Programmes		Introduction to Constitution	Human Values
69.	All PG Programmes		Introduction to Indian Constitution	Human Values
70.	All UG Programmes		EVS 231 – Environmental Awareness	Environment and Sustainability
71.	All UG Programmes		Physical Education	Human Values
72.	S.Y.B.S.c. Microbiology		Certificate course in Health and Environment Awareness	Environment and Sustainability

Head
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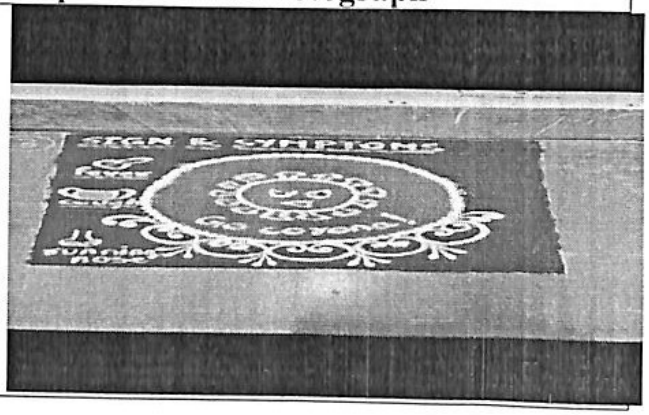
K. J. Somaiya College, Kopargaon

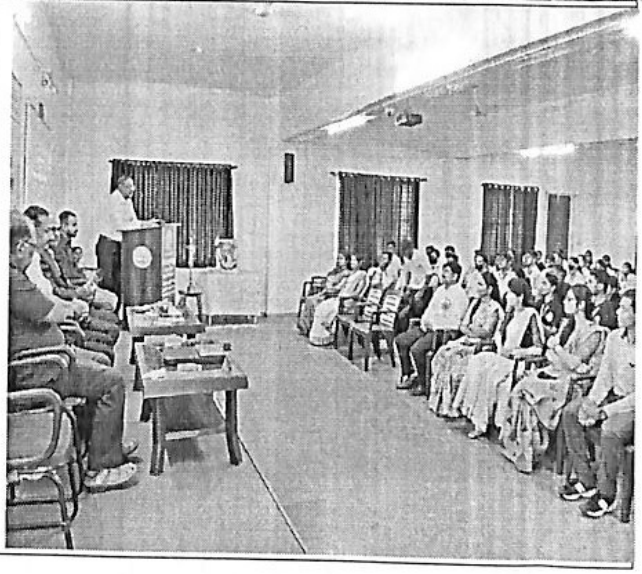
Principal
K.J.Somaiya College of Arts
Commerce & Science,Kopargaon

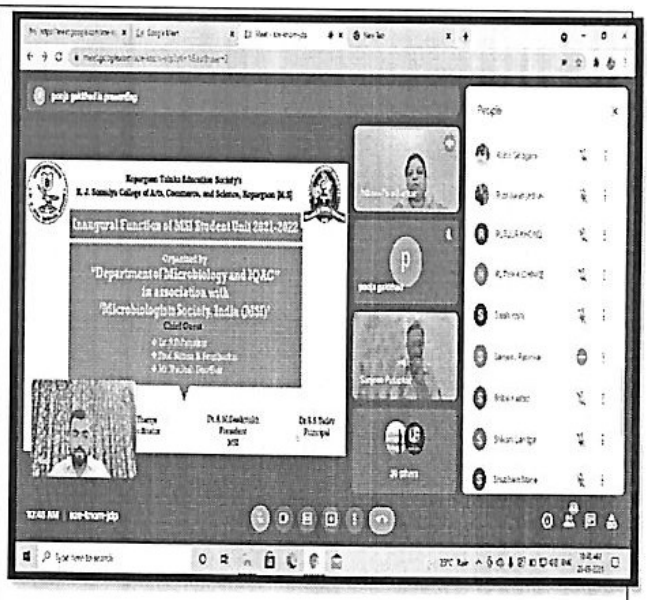
List of Add-on/Value Added/ Certificate Courses

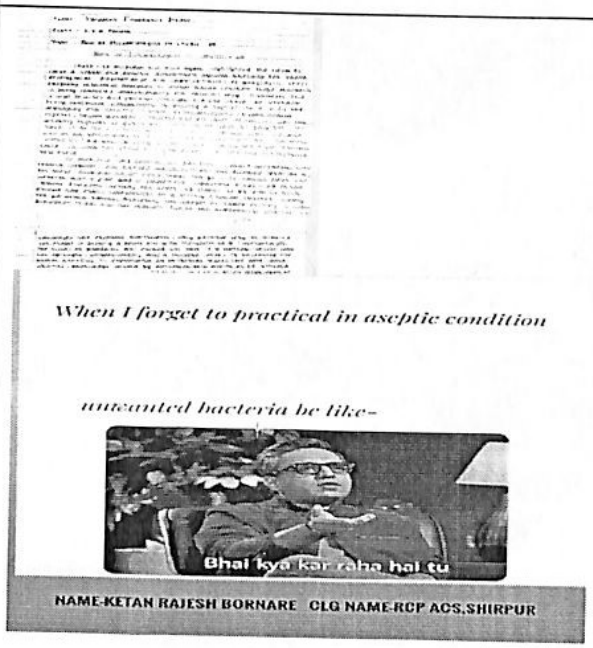
Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Microbiology	Health and Environment Awareness	—	From 2018-19 till Current Year...	Professional Ethics

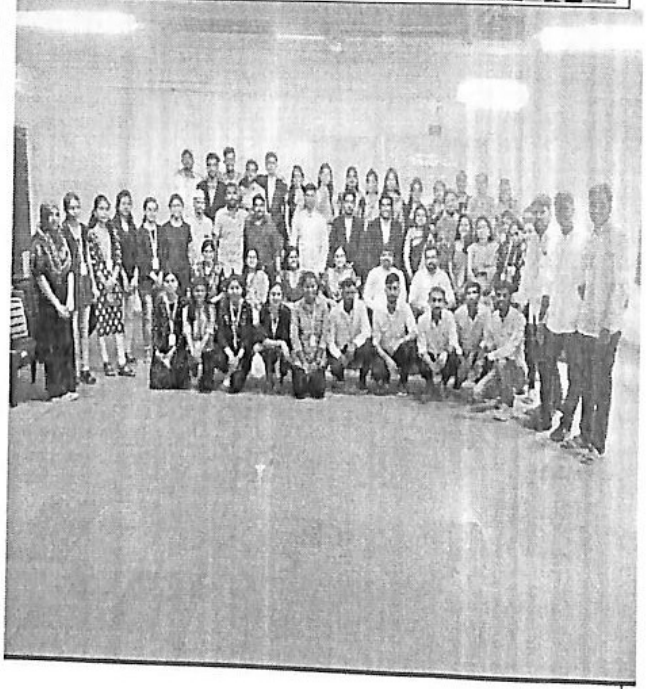
List Showing Curricular and Extra Curricular activities to address Crosscutting Issues (Similar/repeated activities are not listed).

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1	"Immunology Rangoli competition" on 22nd Aug 2019.	Professional Ethics, Human Values	

2	Microbiome Food Festival-2019 on13th Jan 2019	Human Values, Environment and Sustainability	
3	Guest lecture for Postgraduate students on topic 'Recent Trends in Life science Research on 27th Feb 2021.	Professional Ethics, Human Values	
4	On the occasion of "National Science Day," the Department of Microbiology organized 'National Science fest 2021	Professional Ethics, Gender, Human Values, Environment and Sustainability	

5	Department of Microbiology and IQAC in association with Microbiologists Society, India (MSI) had organized a "Inaugural Function of MSI students Unit" dated on 28th Sep 2021	Professional Ethics Human Values	
6	Department of Microbiology and IQAC in association with Microbiologists Society, India (MSI) had organized a One day National Webinar on "Challenges of Addressing Microbial Resistance" dated on 23rd Sep 2021.	Professional Ethics, Human Values, Environment and Sustainability	
7	Department of Microbiology had organized a Micro-Fiesta as a welcome gesture for MSc I Microbiology students on 4th Dec 2021. To	Professional Ethics	

8	Department of Microbiology had organized a One day 'Educational Visit' for T.Y.B.Sc and Post graduate Microbiology students on 15th Dec 2021	Professional Ethics	
9	On the occasion of "National Science Day," the Department of Microbiology and IQAC in association with Microbiologist s Society, India (MSI) had organized a competition named 'National Science Utsav 2022' on 28th Feb 2022.	Professional Ethics, Human Values, Environment and Sustainability	
10	On the occasion of "National Science Day," the Department of Microbiology in association with Microbiologist s Society, India (MSI) had	Professional Ethics, Gender, Human Values, Environment and Sustainability	

	organized a competition named 'Micro Carnival 2022' on 28th Feb 2022		
1 1	Department of Microbiology had organized anOffline Guest lecture for Postgraduate students on topic "A Journey in the World of Invisible" on 28th Feb 2022.	Professional Ethics	 
1 2	MSc I Students of Department of Microbiology, K. J. Somiaya College of Arts, Science and Commerce, Kopargaon have organized a 'Farewell Programme' named "Farewell	Professional Ethics	

	Feast 2022" for MSc II Students on 13th May 2022		
13	On the occasion of "International Microorganisms Day", the Department of Microbiology and IQAC in association with Unnat Bharat Abhiyan (UBA) and Lions Club Kopargaon have organized "Personal Hygiene, Health Awareness and Blood Group Detection Camp" for ZP Students at different villages. All UG and PG Microbiology Students presented posters and Models. Msc II Microbiology students presented a play on "Personal Hygiene".	Professional Ethics, Gender, Human Values, Environment and Sustainability	  

14	Department of Microbiology had organized a one day event called "Science Mania" for UG and PG student on 28th February 2023.	Professional Ethics, Gender, Human Values, Environment and Sustainability	
15	Department of Microbiology had organized a One day 'Educational Visit' for T.Y.B.Sc and Post graduate Microbiology students on 2nd March 2023.	Professional Ethics, Gender, Human Values, Environment and Sustainability	 

Sr.No.	Title of the Activity	Period		Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
		From	To	
1	National Science day	Every Academic year (from 2019-20		Professional Ethics, Human values

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Representative Example

Crosscutting issue: Professional Ethics

Programme Name – M Sc-I (Microbiology)

Course Name – Microbial Systematics

Course Code – MBCT 111

	Semester I	
Credits	**MBCT 111: Microbial Systematics** **Core Compulsory Theory Paper** Total: 4 Credits; Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**Bacterial Systematics** 1. Species concept in prokaryotes and eukaryotes 2. 5-Kingdom classification system 3. 3-Domain classification system 4. Determinative Bacteriology (Phenetic Approach) 5. Systematic Bacteriology (Phylogenetic Approach) 6. Polyphasic Approach 7. Molecular clocks, phylogeny and molecular distances	**15**
Credit II	**Microbial Diversity** Facets of microbial diversity: morphological, structural, metabolic, ecological, behavioral and evolutionary Species divergence and measurement of microbial diversity Measures and indices of diversity; alpha, beta and gamma diversity	**15**
Credit III	**Exploration of Un-culturable microbial diversity:** 1. Concept of 'unculturable' bacterial diversity 2. Strategies for culture of 'unculturable' bacteria 3. Culture independent molecular methods for identifying unculturable bacteria (PCR, RFLP,ARDRA, DGGE, TGGE, RAPD, Microarray, FISH, RISA) 4. Methods of extracting total bacterial DNA from a habitat and metagenome analysis	**15**

Credit IV	**Evolution** 1. History and development of evolutionary theory (Lamarckism, Darwinism), Neo Darwinism: Spontaneous mutation controversy, evolution of rates of mutation, types of selection, levels of selection, group selection and selfish gene. 2. Socio-biology, kin selection, evolutionary stability of cooperation, sociality and multi- cellularity in microorganisms, Game theory. Co-evolutionary strategies, host parasite co- evolution 3. Molecular evolution: origin of life, the origin of new genes and proteins ageing, evolutionary trade-offs, r and k selection	**15**

References:

1. Barnett H. L. and Hunter B. B. (1960). Illustrated Genera of Imperfect Fungi.BurgessPublishing Co., Minnesota.
2. Black J. G. (2013). Microbiology: Principles and Explorations. 6th Edition. JohnWiley&Sons, Inc
3. Bromham L. and Penny D. (2003). The Modern Molecular Clock. Nat Rev Genet.4(3):216-224. Nature Publishing Group.
4. Brown J. (2014). Principles of Microbial Diversity. ASM Press.
5. Buchanan, R. E. and Gibbons, N. E. (editors). 1974. Bergey's Manual of Determinative Bacteriology. 8th ed. Williams & Wilkins Co., Baltimore

Representative Example

Crosscutting issue: Professional Ethics
Programmer Name – M Sc-I (Microbiology)
Course Name – Quantitative Biology
Course Code – MBCT 112

	Semester I	
Credits	**MBCT 112: Quantitative Biology** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	Descriptive Statistics 1. Fundamental concepts –Sample Statistics and Population parameter, data (qualitative and quantitative data, discrete and continuous series data), data sources, variables, measurement scales (nominal, ordinal, interval and ratio), variability and uncertainty in measurements	**15**
	Descriptive Statistics 2. Measures of central tendency – Mean Mode, median 3. Measures of dispersion – Mean deviation Standard deviation and Variance 4. Data presentation-Tables and Graphs (Histogram, bar, pie and line) 5. Simple linear Regression and correlation (significance testing not necessary) *(Sr. No. 1: - only theory questions to be asked in exam.* *Sr. No. 2 – 5: - only problem-solving questions to be asked in exam.)*	
Credit II	**Inferential Statistics-1** 1. Uncertainty: Variation, Probability and inference 2. Central Limit Theorem, Standard deviation of the means standard error and confidence interval 3. The concepts of null hypothesis, Test statistics, P-value significance level, type I and type II errors, one tailed and two tailed tests, degrees of freedom, Parametric and nonparametric test, statistical decision tree, Parametric statistical test: Z-test, t-test and F-test *(Sr. No 1 – 3: - only theory questions to be asked in exam except Z-test, T-test and F-test.)*	**15**
Credit III	**Inferential Statistics-2** 1. Test of Significance: Chi square test (Goodness of fit and Independence), 2. Comparison of 3 or more samples – ANOVA One way and two-way, Post Hoc test (Tukey's) 3. Nonparametric Tests: comparison to parametric tests, Sign test, Wilcoxon's signed rank testand Mann-Whitney U test	**15**

Credit IV	**Probability and Probability Distribution** 1. Concept of experiment, event (mutually exclusive & non-exclusive events, dependent &independent events); 2. Laws of probability (addition and multiplication); 3. Probability distribution – Normal (x-scale and z-scale), Binomial and Poisson distributions	**15**

References:

1. Bailey N. T. J. (1981). Statistical Methods in Biology. United Kingdom: Hodder andStoughton. ISBN: 9780340247563,
2. Brown D. and Rothery P. (1993). Models in biology: mathematics, statistics, andcomputing. United Kingdom: Wiley. ISBN: 9780471933229. Digitized 20th June 2009
3. Chetwynd A., Chetwynd A. G. and Diggle P. J. (2011). Statistics and Scientific Method:An Introduction for Students and Researchers. Italy: OUP Oxford. ISBN:9780199543182
4. Daniel W. W. and Cross C. L. (2018). Biostatistics: A Foundation for Analysis in theHealth Sciences. United Kingdom: Wiley. ISBN: 9781119282372

	Semester I	
Credits	**MBCT 111: Microbial Systematics** **Core Compulsory Theory Paper** Total: 4 Credits; Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**Bacterial Systematics** 1. Species concept in prokaryotes and eukaryotes 2. 5-Kingdom classification system 3. 3-Domain classification system 4. Determinative Bacteriology (Phenetic Approach) 5. Systematic Bacteriology (Phylogenetic Approach) 6. Polyphasic Approach 7. Molecular clocks, phylogeny and molecular distances	**15**
Credit II	**Microbial Diversity** Facets of microbial diversity: morphological, structural, metabolic, ecological, behavioral and evolutionary Species divergence and measurement of microbial diversity Measures and indices of diversity; alpha, beta and gamma diversity	**15**
Credit III	**Exploration of Un-culturable microbial diversity:** 1. Concept of 'unculturable' bacterial diversity 2. Strategies for culture of 'unculturable' bacteria 3. Culture independent molecular methods for identifying unculturable bacteria (PCR, RFLP,ARDRA, DGGE, TGGE, RAPD, Microarray, FISH, RISA) 4. Methods of extracting total bacterial DNA from a habitat and metagenome analysis	**15**
Credit IV	**Evolution** 1. History and development of evolutionary theory (Lamarckism, Darwinism), Neo Darwinism: Spontaneous mutation controversy, evolution of rates of mutation, types of selection, levels of selection, group selection and selfish gene. 2. Socio-biology, kin selection, evolutionary stability of cooperation, sociality and multi- cellularity in microorganisms, Game theory. Co-evolutionary strategies, host parasite co- evolution 3. Molecular evolution: origin of life, the origin of new genes and proteins ageing, evolutionary trade-offs, r and k selection	**15**

	Semester I	
Credits	**MBCT 112: Quantitative Biology** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	Descriptive Statistics 1. Fundamental concepts –Sample Statistics and Population parameter, data (qualitative and quantitative data, discrete and continuous series data), data sources, variables, measurement scales (nominal, ordinal, interval and ratio), variability and uncertainty in measurements	**15**
	Descriptive Statistics 2. Measures of central tendency – Mean Mode, median 3. Measures of dispersion – Mean deviation Standard deviation and Variance 4. Data presentation-Tables and Graphs (Histogram, bar, pie and line) 5. Simple linear Regression and correlation (significance testing not necessary) *(Sr. No. 1: - only theory questions to be asked in exam.* *Sr. No. 2 – 5: - only problem-solving questions to be asked in exam.)*	
Credit II	**Inferential Statistics-1** 1. Uncertainty: Variation, Probability and inference 2. Central Limit Theorem, Standard deviation of the means standard error and confidence interval 3. The concepts of null hypothesis, Test statistics, P-value significance level, type I and type II errors, one tailed and two tailed tests, degrees of freedom, Parametric and nonparametric test, statistical decision tree, Parametric statistical test: Z-test, t-test and F-test *(Sr. No 1 – 3: - only theory questions to be asked in exam except Z-test, T-test and F-test.)*	**15**
Credit III	**Inferential Statistics-2** 1. Test of Significance: Chi square test (Goodness of fit and Independence), 2. Comparison of 3 or more samples – ANOVA One way and two-way, Post Hoc test (Tukey's) 3. Nonparametric Tests: comparison to parametric tests, Sign test, Wilcoxon's signed rank testand Mann-Whitney U test	**15**
Credit IV	**Probability and Probability Distribution** 1. Concept of experiment, event (mutually exclusive & non-exclusive events, dependent &independent events); 2. Laws of probability (addition and multiplication); 3. Probability distribution – Normal (x-scale and z-scale), Binomial and Poisson distributions	**15**

	Semester I	
Credit	**MBCT 113: Biochemistry and Metabolism** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**Protein Chemistry:** 1. Structural features of amino acids, classification of amino acids, Amino acids as buffers, 2. Henderson Hasselbalch equation and its role in buffer formulation Peptide linkage, partial double bond nature of peptide bond 3. Determination of primary structure of polypeptide (N-terminal, C-terminal determination, methodof sequencing of peptides), 4. Structural classification of proteins: primary, secondary, tertiary, quaternary structures of proteins, 5. Non-covalent interactions, Conformational properties of proteins, Polypeptide chain geometry, Resonance forms of the peptide group, cis/trans isomers of peptide group Ramachandran plot 6. Secondary, Super-secondary, Motif & Domain, 7. Tertiary and Quaternary structures of proteins, (Myoglobin &hemoglobin)	**15**
Credit II	**Biochemistry and Molecular Biology Techniques:** 1. Chromatography: Principles and applications of gel filtration, Ion exchange, affinity chromatography 2. Electrophoresis: Agarose, Native PAGE, SDS PAGE 3. Polymerase chain reaction: Principle, variations of PCR (Hot start, Nested, Reverse transcription, real time PCR) and its applications. 4. Sequencing methods: a) RNA-sequencing methods and applications, b) DNA sequencing: Classical and next generation sequencing methods (Pyro-sequencing, Ion torrent, Nano-pore sequencing).	**15**

Credit III	**Developmental Biology:** 1. Introduction to developmental biology. Different model systems used to study developmental biology 2. Conserved nature of development, Concepts of commitment, determination and differentiation, 3. Morphogen gradients in developmental regulation, Hox code, MPF 4. Gastrulation and cellular movements involved in it, Organizer and its importance giving examplesof invertebrates (*Drosophilla*) and vertebrate (*Xenopus*) model systems, pattern formation in body axis, antero-posterior and dorso-ventral polarity. 5. Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristem; shoot and root development; transition to flowering, floral meristems and floral development in *Arabidopsis*.	**15**
Credit IV	**Cell biology:** 1. Structural organization and function of Endoplasmic Reticulum, Golgi apparatus, Nucleus, Mitochondrion, chloroplast, Lysosomes, peroxisomes; Cytoskeleton and function of Molecularmotors. 2. Protein trafficking among various cellular compartments (by secretory and cytosolic pathway: targeting to secretory vesicles, cell membrane, lysosomes, nucleus, mitochondria and peroxisomes) 3. Events in cell cycle, Regulation of cell cycle. Apoptosis	**15**

Semester I

Suggested References: MBCT 113 Biochemistry and Metabolism

Credit I and II : Protein Chemistry, Biochemistry and Molecular Biology Techniques

1. Branden C. I. and Tooze J. (2012). Introduction to Protein Structure. United States:CRC Press. ISBN:9781136969898,
2. Garrett, R. H. and Grisham, C. M. (2004) Biochemistry. 3rd Ed. Brooks/Cole, PublishingCompany, California.
3. Moat A. G., Foster J. W. and Spector M. P. (2003) Microbial Physiology. Germany: Wiley. ISBN: 9780471461197
4. Nelson D. L. and Cox M. M. (2021). Lehninger's Principles of Biochemistry.8thEdition. Mac Millan Worth Pub. Co. New Delhi. ISBN:9781319228002
5. Segel I. H. (2010). Biochemical Calculations. 2nd Ed. Wiley India Pvt. Limited. ISBN:9788126526437

	Semester I
	MBCP 114: Biochemical Techniques **Core Compulsory Practical Paper** Total: 4 CreditsWorkload: -30 hrs /credit (Total Workload: - 4 credits x 30 hrs. = 120 hrs in semester)
1.	Safety rules in Laboratory: Laboratory safety, hazard from chemicals, handling of chemicals, disposal of chemicals and cultures, recording of scientific experiments. Standardization of laboratory procedures, calibration and validation instruments, preparing / designing SOP for the same, maintenance of instruments
2.	Buffer: Determination of pKa of a monoprotic weak organic acid; Preparation of buffers using KH_2PO_4 and K_2HPO_4, acetic acid and sodium acetate, K_2HPO_4 and H_3PO_4.
3.	Computer applications: Using data sheets, and sorting data with different parameters, plotting graphs – bar charts, line graphs, pie charts, adding error bars. (Using Microsoft Excel Statistical analysis of data – Students t test, ANOVA, Chi square test, F test using computer softwares (Using Microsoft Excel)
4.	Enrichment, Isolation and identification of the following extremophiles from natural samples: Alkaliphiles and Thermophiles Identification of the bacteria to at least the Genus level using the Bergey's Manuals is expected. The identification key must be designed for each isolated and identified bacterium. Students are expected to isolate at least one Genus from each group. (At least 5 different types of samples should be processed to obtain isolates)
5.	Studying the stages mitosis in growing tip of onion root cells and to observe polyploidy induced by colchicine treatment on root tip. Demonstration of mounting of embryos (frog and fruit fly) at various developmental stages on permanent slides
6.	Demonstration of mounting of embryos (frog and fruit fly) at various developmental stages on permanent slides
7.	Extraction of Protein and Exo-polysaccharide from bacterial culture (may use TCA and ethanol method)
8.	Colorimetry and spectrophotometry: estimation of above sample: Bradford and UV Spectrophotometry (purity using A_{280} method).

9.	Chromatography: Separation of hydrolyzed protein and EPS sample (above) using paper and thin layer chromatography. (*Explain concept of two-dimensional chromatography and descending chromatography*)
10.	Electrophoresis: SDS-PAGE of above proteins / To determine the ion-exchangecapacity and nature of given resin using anion exchange chromatography
11.	Interpretation of Ramachandran Plot and study of conformations of protein molecule using Molecular Graphics Visualization Tool (e.g., Swiss PDB)

Semester I

Suggested references MBCP 114: Biochemical Techniques

1. Safety rules in Laboratory: Laboratory safety, hazard from chemicals, handling of chemicals, disposal of chemicals and cultures, recording of scientific experiments. Standardization of laboratory procedures, calibration and validation instruments, preparing / designing SOP for the same, maintenance of instruments

- Fuscaldo A. (2012). Laboratory Safety Theory and Practice. United Kingdom: Elsevier Science.
- Leboffe M. J. and Pierce B. E. (2010). Microbiology Laboratory theory and Application. Chapter 1. Introduction: Safety and laboratory guidelines. 3rd edition. Morton Publishing Company. 1-8.
- Plummer M. and Plummer D.T. (2001). Introduction to practical biochemistry. 3rd Edition, Tata McGraw- Hill Edition.
- United States Environmental protection agency (EPA), EPA QA/G-6. 2007. Guidance for preparing SOP. 1-6.
- World Health Organization Staff, World Health Organization. Laboratory Biosafety Manual, 3/Ed. (2006). India: AITBS Publishers.
- https://www.labmanager.com/lab-health-and-safety/science-laboratory-safety-rules-guidelines-5727

2. Buffer: Determination of pKa of a monoprotic weak organic acid; Preparation of buffers using KH_2PO_4 and K_2HPO_4, acetic acid and sodium acetate, K_2HPO_4 and H_3PO_4.

- Jayaraman J. (2004). Laboratory Manual in Biochemistry. India: New AgeInternational (P) Limited Publishers.

	Semester I	
Credits	**MBET 115: Fungal Systematics and Extremophiles** **Choice based Optional Theory Paper (Elective)** Total: 2 Credits Workload: -15 hrs /credit (Total Workload: - 2 credits x 15 hrs = 30 hrs in semester)	**Lectures**
Credit I	**Fungal Systematics:** 1. Six Classes of Fungi 2. Differentiating characters among different Classes of fungi 3. Importance of morphological characters in fungal differentiation and classification	**15**
Credit II	**Extremophiles** 1. Enrichment, isolation, classification, properties and application of extremophiles: Thermophiles, Psychrophiles, Halophiles, Acidophiles, Methanogens 2. Adaptation mechanisms of extremophiles	**15**

Semester I

Suggested References: MBET 115: Fungal Systematics and Extremophile

Credit I : Fungal Systematics:

1. Athearn Bessey E. (2020). Morphology and Taxonomy of Fungi. India: Alpha Editions. ISBN: 9789354009730,
2. Barnett H. L. and Hunter, B. B. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Co., Minnesota.
3. Carlile M. J., Watkinson S. C. and Gooday G. W. (2001). The Fungi. Netherlands: Elsevier Science. ISBN: 9780127384467
4. Lodder J. (1974). The Yeasts: A Taxonomic Study, North Holland Publishing Co. Amsterdam
5. Manoharachary C. and Mukerji K. G. (2010). Taxonomy and Ecology of Indian Fungi. India: I.K. International Publishing House Pvt. Limited.ISBN:9789380026923

Credit II : Extremophiles

1. Gerday C. and Glansdorff N. (2009). Extremophiles. United Kingdom: EolssPublishers. ISBN: 9781905839933
2. Horikoshi K., Stetter K. O., Antranikian G., Robb F. and Bull A. (2010).Extremophiles Handbook. Germany: Springer.
3. Sharma V. and Salwan R. (2020). Physiological and Biotechnological Aspects of Extremophiles. Netherlands: Elsevier Science. ISBN: 9780128183236
4. Stan-Lotter H., Oren A. and Seckbach J. (2013). Polyextremophiles: Life UnderMultiple Forms of Stress. Netherlands: Springer Netherlands.
5. Subba Rao D. V. and Durvasula R. V. (2018). Extremophiles: From Biology to Biotechnology. United States: CRC Press. ISBN: 9781351650731

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9.	Chromatography: Separation of hydrolyzed protein and EPS sample (above) using paper and thin layer chromatography. (*Explain concept of two-dimensional chromatography and descending chromatography*)
10.	Electrophoresis: SDS-PAGE of above proteins / To determine the ion-exchangecapacity and nature of given resin using anion exchange chromatography
11.	Interpretation of Ramachandran Plot and study of conformations of protein molecule using Molecular Graphics Visualization Tool (e.g., Swiss PDB)

Semester I

Suggested references MBCP 114: Biochemical Techniques

1. Safety rules in Laboratory: Laboratory safety, hazard from chemicals, handling of chemicals, disposal of chemicals and cultures, recording of scientific experiments. Standardization of laboratory procedures, calibration and validation instruments, preparing / designing SOP for the same, maintenance of instruments

- Fuscaldo A. (2012). Laboratory Safety Theory and Practice. United Kingdom: Elsevier Science.
- Leboffe M. J. and Pierce B. E. (2010). Microbiology Laboratory theory and Application. Chapter 1. Introduction: Safety and laboratory guidelines. 3rd edition. Morton Publishing Company. 1-8.
- Plummer M. and Plummer D.T. (2001). Introduction to practical biochemistry. 3rd Edition, Tata McGraw- Hill Edition.
- United States Environmental protection agency (EPA), EPA QA/G-6. 2007. Guidance for preparing SOP. 1-6.
- World Health Organization Staff, World Health Organization. Laboratory Biosafety Manual, 3/Ed. (2006). India: AITBS Publishers.
- https://www.labmanager.com/lab-health-and-safety/science-laboratory-safety-rules-guidelines-5727

2. Buffer: Determination of pKa of a monoprotic weak organic acid;

Preparation of buffers using KH_2PO_4 and K_2HPO_4, acetic acid and sodium acetate, K_2HPO_4 and H_3PO_4.

- Jayaraman J. (2004). Laboratory Manual in Biochemistry. India: New AgeInternational (P) Limited Publishers.

	Semester I	
Credits	**MBET 115: Fungal Systematics and Extremophiles** **Choice based Optional Theory Paper (Elective)** Total: 2 Credits Workload: -15 hrs /credit (Total Workload: - 2 credits x 15 hrs = 30 hrs in semester)	**Lectures**
Credit I	**Fungal Systematics:** 1. Six Classes of Fungi 2. Differentiating characters among different Classes of fungi 3. Importance of morphological characters in fungal differentiation and classification	**15**
Credit II	**Extremophiles** 1. Enrichment, isolation, classification, properties and application of extremophiles: Thermophiles, Psychrophiles, Halophiles, Acidophiles, Methanogens 2. Adaptation mechanisms of extremophiles	**15**

Semester I

Suggested References: MBET 115: Fungal Systematics and Extremophile

Credit I : Fungal Systematics:

1. Athearn Bessey E. (2020). Morphology and Taxonomy of Fungi. India: Alpha Editions. ISBN: 9789354009730,
2. Barnett H. L. and Hunter, B. B. 1960. Illustrated Genera of Imperfect Fungi. Burgess Publishing Co., Minnesota.
3. Carlile M. J., Watkinson S. C. and Gooday G. W. (2001). The Fungi. Netherlands: Elsevier Science. ISBN: 9780127384467
4. Lodder J. (1974). The Yeasts: A Taxonomic Study, North Holland Publishing Co. Amsterdam
5. Manoharachary C. and Mukerji K. G. (2010). Taxonomy and Ecology of Indian Fungi. India: I.K. International Publishing House Pvt. Limited.ISBN:9789380026923

Credit II : Extremophiles

1. Gerday C. and Glansdorff N. (2009). Extremophiles. United Kingdom: EolssPublishers. ISBN: 9781905839933
2. Horikoshi K., Stetter K. O., Antranikian G., Robb F. and Bull A. (2010).Extremophiles Handbook. Germany: Springer.
3. Sharma V. and Salwan R. (2020). Physiological and Biotechnological Aspects of Extremophiles. Netherlands: Elsevier Science. ISBN: 9780128183236
4. Stan-Lotter H., Oren A. and Seckbach J. (2013). Polyextremophiles: Life UnderMultiple Forms of Stress. Netherlands: Springer Netherlands.
5. Subba Rao D. V. and Durvasula R. V. (2018). Extremophiles: From Biology to Biotechnology. United States: CRC Press. ISBN: 9781351650731

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Credits	Semester I MBEP 115: Practicals Based on Fungal Systematics and Extremophiles Choice based Optional Practical Paper (Elective) Total: 2 Credits Workload: -30 hrs /credit (Total Workload: - 2 credits x 30 hrs = 60 hrs in semester)	Lectures
Credit I	**Isolation and identification of yeasts and saprophytic molds from natural samples.** The identification key must be designed for each isolated and identified fungus. Students are expected to isolate at least one Genus from Mold and Yeast each *(Varied types of samples should be processed to obtain representative isolate of the groups)*	30
Credit II	**Isolation and identification of the following extremophiles from natural samples: Acidophiles and Halophiles** Identification of the bacteria to at least the Genus level using the Bergey's Manuals is expected. The identification key must be designed for each isolated and identified bacterium. Students are expected to isolate at least one Genus from each group. *(At least 5 different types of samples should be processed to obtain isolates)*	30

Semester I

Suggested References: MBEP 115:

Practicals Based on Fungal Systematics and Extremophiles

Credit I : Isolation and identification of yeasts and saprophytic molds from naturalsamples.

- Alexopoulos C. J., Mims C. W. and Blackwell M. (2007). Introductory Mycology, 4th Edition. India: Wiley India Pvt. Limited.
- Bills G. F., Mueller G. M. and Foster M. S. (2011). Biodiversity of Fungi: Inventoryand Monitoring Methods. Netherlands: Elsevier Science.
- Deacon J. W. (2013). Fungal Biology. Germany: Wiley.
- Hudson H. J. (1992). Fungal Biology. United Kingdom: Cambridge University Press.
- Kreger-Van Rij N. J. W. (2013). The Yeasts: A Taxonomic Study. Netherlands:Elsevier Science.

Credit	Semester II MBCT 121: Instrumentation and Molecular Biophysics Core Compulsory Theory Paper Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	Lectures
Credit I	**Separation and analysis of biomolecules:** 1. Techniques for sample preparation: Dialysis, ultra-filtration, centrifugal vacuum concentration 2. Chromatography- i. Partition Coefficient, Selectivity, Resolution, Column Efficiency, Van Deemter equation, Interpretation of chromatograms, ii. Principle, instrumentation and applications of High Performance Liquid Chromatography (HPLC), iii. Fast Protein Liquid Chromatography (FPLC), iv. Supercritical Fluid Chromatography v. Reversed Phase Chromatography and Gas chromatography. 3. Electrophoresis Methods: Pulse field gel electrophoresis, capillary electrophoresis, isoelectric focusing, 2-dimensional electrophoresis, immune-electrophoresis	15
Credit II	**Spectroscopy** 4. Introduction: Electromagnetic spectrum, Atomic orbitals, Molecular orbitals, Electronic, Rotational and Vibrational transitions in spectroscopy, Interpretation of spectra. 5. UV/Visible spectroscopy- Instrumentation, Molar Absorptivities, Beer and Lamberts Law, Bathochromic and hypochromic shifts. 6. Fluorescence spectroscopy- Instrumentation, Quantum Yield, Quenching, FRET, Binding and Folding studies, Flow cytometry and FACS 7. Infrared spectroscopy- Principle, Instrumentation, Absorption bands, FTIR and its applications 8. Mass spectroscopy- Principles of operation, Ionization, Ion fragmentation, Mass Analysers, GC- MS, MALDI-TOF	15

Credit III	**Biophysical Techniques** 1. NMR spectroscopy: i. Basic Principles of NMR, Chemical shift, Intensity, Line width, Relaxation parameters, Spin coupling, ii. Nuclear Overhauser Effect Spectroscopy, Correlation Spectroscopy, Approach to structure determination by 2D-NMR 2. X-ray crystallography: i. Purification of proteins, Crystallization of proteins, Instrumentation, ii. acquisition of the diffraction pattern, basic principles of x-ray diffraction, iii. Crystal Structures (Bravais Lattices), Crystal planes and Miller Indices, Direct Lattice and Reciprocal lattice, iv. Fourier Transform and Inverse Fourier, v. Ewald sphere, Electron density Maps, Phase determination	**15**
Credit IV	**Radioisotopes in Biology and Confocal Microscopy** 3. Radioisotopes in Biology: i. Principles and applications of radio tracers in medicine, agriculture, industry, and fundamental research ii. Radiation and Radioactive isotopes: Types, Quantities and units of estimation, half-life of isotopes iii. Detection and measurement of radioactivity- Autoradiography, Liquid scintillation counting. iv. Effect of radiation on biological system 4. Confocal Microscopy: i. Scanning optical microscope, confocal principle, ii. Resolution and point spread function, light source: gas lasers & solid-state, primary beam splitter; beam scanning, iii. Pinhole and signal channel configurations, detectors; pixels and voxels; contrast, iv. Spatial sampling: temporal sampling: signal-to noise ratio, multichannel images	**15**

	Semester II	
Credit	**MBCT 122: Molecular Biology** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**RNA processing &Molecular Techniques** 1. Eukaryotic RNA Processing: i. mRNA splicing (Spliceosome and auto splicing by Intron I and Intron II); rRNA processing; tRNA processing; RNA Editing, ii. Nuclear export of mRNA iii. Regulatory RNAs and noncoding RNAs: Si RNA, Micro RNA, RNA interference (RNAi) iv. Pi RNA (Piwi interacting RNAs) 2. Molecular Techniques: Knockout mice, phage display system, expressed sequence tags, yeast two and three hybrid assay, Activity gel assay, DNA helicase assay, Chromatin Immuno-precipitation (ChIP), Designing probe, Epitope tagging	**15**
Credit II	**Tools for Genetic engineering** 3. i. Enzymes: Restriction endonucleases and methylases DNA ligase, klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; ii. Cohesive and blunt end ligation, linkers; adaptors; homopolymeric tailing labeling of DNA: iii. Nick translation, random priming, radioactive and non-radioactive probes iv. Hybridization techniques: Northern, Southern, south-western and far-western and colony hybridization, fluorescence *in situ* hybridization. 4. Vectors for cloning and gene expression: i. Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Blue script vectors, *Baculovirus* and *Pichia* vectors, plant-based vectors (Ti and Ri as vectors). Vectors for gene expression:	**15**

Credit III	**Biophysical Techniques** 1. NMR spectroscopy: i. Basic Principles of NMR, Chemical shift, Intensity, Line width, Relaxation parameters, Spin coupling, ii. Nuclear Overhauser Effect Spectroscopy, Correlation Spectroscopy, Approach to structure determination by 2D-NMR 2. X-ray crystallography: i. Purification of proteins, Crystallization of proteins, Instrumentation, ii. acquisition of the diffraction pattern, basic principles of x-ray diffraction, iii. Crystal Structures (Bravais Lattices), Crystal planes and Miller Indices, Direct Lattice and Reciprocal lattice, iv. Fourier Transform and Inverse Fourier, v. Ewald sphere, Electron density Maps, Phase determination	15
Credit IV	**Radioisotopes in Biology and Confocal Microscopy** 3. Radioisotopes in Biology: i. Principles and applications of radio tracers in medicine, agriculture, industry, and fundamental research ii. Radiation and Radioactive isotopes: Types, Quantities and units of estimation, half-life of isotopes iii. Detection and measurement of radioactivity- Autoradiography, Liquid scintillation counting. iv. Effect of radiation on biological system 4. Confocal Microscopy: i. Scanning optical microscope, confocal principle, ii. Resolution and point spread function, light source: gas lasers & solid-state, primary beam splitter; beam scanning, iii. Pinhole and signal channel configurations, detectors; pixels and voxels; contrast, iv. Spatial sampling: temporal sampling: signal-to noise ratio, multichannel images	15

	Semester II	Lectures
Credit	**MBCT 122: Molecular Biology** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	
Credit I	**RNA processing &Molecular Techniques** 1. Eukaryotic RNA Processing: i. mRNA splicing (Spliceosome and auto splicing by Intron I and Intron II); rRNA processing; tRNA processing; RNA Editing, ii. Nuclear export of mRNA iii. Regulatory RNAs and noncoding RNAs: Si RNA, Micro RNA, RNA interference (RNAi) iv. Pi RNA (Piwi interacting RNAs) 2. Molecular Techniques: Knockout mice, phage display system, expressed sequence tags, yeast two and three hybrid assay, Activity gel assay, DNA helicase assay, Chromatin Immuno-precipitation (ChIP), Designing probe, Epitope tagging	15
Credit II	**Tools for Genetic engineering** 3. i. Enzymes: Restriction endonucleases and methylases DNA ligase, klenow enzyme, T4 DNA polymerase, polynucleotide kinase, alkaline phosphatase; ii. Cohesive and blunt end ligation, linkers; adaptors; homopolymeric tailing labeling of DNA: iii. Nick translation, random priming, radioactive and non-radioactive probes iv. Hybridization techniques: Northern, Southern, south-western and far-western and colony hybridization, fluorescence *in situ* hybridization. 4. Vectors for cloning and gene expression: i. Plasmids; Bacteriophages; M13 mp vectors; PUC19 and Blue script vectors, *Baculovirus* and *Pichia* vectors, plant-based vectors (Ti and Ri as vectors). Vectors for gene expression:	15

	types (pMal, GST, pET-based vectors), ii. Protein tagging and purification (His-tag, GST-tag, MBP-tag) 5. Construction of genomic DNA and cDNA libraries	
Credit III	**Genome projects** 6. i. Concept and meaning of genome projects ii. Techniques used in deciphering genome (blotting, sequencing) iii Applications of genome projects 7. Introduction to Genome projects of *E. coli*, yeast (*Saccharomyces cerevisia*), *Plasmodium*, Mouse (*Mus musculus*), *Drosophila*, Rice (*Oryza sativa*) and comparative genomics 8. Gene annotation 9. Human Genome project and its applications	**15**
Credit IV	**Molecular diagnostics and applications** 11. Introduction to protein array, protein arrays to detect polygenic diseases, Immunoassay for protein confirmation in specific disorders 12. Detection of diseases-associated changes in gene expression using microarray 13. Detection of RNA signatures of 'Antibiotic Resistance' in bacteria 14. Detection of micro RNA (miRNA): A signature of cancer diagnostics	**15**

Semester II
Suggested References: MBCT 122: Molecular Biology
1. Alberts B. (2017). Molecular Biology of the Cell. Sixth Edition. United States: W.W. Norton.
2. Amon A., Berk A., Martin K. C., Lodish H., Kaiser, C. A., Ploegh H., Krieger M., Bretscher A. (2016). Molecular Cell Biology. United States: Macmillan Learning.
3. Cooper G. M. and Hausman R. E. (2007). The Cell: A Molecular Approach. United Kingdom: ASM Press.
4. Farrell Jr. R. E. (2017). RNA Methodologies: Laboratory Guide for Isolation and Characterization. United Kingdom: Elsevier Science.
5. Garg N. and Kumar A. (2005). Genetic engineering. New York: Nova Biomedical Books

	Semester II	
Credit	**MBCT 123: Enzymology, Bioenergetics and Metabolism** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**Enzymology:** 1. Purifications of enzyme, purification chart, 2. Kinetics of reversible inhibitions: Competitive, uncompetitive, non-competitive, mixed, substrate. Primary and secondary plots, Determination of Ki using secondary plots. Significance of inhibitors 3. King Altman approach to derive – two substrate enzyme catalysed reactions 4. Concept of allosterism, positive and negative co-operativity, models of allosteric enzymes (Monad, Wyamann and Changuax and Koshland, Nemethy and Filmer model), kinetics of allosteric enzyme, Hill plot, examples of allosteric enzymes and their significance in regulation.	**15**
Credit II	**Bioenergetics:** 1. Laws of thermodynamics, entropy, enthalpy, free energy, free energy and equilibrium constant Gibbs free energy equation with reference to biological significance. 2. Determination of free energy of hydrolytic and biological oxidation reduction reactions under standard and non-standard conditions 3. High energy compounds 4. Coupled reactions 5. Determination of feasibility of reactions 6. Problems based on 2 and 4. 7. Atkinson's energy charge.	**15**
Credit III	**Lipid Chemistry and Metabolism:** 1. Classification of lipids according to chemical structure, 2. Fatty acids, saturated, unsaturated, branched, nomenclature system,	**15**

	Semester II	
Credit	**MBCT 123: Enzymology, Bioenergetics and Metabolism** **Core Compulsory Theory Paper** Total: 4 Credits Workload: -15 hrs /credit (Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)	**Lectures**
Credit I	**Enzymology:** 1. Purifications of enzyme, purification chart, 2. Kinetics of reversible inhibitions: Competitive, uncompetitive, non-competitive, mixed, substrate. Primary and secondary plots, Determination of Ki using secondary plots. Significance of inhibitors 3. King Altman approach to derive – two substrate enzyme catalysed reactions 4. Concept of allosterism, positive and negative co-operativity, models of allosteric enzymes (Monad, Wyamann and Changuax and Koshland, Nemethy and Filmer model), kinetics of allosteric enzyme, Hill plot, examples of allosteric enzymes and their significance in regulation.	**15**
Credit II	**Bioenergetics:** 1. Laws of thermodynamics, entropy, enthalpy, free energy, free energy and equilibrium constant Gibbs free energy equation with reference to biological significance. 2. Determination of free energy of hydrolytic and biological oxidation reduction reactions under standard and non-standard conditions 3. High energy compounds 4. Coupled reactions 5. Determination of feasibility of reactions 6. Problems based on 2 and 4. 7. Atkinson's energy charge.	**15**
Credit III	**Lipid Chemistry and Metabolism:** 1. Classification of lipids according to chemical structure, 2. Fatty acids, saturated, unsaturated, branched, nomenclature system,	**15**

	3. Structure and function of: triglycerides, phospholipids,sphingolipids, terpencs, prostaglandins,waxes, and steroids. 4. Synthesis of storage lipids: Fatty acids and triacylglycerols, 5. Synthesis of membrane lipids: Glycerophospholipids,sphingolipids, sterols, 6. Degradation of fatty acids (beta oxidation and unsaturatedfatty sacid) and fats in animals 7. Lipids as signal molecules (eg phosphatidyl inositol and eicosanoids).	
Credit IV	**Carbohydrate Chemistry and Metabolism:** 1. Mono, di, oligosaccharides and polysaccharides, with examples 2. Isomerism in sugars: asymmetric centres in sugars, dextro, leavo-rotatory, sugar anomers (reducing and non-reducing sugars), sugar epimers 3. Sugar derivatives such as sugar alcohols, amino sugars, sugar acids, deoxy sugars 4. Glycolysis and gluconeogenesis, Regulation of glycolysis and gluconeogenesis, 5. Synthesis of microbial exopolysaccharides (alginate) 6. Cellulose synthesis and breakdown 7. Regulation of Glycogen synthesis; breakdown, 8. Metabolic flux and its regulation by various metabolicintermediates 9. TCA cycle- regulation, role in energy generation, Role in generating biosynthetic intermediates and glyoxylate cycle	**15**

Semester II

Suggested References MBCT 123: Enzymology, Bioenergetics and Metabolism

1. Cornish-Bowden A. (2014). Fundamentals of Enzyme Kinetics. Netherlands: ElsevierScience.
2. Farrell S. O., Bettelheim F. A., Torres O., Brown W. H. and Campbell M. K. (2015).Introduction to General, Organic and Biochemistry. United States: Cengage Learning.
3. Ferguson S. J. and Nicholls D. G. (2014). Bioenergetics 2. United Kingdom: ElsevierScience.
4. Frayn K. N., Gurr M. I. and Harwood J. L. (2008). Lipid Biochemistry: AnIntroduction. Germany: Wiley.

Semester II

MBCP 124: Molecular Biology, Enzymology and InstrumentationTechniques
Core Compulsory Practical Paper

Total: 4 Credits Workload: -30 hrs /credit
(Total Workload: - 4 credits x 30 hrs = 120 hrs in semester)

1. Concept of lac-operon: Lactose induction of Beta galactosidase; Glucose Repression;Diauxic growth curve of *E. coli.*
2. Plasmid DNA isolation, DNA quantitation and characterization by gel electrophoresis.
3. Construction of restriction digestion map of plasmid DNA
4. Curing of bacterial Plasmid
5. Gene annotation
6. Purification of enzymes (Amylase/Invertase): (ammonium sulphate precipitation, organic solvent precipitation, gel filtration (any two methods); Establishment of enzyme purification chart
7. Determination of Km, Vmax and Kcat values of enzyme
8. Determination of molecular extinction coefficient of biomolecule
9. Isolation of Aflatoxin producing organism. Extraction and detection of Aflatoxin in food.
10. Isolation and characterization of lipase/cellulase/chitinase producing microbe.
11. Scientific Communication and Research Methodology

    Concept of effective communication: Presentation skills, formal scientific presentation skills; Preparing power point presentation, Presenting the work, Scientific poster preparation and oral presentation; Participating in group discussions. Technical writing skills: Types, Formats of scientific reports, scientific writing skills, Significance of communicating science, ethical issues, copyrights and plagiarism, Components of a research paper, publishing scientific papers - peer review process and problems. Use of search engines for scientific data mining, use of reference, use of reference management tools (e.g. Zotero). (Assignment/activity-based teaching method may be used)
12. Virtual lab exercise to understand the instrumentation, experimentation and interpretation of data obtained using HPLC, FACS, FTIR, GC-MS, NMR, X-Ray crystallography MALDI TOF, SEM, TEM, AFM, Confocal Microscope (representative websites)
13. Visit to any lab or institute to understand the principle and working of the bio-analytical instrument studied in theory courses(optional)

	3. Structure and function of: triglycerides, phospholipids,sphingolipids, terpenes, prostaglandins,waxes, and steroids. 4. Synthesis of storage lipids: Fatty acids and triacylglycerols, 5. Synthesis of membrane lipids: Glycerophospholipids,sphingolipids, sterols, 6. Degradation of fatty acids (beta oxidation and unsaturatedfatty sacid) and fats in animals 7. Lipids as signal molecules (eg phosphatidyl inositol and eicosanoids).	
Credit IV	**Carbohydrate Chemistry and Metabolism:** 1. Mono, di, oligosaccharides and polysaccharides, with examples 2. Isomerism in sugars: asymmetric centres in sugars, dextro, leavo-rotatory, sugar anomers (reducing and non-reducing sugars), sugar epimers 3. Sugar derivatives such as sugar alcohols, amino sugars, sugar acids, deoxy sugars 4. Glycolysis and gluconeogenesis, Regulation of glycolysis and gluconeogenesis, 5. Synthesis of microbial exopolysaccharides (alginate) 6. Cellulose synthesis and breakdown 7. Regulation of Glycogen synthesis; breakdown, 8. Metabolic flux and its regulation by various metabolicintermediates 9. TCA cycle- regulation, role in energy generation, Role in generating biosynthetic intermediates and glyoxylate cycle	**15**

Semester II

Suggested References MBCT 123: Enzymology, Bioenergetics and Metabolism

1. Cornish-Bowden A. (2014). Fundamentals of Enzyme Kinetics. Netherlands: ElsevierScience.
2. Farrell S. O., Bettelheim F. A., Torres O., Brown W. H. and Campbell M. K. (2015).Introduction to General, Organic and Biochemistry. United States: Cengage Learning.
3. Ferguson S. J. and Nicholls D. G. (2014). Bioenergetics 2. United Kingdom: ElsevierScience.
4. Frayn K. N., Gurr M. I. and Harwood J. L. (2008). Lipid Biochemistry: AnIntroduction. Germany: Wiley.

Semester II

MBCP 124: Molecular Biology, Enzymology and InstrumentationTechniques
Core Compulsory Practical Paper

Total: 4 Credits Workload: -30 hrs /credit
(Total Workload: - 4 credits x 30 hrs = 120 hrs in semester)

1. Concept of lac-operon: Lactose induction of Beta galactosidase; Glucose Repression;Diauxic growth curve of *E. coli.*
2. Plasmid DNA isolation, DNA quantitation and characterization by gel electrophoresis.
3. Construction of restriction digestion map of plasmid DNA
4. Curing of bacterial Plasmid
5. Gene annotation
6. Purification of enzymes (Amylase/Invertase): (ammonium sulphate precipitation, organic solvent precipitation, gel filtration (any two methods); Establishment of enzyme purification chart
7. Determination of Km, Vmax and Kcat values of enzyme
8. Determination of molecular extinction coefficient of biomolecule
9. Isolation of Aflatoxin producing organism. Extraction and detection of Aflatoxin in food.
10. Isolation and characterization of lipase/cellulase/chitinase producing microbe.
11. Scientific Communication and Research Methodology

    Concept of effective communication: Presentation skills, formal scientific presentation skills; Preparing power point presentation, Presenting the work, Scientific poster preparation and oral presentation; Participating in group discussions. Technical writing skills: Types, Formats of scientific reports, scientific writing skills, Significance of communicating science, ethical issues, copyrights and plagiarism, Components of a research paper, publishing scientific papers - peer review process and problems. Use of search engines for scientific data mining, use of reference, use of reference management tools (e.g. Zotero). (Assignment/activity-based teaching method may be used)
12. Virtual lab exercise to understand the instrumentation, experimentation and interpretation of data obtained using HPLC, FACS, FTIR, GC-MS, NMR, X-Ray crystallography MALDI TOF, SEM, TEM, AFM, Confocal Microscope (representative websites)
13. Visit to any lab or institute to understand the principle and working of the bio-analytical instrument studied in theory courses(optional)

Semester II		
Credit	**MBET 127: Nitrogen Metabolism, respiration and Photosynthesis** **Choice based Optional Theory Paper (Elective)** Total: 2 Credits Workload: -15 hrs /credit (Total Workload: - 2 credits x 15 hrs = 30 hrs in semester)	**Lectures**
Credit I	**Nitrogen Metabolism** 1. Biochemistry of biological nitrogen fixation, properties of nitrogenase and its regulation 2. Ammonia assimilation, glutamine synthetase, glutamate dehydrogenase, glutamate synthetase, their properties and regulation, 3. Biosynthesis of five families of amino acids and histidine, 4. Biosynthesis of purine and pyrimidine bases	**15**
Credit II	**Respiration and photosynthesis:** 5. Respiration: Concept of anaerobic respiration, oxidized sulfur compounds and nitrate as electron acceptor with respect to electron transport chain and energy generation, Biochemistry of methanogenes. 6. Photosynthesis: a) Organization of photosystem I and II, cyclic and non-cyclic flow of electrons, Z scheme, Hill reaction, photolysis of water b) C3, C4 CAM plants, Photorespiration, Regulation of photosynthesis	**15**

Semester II

MBEP 127: Practicals based on Nitrogen Metabolism, respiration and Photosynthesis

Choice based Optional Practical Paper (Elective)

Total: 2 Credits Workload: -30 hrs /credit

(Total Workload: - 2 credits x 30 hrs = 60 hrs in semester)

1. Isolation of IAA producing organism, Detection of Indole acetic acidproduction by microorganism
2. Detection of siderophore production by microorganism
3. Enrichment ,Isolation and characterisation of nitrogen fixing activity ofbacteria
4. Extraction and estimation of polyphenols and tannins by Folin Danismethod
5. Enrichment and isolation of lignin/xylan degraders from Soil
6. Enrichment, Isolation and characterization of Sulphur reducingbacteria/ Methanogens.
7. Enrichment, Isolation and characterization of Cyanobacteria.
8. Detection of chlorophyll-a activity of Cyanobacteria

Semester II

Suggested references: MBEP 127:

Practicals based on Nitrogen Metabolism, respiration and Photosynthesis

1. Isolation of IAA producing organism, Detection of Indole acetic acid production by microorganisms: -

- Gang S., Sharma, S., Saraf M., Buck M. and Schumacher J. (2019). Analysis of Indole-3-acetic Acid (IAA) Production in Klebsiella by LC-MS/MS and the Salkowski Method. Bio-protocol 9(9): e3230. DOI: 10.21769/BioProtoc.3230.
- Mohite B. (2013). Isolation and characterization of indole acetic acid (IAA) producing bacteria from rhizospheric soil and its effect on plant growth. Journal of Soil Science and Plant Nutrition, 13(3): 638-649.

2. Detection of siderophore production by microorganisms: -

- Ferreira C. M. H., Vilas-Boas Â, Sousa C. A., Soares H. M. V. M. and Soares E. V. (2019) Comparison of five bacterial strains producing siderophores with ability to chelate iron under alkaline conditions. AMB Express. 9(1):78. doi: 10.1186/s13568-019-0796-3.
- Senthilkumar M., Amaresan N. and Sankaranarayanan A. (2021). Detection of siderophore producing microorganisms. In: Plant-Microbe Interactions. Springer Protocols Handb... Humana, New York, NY. https://doi.org/10.1007/978-1-0716-...

MBCT 231- Immunology - Semester III

Core Compulsory Theory Paper

Total: 4 Credits **Workload: -15 hrs /credit**

(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)

Credit	Credit Title and Contents	Lectures
Credit I	**Cell surface molecules and receptors** i. Definition, general Structure and mechanism (dimerization and rotation), components of signal transduction (extracellular signaling molecule, receptor proteins, intracellular signaling proteins and target proteins) ii. Adhesion molecules in immune activation,structure and function of B Cell Receptor, TCR-CD3 complex, Toll-like receptors, Cytokine receptors, G-protein coupled receptors iii. Signal transduction pathways: IL-2 pathway(JAK/STAT, Ras /MAP Kinase Pathways, TCR-CD3 activation pathway)	15
Credit II	**Regulation of Immune response** i. Negative regulation-Immunological tolerance,Mechanisms of tolerance induction (related experimentation using transgenic animals), T cell mediated suppression of immune response ii. Regulation of immune responses by antigen, iii. Antigen-antibody complexes, Network theoryand its experimental evidence iv. Cytokine mediated cross regulation of THsubsets (TH1-TH2) v. Regulation of complement system – Classicaland alternative pathway vi. Biological Response Modifiers for cancertherapy and autoimmune disorders	15
Credit III	**Experimental Immunology** i. *In vitro* systems –Quantification of cytokines(ELISPOT assay), functional assays for phagocytes and cytokines (cytotoxicity and growth assays) ii. *In vivo* systems – Experimental animals in immunology research (Inbred animal strains,Knockout mice, transgenic animals), Animalmodels for autoimmunity and AIDS	15
Credit IV	**Tumor Immunology** i. Cellular transformations during neoplastic growth, Classification of tumors based on histological, Tumors of lymphoid system (lymphoma, myeloma, Hodgkin's disease) ii. Escape mechanisms of tumor from host defense, Host immune response to tumor – Effecter mechanisms, Immuno- surveillance theory iii. Diagnosis of tumors – biochemical and immunological tumor markers iv. Approaches in cancer immunotherapy: Immune adjuvant and tumor	15

MBCT 231- Immunology - Semester III

Core Compulsory Theory Paper

Total: 4 Credits **Workload: -15 hrs /credit**

(Total Workload: - 4 credits x 15 hrs = 60 hrs in semester)

Credit	Credit Title and Contents	Lectures
Credit I	**Cell surface molecules and receptors** i. Definition, general Structure and mechanism (dimerization and rotation), components of signal transduction (extracellular signaling molecule, receptor proteins, intracellular signaling proteins and target proteins) ii. Adhesion molecules in immune activation,structure and function of B Cell Receptor, TCR-CD3 complex, Toll-like receptors, Cytokine receptors, G-protein coupled receptors iii. Signal transduction pathways: IL-2 pathway(JAK/STAT, Ras /MAP Kinase Pathways, TCR-CD3 activation pathway)	15
Credit II	**Regulation of Immune response** i. Negative regulation-Immunological tolerance,Mechanisms of tolerance induction (related experimentation using transgenic animals), T cell mediated suppression of immune response ii. Regulation of immune responses by antigen, iii. Antigen-antibody complexes, Network theoryand its experimental evidence iv. Cytokine mediated cross regulation of THsubsets (TH1-TH2) v. Regulation of complement system – Classicaland alternative pathway vi. Biological Response Modifiers for cancertherapy and autoimmune disorders	15
Credit III	**Experimental Immunology** i. *In vitro* systems –Quantification of cytokines(ELISPOT assay), functional assays for phagocytes and cytokines (cytotoxicity and growth assays) ii. *In vivo* systems – Experimental animals in immunology research (Inbred animal strains,Knockout mice, transgenic animals), Animalmodels for autoimmunity and AIDS	15
Credit IV	**Tumor Immunology** i. Cellular transformations during neoplastic growth, Classification of tumors based on histological, Tumors of lymphoid system (lymphoma, myeloma, Hodgkin's disease) ii. Escape mechanisms of tumor from host defense, Host immune response to tumor – Effecter mechanisms, Immuno- surveillance theory iii. Diagnosis of tumors – biochemical and immunological tumor markers iv. Approaches in cancer immunotherapy: Immune adjuvant and tumor vaccine therapy	15

MBCT -232 Molecular Biology: Semester III
Core Compulsory Theory Paper
Total: 4 Credits **Workload: -15 hrs /credit**
(Total Workload:- 4 credits x 15 hrs = 60 hrs. in semester)

Credit	Description	Lectures
Credit I	**1. Genomics** a) Gene sequencing, conserved genes, finding base sequences which form genes b) Many proteins from one gene, alternative gene expression: DNA imprinting and Epigenetics. c) Genomic variation -SNPs, SNPS and diseases, SNPS detection and medical therapies. Eukaryotic andprokaryotic SNPs d) Role of genomic variation in aging, Recognition of trades offs associated with genomic variation.	15
Credit II	**2. Genetically modified plants andanimals** a) Genetically modified organisms-social and ethical issues b) Gene augmentation and genetherapy c) Applications in medicine – prevention, early detection and cure of diseases d) Applications of transgenic plants and animals - advantages and disadvantages	15
Credit III	**3. Mobile DNA elements** a) Transposable elements in bacteria, IS elements, composite transposons,Integrons. b) Replicative, nonreplicative transposons, and Mu transposition c) Controlling elements in Tn A, Tn 5and Tn 10 transposition d) Transposons in maize and Drosophila e) Retroviruses and retrotransposon, Ty elements in yeasts SINES, LINES and Alu elements	15
Credit IV	**4. Proteomics** a) Basic concept of proteomics Expression, analysis and characterization of Protein. b) Analysis of protein structure c) Protein interaction. d) Basic concept of Metabolomics with examples and global biochemical networks	15

MBCT 233 - Clinical Microbiology: Semester III
Core Compulsory Theory Paper
Total: 4 Credits **Workload: -15 hrs. /credit**
(Total Workload: - 4 credits x 15 hrs. = 60 hrs. in semester)

Credit	Credit Title and Content	Lectures
Credit I	**A. Determinants of Microbial Pathogenicity** i. Adhesion ii. Invasion iii. Evasion iv. Toxigenesis (mode of action –In vivo and Invitro assay systems for diphtheria, cholera, tetanus toxoid and endotoxins of Gram negative bacteria) v. Bacterial resistance to host defenses- Phagocytosis, specific and nonspecifichumoral factors) **vi.** Molecular basis of bacterial pathogenicity – Cytoskeletal modulation of host cell. Virulence genes and pathogenicity islands.	15
	B. Disease Prediction Epidemiological Models: i. Introduction to epidemiological modeling for infectious disease dynamics ii. Types of Models: a. Susceptible infectious recovered (SIR) b. Susceptible exposed infectious recovered(SEIR) iii A case study: Disease Prediction Epidemiological Models COVID 19	
Credit II	Bacterial diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing ofinfectious material i. *Helicobacter pylori* ii. *Campylobacter jejuni* iii. *Mycobactertium tuberculosis* iv. *Acinetobacter boumanii* v. *Actinomycetes bovis/israelli*	15
Credit III	Viral diseases with respect to causative agents, general characters, detection method, therapeutic agents and prophylaxis. Handling and disposing of infectious material. i. Hepatitis B ii. H1N1 iii. HIV iv. Oncoviruses v. Ebola Virus	154

MBCT -232 Molecular Biology: Semester III
Core Compulsory Theory Paper
Total: 4 Credits **Workload: -15 hrs /credit**
(Total Workload:- 4 credits x 15 hrs = 60 hrs. in semester)

Credit	Description	Lectures
Credit I	**1. Genomics** a) Gene sequencing, conserved genes, finding base sequences which form genes b) Many proteins from one gene, alternative gene expression: DNA imprinting and Epigenetics. c) Genomic variation -SNPs, SNPS and diseases, SNPS detection and medical therapies. Eukaryotic andprokaryotic SNPs d) Role of genomic variation in aging, Recognition of trades offs associated with genomic variation.	15
Credit II	**2. Genetically modified plants andanimals** a) Genetically modified organisms-social and ethical issues b) Gene augmentation and genetherapy c) Applications in medicine – prevention, early detection and cure of diseases d) Applications of transgenic plants and animals - advantages and disadvantages	15
Credit III	**3. Mobile DNA elements** a) Transposable elements in bacteria, IS elements, composite transposons,Integrons. b) Replicative, nonreplicative transposons, and Mu transposition c) Controlling elements in Tn A, Tn 5and Tn 10 transposition d) Transposons in maize and Drosophila e) Retroviruses and retrotransposon, Ty elements in yeasts SINES, LINES and Alu elements	15
Credit IV	**4. Proteomics** a) Basic concept of proteomics Expression, analysis and characterization of Protein. b) Analysis of protein structure c) Protein interaction. d) Basic concept of Metabolomics with examples and global biochemical networks	15

MBCT 233 - Clinical Microbiology: Semester III
Core Compulsory Theory Paper
Total: 4 Credits **Workload: -15 hrs. /credit**
(Total Workload: - 4 credits x 15 hrs. = 60 hrs. in semester)

Credit	Credit Title and Content	Lectures
Credit I	**A. Determinants of Microbial Pathogenicity** i. Adhesion ii. Invasion iii. Evasion iv. Toxigenesis (mode of action –In vivo and Invitro assay systems for diphtheria, cholera, tetanus toxoid and endotoxins of Gram negative bacteria) v. Bacterial resistance to host defenses- Phagocytosis, specific and nonspecifichumoral factors) vi. Molecular basis of bacterial pathogenicity – Cytoskeletal modulation of host cell. Virulence genes and pathogenicity islands.	15
	B. Disease Prediction Epidemiological Models: i. Introduction to epidemiological modeling for infectious disease dynamics ii. Types of Models: a. Susceptible infectious recovered (SIR) b. Susceptible exposed infectious recovered(SEIR) iii A case study: Disease Prediction Epidemiological Models COVID 19	
Credit II	Bacterial diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing ofinfectious material i. *Helicobacter pylori* ii. *Campylobacter jejuni* iii. *Mycobactertium tuberculosis* iv. *Acinetobacter boumanii* v. *Actinomycetes bovis/israelli*	15
Credit III	Viral diseases with respect to causative agents, general characters, detection method, therapeutic agents and prophylaxis. Handling and disposing of infectious material. i. Hepatitis B ii. H1N1 iii. HIV iv. Oncoviruses v. Ebola Virus	154

Credit IV	Fungal and protozoal diseases with respect to causative agents, general characters, detection methods, therapeutic agents and prophylaxis. Handling and disposing of infectious material i. *Candida albicans* ii. *Trichophyton metagrophytes* iii. *Aspergillus flavus* iv. *Entamoeba histolytica* v. *Ascaris lumbricoides* vi. *Giardia lamblia*	15

Suggested References MBCT 233 Clinical Microbiology Semester III
Core Compulsory Theory Paper

Credit	References
Credit I	**A. Determinants of Microbial Pathogenicity** 1. Gal-Mor B. and Finlay B. B. (2006). Pathogenicity islands: a molecular toolbox forbacterial virulence. Cellular Microbiology. 8 (11): 1707-1719. 2. Iglewski B. H. (1990). Molecular Basis of Bacterial Pathogenesis, first edition, AcademicPress: United States. 3. Kudva I. T., Cornick N. A., Plummer P. J., Zhang Q., T. L., Bannantine J.P. and Bellaire B. H. (2016). Virulence Mechanisms of Bacterial Pathogens. Fifth Edition, ASM:Washington. 4. Peterson J. W. (1996). Bacterial Pathogenesis In: Medical Microbiology. 4th Edition. Editor by Samuel Baron, Galveston, Texas, Link to the book: https://www.ncbi.nlm.nih.gov/books/NBK8526/ 5. Rosenberg E. (2005). The diversity of bacterial pathogenicity mechanisms. GenomeBiol. doi: 10.1186/gb-2005-6-5-320 6. Schmidt H. and Hensel M. (2004) Pathogenicity islands in bacterial pathogenesis. ClinMicrobiol Rev. 17(1): 14-56. **B. Disease Prediction Epidemiological Models:** 1. Hethcote H. W. (1989). The basic epidemiology models: models, expressions for r0, parametcr estimation, and applications mathematical understanding of infectious diseasedynamics. © World Scientific Publishing Co. Pte. Ltd. 1-61 2. Li L., Yang Z., Dang Z., Meng C., Huang J., Meng H., Wang D., Chen G., Zhang J., Peng H. and Shao Y. (2020). Propagation analysis and prediction of the COVID-19. Infect Dis Model, 5: 282-292 3. Siettos C.I. and Russo L. (2013). Mathematical modeling of infectious disease dynamics.Virulcnce. 4(4): 295-306. 4. Wearing H. J., Rohani P.and Keeling M. J. (2005). Appropriate models for the management of infectious diseases. PLoS Med 2(7): e174 5. Yang Z., Zeng Z., Wang K., Wong S., *et al.*, (2020). Modified SEIR and AI prediction ofthe epidemics trend of COVID-19 in China under public health interventions. Journal ofThoracic Disease. 12(3): 165-174

MBCP 234: Practicals based on Immunology, Molecular Biology and Clinical Microbiology - Semester III
Core Compulsory Practical Paper
Total Workload: - 4 credits = 120 hrs. in semester

Units	Description	Lectures
Unit I	**Practicals based on MBCT 231: Immunology** 1. Precipitation reactions of Antigen - Antibody: Single radial diffusion. 2. Rocket Immuno - electrophoresis 3. Preparation of serum from the blood sample and analysis of its proteins by electrophoresis a) Preparation of serum from whole blood sample. b) Separation of serum proteins by agarose gel electrophoresis. c) Analysis of separated protein fractions by densitometry (by Image J software). 4. Demonstration of Western Blotting 5. Visit to institute/industry for demonstration of ELISPOT/ CFT/FACS/animal inoculation	40
Unit II	**Practicals based on MBCT 232 Molecular Biology** 1. Isolation of Plasmid from Bacteria by Alkaline lysis method 2. Preparation of competent cells by $CaCl_2$ method 3. To Perform Transformation by using suitable Plasmid 4. To check the efficiency of transformation using Blue white screening method 5. Demonstration of gene transfer by bacterial conjugation	40
Unit III	**Practicals based on MBCT 233: Clinical Microbiology** **A.** Isolation, identification and antibiotic sensitivity testing of (any three) 1. *Actinomycetes* 2. *Acinetobacter* 3. *Clostridium* 4. *Corynebacterium* 5. *Vibrio*	21
	B. Isolation, identification and antibiotic sensitivity testing of (any two) 1. *Candida albicans* 2. *Trichophyton mentagrophytes* 3. *Aspergillus flavus*	14
	C. Demonstration of cultivation of viruses by egg inoculation technique with pock and plaque detection	05

MBET: 236 Bioremediation and Biomass Utilization : Semester III Choice Based Optional Theory Paper (Elective) Total: 2 Credits Workload: -15 hrs /credit Total Workload: - 2 credits x 15 hrs. = 30 hrs. in semester		
Credit	**Credit Title and Contents**	**Lectures**
Credit I	**Bioremediation** A. Microbial Degradation of xenobiotics, B. Engineered bio- degradative pathways: Camphor, octane, xylene, naphthalene degradation pathway C. Aromatic compound degradation: Manipulation by plasmid transfer Manipulation by gene alteration	15
Credit II	**Biomass utilization** A. Utilization of starch and cellulose; B. Isolation of the prokaryotic and eukaryotic cellulase genes, manipulation of the cellulase gene, advantages of using *Zymomonas mobilis* C. Alcohol, fructose, and silage production;advantages of each D. Improvisation of the processes of alcoholproduction E. Improvisation of the processes of fructoseproduction F. Commercial production processes of alcoholand fructose	15

Suggested References MBET: 236 Semester III Bioremediation and Biomass Utilization Choice Based Optional Theory Paper (Elective)	
Credit	**References**
Credit I	**Bioremediation** 1. Glick B. R., Pasternak J. J., Cheryl L. and Patten C. L. (1998). Molecular Biotechnology: Principles and Applications of Recombinant DNA. Washington DC, ASM Press 2. Jaiswal S., Singh D. K. and Shukla P. (2019). Gene Editing and Systems Biology Tools for Pesticide Bioremediation: A Review. Front Microbiol. 10:87 3. Karpouzas D. G. and Singh B. K. (2006) Microbial degradation of organophosphorus xenobiotics: metabolic pathways and molecular basis. AdvMicrob Physiol. 51: 119-185. 4. .Ramos J. L., González-Pérez M. M. and Caballero A., van Dillewijn P. (2015). Bioremediation of polynitrated aromatic compounds: plants and microbes put up afight. Curr Opin Biotechnol. 16(3): 275-281. 5. Weaver R. (2007). Molecular Biology. 4th Edition. Mc-Grew Hill Publication

MBEP: 236 Practicals based on Bioremediation and Biomass Utilization : Semester III

Choice Based Optional Practical Paper

Total: 2 Credits

Workload: -30 hrs /credit

(Total Workload) :- 2 credits x 30 hrs = 60 hrs in semester

Credit	Credit Title and Contents	Lectures
Credit I	**Bioremediation** 1. Degradation of para nitrophenol using *Pseudomonas putida* 2. Low density plastic/bioplastic degradation using bacterial isolates 3. Demonstration of DNA finger-printingtechnique	30
Credit II	**Biomass utilization** 1. Biodiesel production using micro-algae 2. Isolation of bio-emulsifier producing organisms for degradation of aromaticcompounds	30

Suggested References MBEP: 236 Semester III

Practicals based on Bioremediation and Biomass Utilization

Choice Based Optional Practical Paper

Credit	References
Credit I	**Bioremediation** 1. Arora P. K., Srivastava A., and Singh V. P. (2014). Bacterial degradation of nitrophenolsand their derivatives.J Hazard Mater. 266: 42-59. 2. Bánfalvi G and Antoni F. (1990). DNA-based diagnosis. Orv Hetil. 131(18): 953-964. 3. Kulkarni M. and Chaudhari A. (2006). Biodegradation of p-nitrophenol by *P. putida*.Bioresour Technol. 97(8): 982-988. 4. Kumar Khanna V. (2007). Existing and emerging detection technologies for DNA (Deoxyribonucleic Acid) finger printing, sequencing, bio- and analytical chips: a multidisciplinary development unifying molecular biology, chemical and electronicsengineering. Biotechnol Adv. 25(1): 85-98. 5. Li J., Kim H. R., Lee H. M. and Yu H. C., Jeon E., Lee S. and Kim D. (2020). Rapid biodegradation of polyphenylene sulfide plastic beads by *Pseudomonas* sp. Sci TotalEnviron. 720: 137616. 6. Qiu X., Wu P., Zhang H., Li M. and Yan Z. (2009). Isolation and characterization of *Arthrobacter* sp. HY2 capable of degrading a high concentration of p-nitrophenol. Bioresour Technol. 100(21): 5243-5248 7. Bano K. R., Kuddus M., Zaheer M. R., Zia Q., Khan M. F., Ashraf G. M., Gupta A. and Aliev G. (2017). Microbial enzymatic degradation of biodegradable plastics. Curr PharmBiotechnol. 18(5): 429-440. 8. Sangeetha Devi R., Ramya R., Kannan K., Robert Antony A. and Rajesh Kannan V. (2019). Investigation of biodegradation potentials of high density polyethylene degrading marine bacteria isolated from the coastal regions of

MBCT 241: Pharmaceutical Microbiology Semester IV

Core Compulsory Theory Paper

Total: 4 Credits

Workload :-15 hrs /credit

(Total Workload :- 4 credits x 15 hrs = 60 hrs in semester)

Credit	Description	Lectures
Credit I	**General introduction to medicinal chemistry** A. Definition and explanation of terms used in medicinal chemistry (HITS, Lead compound, Toxicity studies, HTS, ADME). Nomenclature of drugs B. Historical perspectives, significance of medicinalchemistry C. Introduction to modern drug discovery, rational drug design, molecular modeling, gene and DNA technology in chemotherapy D. Classification of drugs based on therapeutic classes, target, mechanism of action, chemistry, etc.	15
Credit II	**Drug development** A. Lead optimization: lead likeness, drug likeness, determination of biological, biochemical properties of drug, pharmacovigilance. B. Drug designing: Ligand based receptor based drug design. (Protein Crystallography, molecular docking) C. Drug development: Preclinical development. Toxicity testing – acute, sub acute, chronic. D. Clinical development: Clinical trials (aims, objectives and conduct). Clinical trials I, II, III and IV.	15
Credit III	**Biopharmaceuticals: Regulations and sources** A. Regulatory authorities and its role: FDA, WHO and CLSI B. Introduction to pharmacopeia: IP, USP, and BP C. Formulation of following pharmaceutical preparation as per IP: i. Antibiotics (with any one example) ii. Antipyretics (with any one example) iii. Steroids (with any one example) iv. Injectables (Distilled water, Saline) v. Vitamins (with any one example	15
Credit IV	**Physicochemical properties of drug and drug metabolism** A. Passage of molecules through biological barriers. Membrane transport (paracellular, transcellular). B. Drug absorption: Drug dosages, from gastric emptying to gastric	15

	C. Drug distribution: Drug-plasma/ serum binding, blood brain barrier, accumulations in tissues. D. Drug elimination: Drug excretion, Drug biotransformation, Biotransformation reactions, Functionalization, Conjugation reaction, Reactions leading to toxic metabolites	

Suggested References MBCT 241: Pharmaceutical Microbiology Semester IV
Core Compulsory Theory Paper

Credit	Reference
Credit I	**General introduction to medicinal chemistry** 1. Agarwal S. S. and Paridhavi M. (2007). Herbal drug technology. UniversitiesPress (India) Pvt. Ltd 2. Altreuter D. and Clark D. S. (1999) Combinatorial Biocatalysis: Taking the lead from nature. Curr. Opin. Biotechnol. 10: 130-136 3. Burn J. H. (1957) Principles of Therapeutics. Blackwell Scientific Pub. O. Ltd.Oxford. 4. Chatwal G. P. (2003) Bio-pharmaceutics and Pharmacokinetics. Himalaya Publishing House, Mumbai. 5. Committee for the Purpose of Control and Supervision on Experiments on Animals (CPCSEA). www.cpcsea.com 6. Dewick P. M. (2002). Medicinal natural products: A biosynthetic approach, 2nd Ed., John Wiley and Sons 7. Erhardt P. W. (2006). Medicinal Chemistry in the New Millennium: A Glance into the Future, Ed. Chorghade M. S. in Drug discovery and Development Volume I: Drug Discovery. Wiley-Interscience, John Wiley and Sons Inc. USA. 17-102. 8. Graly J. O. and Joubert P.H. (1997). Handbook of Phase I /II clinical drug trials, CRC Press 9. Iyengar M. A. (1993). Pharmacology of Powdered Crude Drugs. Iyengar series. Manipal, India 10. Micheles P. S., Khmelnitsley Y. L., Dordick J. S. and Clark D. S. (1998). Combinatorial biocatalysis, a natural approach to drug discovery. Trends in Biotechnol. 16(5): 210-215 11. Rawlins E. A., (Ed). (2002). Bentley's Textbook of Pharmaceutics. 8th Ed. Baillicre Tindall, London 12. Satoskar R. S. and Bhandarkar S. D. (1991). Pharmacology and Pharmacotherapeutics. 12th Ed., Vol. 1 and 2. Popular Prakashan, Mumbai. 13. Vyas S. P and Dixit V. R. (2002). Pharmaceutical Biotechnology, CBS Publishers and Distributors, New Delhi
Credit II	**Drug development** 1. Franklin T. J. and Snow G. A. (1975). Biochemistry of Antimicrobial Action.Chapman and Hall, London. 1-22 and 160-174 2. Gale E. F., Cundliffe E., Reynolds P. E., Richmond M. H. and Waring M. J. (1972). The molecular basis of antibiotic action. John Wiley and Sons.

MBCT 242: Microbial Technology Semester IV
Core Compulsory Theory Paper
Total: 4 Credits **Workload: -15 hrs /credit**
(Total Workload :- 4 credits x 15 hrs = 60 hrs in semester)

Credit	Credit Title and Contents	Lectures
Credit I	**Bioreactor design and operation** A. Designing of bioreactors Design aspects CSTRs: The dimensional ratios of the outer shell, and the operational aspects such as working volume, baffles and impellers. B. The configuration (placement) of impellers in a vessel and the different types of impellers (types of turbines and propellers, and their combinations)	15
	C. Immobilized cell reactors and air-lift reactors– Design and operation. D. Batch, Fed-batch and Continuous operation: Applications, advantages and limitations of each type.	
Credit II	**Process Variables and Monitoring** **A. Process Variables:** i. Aeration Theory of oxygen transfer in bubble aeration, Oxygen transfer kinetics (Oxygen Uptake Rate –OUR; Oxygen Transfer Rate OTR;Ccrit), determination of KLa. ii. Agitation Functions of agitation. Flow patterns with different types of impellers. a) Fermentation broth rheology and powerrequirements for agitation – Concept ofNewtonian and non Newtonian fluids, b) Effect of broth rheology on heat, nutrient andoxygen transfer, c) Reynold's number, Power number, Aeration number: working out examples using differentsoftware. **B. Monitoring of process variables:** i. Use of various types of sensors and biosensors for monitoring environmental parameters (pressure, pH, temperature, DO and DCO2) ii. Basic principles of operation, types of biosensors	15
Credit III	**Microbial Fermentation Processes:** Upstream, Fermentation and Downstream Processing for the following: i. Antibiotics (Rifamycin) ii. Microbial enzymes (Chitinase) iii. Exopolysaccharides (Pullulan) iv. Use of immobilized cells / enzymes for bioconversion v. Use of fungi in agriculture and environmental applications	15

Credit IV	**Principle concepts of IPR, ISO and Validation Process:** A. Intellectual Property Rights (IPR): i. Basic concepts of IPR ii. Introduction to forms of IPR – Patents and Designs B. The concept of ISO Certification. C. Preparation of SOPs D. Validation protocols for methods in: i. Quality Control ii. Process validation The above should be discussed within WHO Norms. Exercises on preparation of SOPs, operation and validation for analytical methods	15

Suggested References MBCT 242: Microbial Technology Semester IV	
Credit	**Core Compulsory Theory Paper**
Credit I	**References** **Bioreactor design and operation** 1. BIOTOL series. (1992). Bioreactor Design and Product Yield. Butterworths Heinemann. 2. Doran P. M. (1995). Bioprocess Engineering Principles. Imprint-Academic Press.Copyright-Elsevier. 3. Lydersen B. K., D'Elia N. A. and Nelson K. M. (Eds.) (1993). Bioprocess Engineering: Systems, Equipment and Facilities. JohnWiley and Sons Inc. 4. Maiti B. R. (2018). Principles of Bioreactor Design. Publisher: Viva books 5. McDuffie N. G. (1991). Bioreactor Design Fundamentals 1st Edition, Elsevier:eBook ISBN: 9781483221083 6. Ratledge C. and Kristiansen B. eds. (2001). Basic Biotechnology. 2nd Ed. Cambridge Univ. Press. Cambridge 7. Singh L., Mahapatra D. and Yousuf A. (2019). Bioreactors: Sustainable Design and Industrial Applications in mitigation of GHG emissions. Elsevier. ISBN-0128212640, 9780128212646
Credit II	**Process Variables and Monitoring** 1. Aiba S., Humphrey A. E. and Millis N. F. (1982). Biochemical Engineering. Second Edition. Academic Press. 2. Chand S. (1998). Fermentation Biotechnology: Industrial Perspectives. Industrial Perspectives: Proceedings of the Symposium on Biotech Industry - a Challenge for 2005 A.D. -with Special Reference to Fermentations. November4-6, 1998. Publisher: All India Biotech Association 3. Jozala A. F. (2017). Fermentation Processes. Publisher-BoD. Books on Demand. ISBN-9535129279, E-Book 9789535129271 4. Mandenius C-F. (2016). Bioreactors: Design, Operation and Novel Applications. Reprint. Publisher-John Wiley & Sons. ISBN 3527683372 E-Book- 9783527683376 5. Larroche C., Sanroman M., Du G. and Pandey A. (Editors). (2016). Current Developments in Biotechnology and Bioengineering: Bioprocesses,

MBET 244: Semester IV

Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants

Choice based Optional Theory Paper (Elective)

Workload :-15 hrs /credit

Total: 2 Credits

(Total Workload :- 2 credits x 15 hrs = 30 hrs in semester

Credit	Description	Lectures
Credit I	**Quality Assurance and Validation inPharmaceutical Industry** A. Good Manufacturing Practices (GMP) and Good Laboratory Practices (GLP) in pharmaceutical industry.Quality assurance and quality management in pharmaceuticals ISO, WHO and US certification. Safety in microbiology laboratory. B. Safety profile of drugs: i. Strerility Testing ii. Pyrogenicity testing iii. Mutagenicity and Carcinogenicity testing iv. Teratogenicity testing C. Safety profile of drugs: i. Strerility Testing ii. Pyrogenicity testing iii. Mutagenicity and Carcinogenicity testing iv. Teratogenicity testing	15
Credit II	**Development of Anti infectives:** Therapeutic ratio, MIC and MBC Susceptibility Testing: A. Use of liquid and solid media B. Factors affecting susceptibility testing,CLSI guidelines C. Diffusion methods – agar dilution technique, gradient plate techniques,E-test, Kirby Bauer, Stokes method D. Susceptibility testing for: i. Anti-mycobacterial agents ii. Anti-fungal agents iii. Anti-protozoan agents iv. Anti-viral agents	15

MBEP 244: Semester IV

Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants

Choice based Optional Practical Paper (Elective)

Total: 2 Credits Workload :-30 hrs /credit

(Total Workload :- 2 credits x 30 hrs = 60 hrs in semester

Credit	Description	Lectures
Credit I	**Sterility testing of following pharmaceuticalpreparations as per IP:** i. Oral preparations preparation: Antipyretic or antibiotic tablets ii. Liquid preparation: water soluble vitamin or cough syrup or ophthalmic drops iii. Bulk preparation: (any two) Surgical Cotton rolls/ gauze/ surgical sutures/ disposable syringes.	30
Credit II	**Detection and isolation of anti-infectives from plant** i. Extraction of bioactive principles from plant and activity fractionation ii. Estimation of its antimicrobial activity using standard guidelines (CLSI)	30

Suggested References MBEP 244: Semester IV

Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants

Choice based Optional Practical Paper(Elective)

Credit	References
Credit I	**Sterility testing of following pharmaceuticalpreparations as per IP** 1. Holliger M. A. (2008). Introduction to pharmacology. 3rd Edition. CRC Press 38 2. Indian Pharmacopoeia. (2007). Government of India, Ministry of Health and Family Welfare. The Indian Pharmacopoeia commission. Ghaziabad. 1:53 3. Knudsen L. F. (1949). Sample size of parenteral solutions for sterility testing. JAmer Pharm Assoc. 38: 332–337. 4. McGuire J. and Kupiec T.C. (2007). Quality-control analytical methods: the quality of sterility testing. Intl J Pharm Compounding. 11(1): 52–55. 5. Madsen R. E. (1994). US vs. Barr Laboratories: a technical perspective. PDA JPharm Sci Tech. 48(4): 176–179. 6. Moldenhauer J. and Sutton S.V.W. (2004). Towards an improved sterility test.PDA J Pharm Sci Tech. 58 (6): 284–286. 7. Moldenhauer J. (2006). Viability-based rapid microbiological methods for sterility testing and the need for identification of contamination. PDA J

MBET 246: Semester IV

Industrial waste water treatment and Industrial production of vaccines

Choice based Optional Theory Paper (Elective)

Total: 2 Credits Workload: -15 hrs. /credit

(Total Workload :- 2 credits x 15hrs = 30 hrs in semester

Credit	Description	Lectures
Credit I	A. **Concept and Introduction** to Primary, Secondary and Tertiary treatment of Wastewater. B. **Biological Treatment-** Aerobic and Anaerobic, Suspended and Attached growth processes. C. Activated Sludge treatment and analysis (reactions and Kinetics, mass balance analysis, Hydraulic characters) Critical Operating parameters like DO, Hydraulic retention time, Mean cell retention time, F/M ratio. D. **Current industrial wastewater treatment processes:** Composition, physico-chemical properties and various effluents treatment methods with reference to: i. Dairies ii. Food processing iii. Dyeing industry / Dye-house effluents iv. Paper and pulp industry: Effluent Disposal and Reuse	15
Credit II	**Industrial production of vaccines** A. **Introduction to vaccines** B. **Types:** Inactivated, Attenuated, Toxoid, Subunit, Conjugate, Experimental, Valence, Heterotypic C. **Production** i. Pilot and Industrial scale production ii. Excipients iii. Role of Adjuvants and preservatives D. **Production of viral, bacterial and protozoal vaccines** – Generations of vaccines: i. First generation vaccines– Live attenuated (BCG, MMR) and Inactivated (Pertussis, Tetanus toxoids) ii. Second generation vaccines(synthetic) protein/ peptide/ polysaccharide):- a. Subunit vaccines (Hep B) b. Recombinant (Rotavirus), Hapten-Conjugate vaccines (diphtheria) iii. Third generation vaccines – DNA/RNA and Idiotype vaccines (Malaria) iv. Next generation vaccines using OMICs approach: SARS.	15

MBEP 244: Semester IV

Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants

Choice based Optional Practical Paper (Elective)

Total: 2 Credits Workload :-30 hrs /credit

(Total Workload :- 2 credits x 30 hrs = 60 hrs in semester

Credit	Description	Lectures
Credit I	**Sterility testing of following pharmaceuticalpreparations as per IP:** i. Oral preparations preparation: Antipyretic or antibiotic tablets ii. Liquid preparation: water soluble vitamin or cough syrup or ophthalmic drops iii. Bulk preparation: (any two) Surgical Cotton rolls/ gauze/ surgical sutures/ disposable syringes.	30
Credit II	**Detection and isolation of anti-infectives from plant** i. Extraction of bioactive principles from plant and activity fractionation ii. Estimation of its antimicrobial activity using standard guidelines (CLSI)	30

Suggested References MBEP 244: Semester IV

Practicals based on Quality Assurance and Validation in Pharmaceutical Industry and Development of Anti Infectives from plants

Choice based Optional Practical Paper(Elective)

Credit	References
Credit I	**Sterility testing of following pharmaceuticalpreparations as per IP** 1. Holliger M. A. (2008). Introduction to pharmacology. 3rd Edition. CRC Press 38 2. Indian Pharmacopoeia. (2007). Government of India, Ministry of Health and Family Welfare. The Indian Pharmacopoeia commission. Ghaziabad. 1:53 3. Knudsen L. F. (1949). Sample size of parenteral solutions for sterility testing. JAmer Pharm Assoc. 38: 332–337. 4. McGuire J. and Kupiec T.C. (2007). Quality-control analytical methods: the quality of sterility testing. Intl J Pharm Compounding. 11(1): 52–55. 5. Madsen R. E. (1994). US vs. Barr Laboratories: a technical perspective. PDA JPharm Sci Tech. 48(4): 176–179. 6. Moldenhauer J. and Sutton S.V.W. (2004). Towards an improved sterility test.PDA J Pharm Sci Tech. 58 (6): 284–286. 7. Moldenhauer J. (2006). Viability-based rapid microbiological methods for sterility testing and the need for identification of contamination. PDA J

MBET 246: Semester IV

Industrial waste water treatment and Industrial production of vaccines

Choice based Optional Theory Paper (Elective)

Total: 2 Credits Workload: -15 hrs. /credit

(Total Workload :- 2 credits x 15hrs = 30 hrs in semester

Credit	Description	Lectures
Credit I	A. **Concept and Introduction** to Primary, Secondary and Tertiary treatment of Wastewater. B. **Biological Treatment-** Aerobic and Anaerobic, Suspended and Attached growth processes. C. Activated Sludge treatment and analysis (reactions and Kinetics, mass balance analysis, Hydraulic characters) Critical Operating parameters like DO, Hydraulic retention time, Mean cell retention time, F/M ratio. D. **Current industrial wastewater treatment processes:** Composition, physico-chemical properties and various effluents treatment methods with reference to: i. Dairies ii. Food processing iii. Dyeing industry / Dye-house effluents iv. Paper and pulp industry: Effluent Disposal and Reuse	15
Credit II	**Industrial production of vaccines** A. **Introduction to vaccines** B. **Types:** Inactivated, Attenuated, Toxoid, Subunit, Conjugate, Experimental, Valence, Heterotypic C. **Production** i. Pilot and Industrial scale production ii. Excipients iii. Role of Adjuvants and preservatives D. **Production of viral, bacterial and protozoal vaccines** – Gencrations of vaccines: i. First generation vaccines– Live attenuated (BCG, MMR) and Inactivated (Pertussis, Tetanus toxoids) ii. Second generation vaccines(synthetic) protein/ peptide/ polysaccharide):- a. Subunit vaccines (Hep B) b. Recombinant (Rotavirus), Hapten-Conjugate vaccines (diphtheria) iii. Third generation vaccines – DNA/RNA and Idiotype vaccines (Malaria) iv. Next generation vaccines using OMICs approach: SARS.	15

MBEP 246: Semester II

Practicals based on Industrial Waste Water Treatmentand Industrial Production of Vaccines

Choice based Optional Practical Paper (Elective)

Total: 2 Credits

Workload :-30 hrs /credit

(Total Workload :- 2 credits x 30 hrs = 60 hrs in semester

Credit	Description	Lectures
Credit I	**Practicals based on industrial waste watertreatment:** i. Estimation of pollution load of a natural sample (e.g. river water / industrial waste water) ii. Setting up a laboratory experiment to assess degradability of synthetic wastewater	30
Credit II	**Practicals based on industrial production of vaccines** i. Checking the potency of a toxoid based vaccine by immune diffusion assay ii. Preparation of *Salmonella* O and H antigen and estimation with known antibodies	30

Suggested References MBEP 246: Semester IV

Practicals based on Industrial Waste Water Treatmentand Industrial Production of Vaccines

Choice based Optional Practical Paper (Elective)

Credit	References
Credit I	1. Barthwal R. R. (2002). Environmental Impact Assessment, New Delhi (India). New AgeInternational (P) Limited Publishers. 2. Eaton A. D. (2005). Standard methods for the examination of water and wastewater. American Public Health Association. American Water Works Association. Water Environment Federation. Publisher: Washington, D.C.: APHA-AWWA-WEF. National government publication: English: 21st edition 3. Glasson J., Therivel R. and Chadwick A. (2012). Rutledge-Taylor and Francis Introduction toEnvironmental Impact Assessment. 4th Edition. 416 pages 4. Srivastava A. K. (2003). Environment Impact Assessment, (A.P.H. Publishing. Corporation, Delhi,ISBN-817648-4423
Credit II	1. Cruickshank R. (1982). Medical Microbiology, 12th Edition, P.403.2. Felix A. (1942) Brit. Med. J. 11: 597. 2. Roitt L. (1994). Essential Immunology. 8th edition. Blackwell Scientific. Oxford, UK.114- 115. 3. Vaerman J. P. (1981). Single radial immune diffusion, in methods in enzymology. 73 (Langone, J. J.And Van Vunakis, H, Eds.) New York. 291-305.

Savitribai Phule Pune University, Pune

For All faculties

2 credit Compulsory course for all the First Year students in All Faculties

Democracy, Election and Governance

Objectives:

1. To introduce the students meaning of democracy and the role of the governance
2. To help them understand the various approaches to the study of democracy and governance

Module 1 Democracy- Foundation and Dimensions

a. Constitution of India
b. Evolution of Democracy- Different Models
c. Dimensions of Democracy- Social, Economic, and Political

Module 2 Decentralization

a. Indian tradition of decentralization
b. History of panchayat Raj institution in the lost independence period
c. 73rd and 74th amendments
d. Challenges of caste, gender, class, democracy and ethnicity

Module 3 Governance

a. Meaning and concepts
b. Government and governance
c. Inclusion and exclusion

References:

1. Banerjee-Dube, I. (2014). *A history of modern India*. Cambridge University Press.
2. Basu, D. D. (1982). *Introduction to the Constitution of India*. Prentice Hall of India.
3. Bhargava, R. (2008). *Political theory: An introduction*. Pearson Education India.

Semester V

DSEC-MB 351: Medical Microbiology- I

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes:

- Understand the human anatomy, pathogens associated with diseases.
- Acquire knowledge of principles underlying establishment of pathogens in human body.
- Comprehend of pathogenesis of specific pathogens causing microbial diseases.
- Assess epidemiological patterns of microbial disease transmission as various modes, intensity at local and global level.
- Gain Knowledge principles of chemotherapy of microbial diseases and development of drug resistance among pathogens and strategies to mitigate.
- Develop identification systems for microbial disease diagnosis, disease treatment and prevention measures.

Credit No.	Topics	No. of Lectures
Credit I	**Introduction to infectious diseases and Epidemiology**	18
	1. Introduction to infectious diseases of following human body systems:(Brief anatomy and Physiology, Diseases, Pathogens, common symptoms)	
	a. Respiratory system	2
	b. Gastrointestinal system and liver	2
	c. Urogenital system	2
	d. Central nervous system	2
	2. Epidemiology:	
	a. Case control and cohort studies – Study design and application	2
	b. Principle and methods – Clinical trials of drugs and vaccines (Randomized control trials Concurrent parallel and cross-over trials)	3
	c. Epidemiology of infectious diseases	
	i. Sources and Reservoirs of Infection	1
	ii. Modes of Transmission of Infections	1
	iii. Disease Prevention and Control Measures, Vaccine-preventablebacterial diseases and nonvaccine-preventable bacterial diseases	3

Credit II	**Study of bacterial pathogens:**	**18**
	3. Study of following groups of bacterial pathogens: (With respect to- Classification and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy):	
	a. Salmonella, Vibrio	2
	b. Streptococcus pneumoniae, Streptococcus pyogenes, Neisseria meningitidis and Neisseria gonorrhoeae	4
	c. Pseudomonas aeruginosa	2
	d. Treponema, Leptospira	2
	e. Clostridium tetani	2
	f. Mycobacterium tuberculosis and *Mycobacterium leprae*	4
	g. *Orientia tsutsugamushi* and *Rickettsia rickettsii*	2

Semester VI

DSEC-MB 361: Medical Microbiology II

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Credit No.	Topics	No. of lectures
Credit I	**Chemotherapy**	**18**
	1. Routes of drug administration.	1
	2. Mode of action of antimicrobial agents on:	
	a. Bacteria:	
	i. Cell wall: Beta lactams: 1st to 6th Generation- e.g. Meropenem, Imipenem, Piperacillin, Tazobactam	2
	ii. Cell membrane: Polymyxin	1
	iii. Protein synthesis: Streptomycin, Tetracycline	1
	iv. Nucleic acids: Fluroquinolones, Rifamycin	1
	v. Enzyme inhibitors: Trimethoprim, Sulfomethaxazole	1
	b. Fungi: Griseofulvin, Amphotericin B, Anidulafungin, Vericonazole	3
	c. Viruses: Acyclovir, Oseltamivir, Remdecivir	1
	d. Protozoa: Metronidazole, Chloroquine	1

	3. Mechanisms of drug resistance on:	
	a. Genetic basis:	3
	i. Mutations in gene(s)	
	ii. Acquisition of foreign DNA coding for resistance determinantsthrough horizontal gene transfer.	
	b. Mechanisms of drug resistance by:	3
	i. Limiting uptake of a drug.	
	ii. Modification of a drug target.	
	iii. Inactivation of a drug.	
	iv. Active efflux of a drug.	
Credit II	**Human and Animal Viruses, Fungal and Protozoal Pathogens**	**18**
	4. Introduction to cultivation of viruses	2
	5. Study of following groups of viral pathogens:	
	a. **Human viruses** (with respect to – Virion, Characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis including serological diagnosis, Epidemiology, Prophylaxis and Chemotherapy):	
	i. Respiratory Viruses: Influenza Virus, Corona Virus	2
	ii. Hemorrhagic Virus: Dengue	2
	iii. Hepatic Virus: Hepatitis A Virus	1
	iv. Gastrointestinal Virus: Rotavirus	1
	v. Cutaneous Viruses: Human papillomavirus	1
	vi. Neurological Viruses: Japanese Encephalitis Virus	1
	b. **Animal Viruses:** FMD Virus and Rinderpest Virus	2
	6. Study of following groups of parasites (with respect to – Classification, Lifecycle, Morphological characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis (Serological diagnosis wherever applicable), Epidemiology, Prophylaxis and Chemotherapy):	
	a. *Plasmodium*	2
	b. *Entamoeba*	1
	7. Study of following groups of yeast and fungal pathogens (With respect to – Morphological and cultural characteristics, Classification, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis,	

	3. Mechanisms of drug resistance on:	
	a. Genetic basis:	3
	i. Mutations in gene(s)	
	ii. Acquisition of foreign DNA coding for resistance determinantsthrough horizontal gene transfer.	
	b. Mechanisms of drug resistance by:	3
	i. Limiting uptake of a drug.	
	ii. Modification of a drug target.	
	iii. Inactivation of a drug.	
	iv. Active efflux of a drug.	
	Human and Animal Viruses, Fungal and Protozoal Pathogens	**18**
Credit II	**4. Introduction to cultivation of viruses**	2
	5. Study of following groups of viral pathogens:	
	a. **Human viruses** (with respect to – Virion, Characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis including serological diagnosis, Epidemiology, Prophylaxis and Chemotherapy):	
	i. Respiratory Viruses: Influenza Virus, Corona Virus	2
	ii. Hemorrhagic Virus: Dengue	2
	iii. Hepatic Virus: Hepatitis A Virus	1
	iv. Gastrointestinal Virus: Rotavirus	1
	v. Cutaneous Viruses: Human papillomavirus	1
	vi. Neurological Viruses: Japanese Encephalitis Virus	1
	b. **Animal Viruses:** FMD Virus and Rinderpest Virus	2
	6. Study of following groups of parasites (with respect to – Classification, Lifecycle, Morphological characteristics, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis (Serological diagnosis wherever applicable), Epidemiology, Prophylaxis and Chemotherapy):	
	a. *Plasmodium*	2
	b. *Entamoeba*	1
	7. Study of following groups of yeast and fungal pathogens (With respect to – Morphological and cultural characteristics, Classification, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis,	

	Epidemiology, Prophylaxis and Chemotherapy) a. *Aspergillus* species (Pathogenic) b. *Cryptococcus neoformans* c. *Histoplasma capsulatum*	 1 1 1

References: MB 351 Medical Microbiology-I and MB 361 Medical Microbiology- II

1. Chakraborty P. (2013). A Textbook of Microbiology. 3rd edition. New Central Book Agency. India. ISBN-13: 978-8173818769
2. Champoux J. J., Neidhardt F. C., Drew W. L. and Plorde J. J. (2004). Sherris Medical Microbiology: An Introduction to infectious diseases. 4th edition. Ryan K. J. and Ray C. G. (editors). McGraw-Hill Companies. DOI: 10.1036/0838585299
3. Dey N. C., Dey T. K. and Sinha D. (2013). Medical Bacteriology Including Medical Mycology and AIDS. 17th Edition. New Central Book Agency (P) Ltd (Publisher). India
4. Dulbecco R., Eisen H. N. and Davis B. D. (1990). Microbiology. United States: Publisher -Lippincott. ISBN: 9780608072432
5. Finch R., Greenwood D., Whitley R. and Norrby S. R. (2010) Antibiotic and Chemotherapy. 9th Edition. Elsevier. ISBN: 9780702040641
6. Franklin T.J and Snow G. A. (1989). Biochemistry of Antimicrobial Action. Springer. First Edition. ISBN: 978-94-009-0825-3
7. Goering R., Dockrell H., Zuckerman M., Roitt I. and Chiodini P. L. (2018). Mims' Medical Microbiology and Immunology. 6th Edition. Elsevier. ISBN: 9780702071546
8. Greer D. L., Kane J., Summerbell R., Sigler L., Krajden S. and G. Land (Editors).(1999). Laboratory Handbook of Dermatophytes: a clinical guide and laboratory manual of dermatophytes and other filamentous fungi from skin, hair, and nails. Mycopathologia. 147: 113–114
9. Joklik W. K., Willett H. P., Amos D. B. and Wilfert C. M. (1995). Zinsser's Microbiology. 20th Edition. Appleton and Lange Publisher. ISBN-13: 978- 0838599839
10. Kanungo Reba. (2017). Ananthanarayan and Paniker's Textbook of Microbiology. Tenth edition. The Orient Blackswan Publisher. ISBN-13: 978-9386235251
11. Kaslow R. A., Stanberry L. R. and Le Duc J. W. (2014). Viral Infections of Humans: Epidemiology and Control. 5th edition. Springer. ISBN 978-1-4899-7448-8
12. Mayers D. L., Sobel J.D., Ouellette M., Kaye K.S. and Marchaim D. (Eds.) (2017). Antimicrobial Drug Resistance: Mechanisms of Drug Resistance. Volume 1. Edition 2. Springer. ISBN 978-3-319-46718-4
13. Mayers D. L., Sobel J.D., Ouellette M., Kaye K.S. and Marchaim D. (Eds.) (2017).

Semester V

DSEC-MB-352 Immunology- I

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes

- Understand immune system structure, composition, function and comparison of different types of immunity.
- Acquire knowledge about antigens, Recognition of pathogens; antigen processing and presentation; Immunity to infection and pathological consequences of immunodeficiencies.
- To learn the applications of Immunology in monoclonal antibodies, vaccines production and Immunotherapy.
- Understand abnormal working of Immune system in hypersensitivity, auto immune diseases, immune tolerance and transplantation immunology.
- To develop strategies for Diagnosis of diseases based on antigen and antibody reactions with emphasis on prevailing communicable diseases.

Credit No.	Topics	No. of Lectures
Credit I	**Organs of immune system, Innate immunity, Antigen and Immunoglobulins**	**18**
	1. Organs of immune system: a. Primary lymphoid organs (Thymus and Bone Marrow): Thymus – structure, thymic education (positive and negative selection) Bone marrow –Structure and Negative selection b. Secondary lymphoid organs – structure and function of spleen and lymph node, mucous associated lymphoid tissue, lymphatic system and lymph circulation	 2 2
	2. Innate immunity: Non-specific mechanisms of defense: Second line of defense: a. Humoral components: Defensins, pattern recognition proteins (PRP) and pathogen associated molecular patterns (PAMPs), complement, kinins, andacute phase reactants. b. Cellular components: Phagocytic cells – PMNL, macrophages (reticulo-endothelial cell system) and dendritic cells c. Phagocytosis (oxygen dependent and independent systems), Complement activation (Classical, Alternative and lectin pathway), Inflammation (cardinal signs, mediators, vascular and cellular changes, role of Toll-like receptors)	 1 1 5

	3. Antigen:	
	a. Factors affecting immunogenecity	1
	b. Antigenic determinants, haptens and cross-reactivity, Carrier, Adjuvants	1
	c. Types of antigens: Thymus-dependent and thymus-independent antigens, Synthetic antigens, Soluble and particulate antigens, Autoantigens, Isoantigens	1
	4. Immunoglobulins:	
	a. Characteristic of domain structure, functions of light and heavy chain domainsand antigenic nature of immunoglobulin molecules	2
	b. Molecular basis of antibody diversity (kappa, lambda and heavy chain)	2
Credit II	**Antigen- Antibody Interactions, Major Histocompatibility Complex, Transplantation and Immunity and Hybridoma Technology and Monoclonal Antibodies**	**18**
	5. Antigen- Antibody Interactions:	
	A. Principles of interactions: Antibody affinity and avidity, ratio of antigen antibody, lattice hypothesis and two stage theory, antigen-antibody reactionkinetics (dialysis equilibrium experiment)	2
	B. Visualization of antigen antibody complexes:	
	a. Precipitation reactions: in fluid and in gel, immunoelectrophoresis	1
	b. Agglutination reactions: hemagglutination, bacterial agglutination, passiveagglutination and agglutination-inhibition	1
	c. Immunofluorescence techniques: direct and indirect, fluorescence-activated cell sorting (FACS)	2
	d. Enzyme-linked immunosorbent assay (ELISA), biotin-avidin system and enzyme-linked immune absorbent spot (ELISpot) assay	2
	e. Radioimmunoassay RIA	1
	6. Major Histocompatibility Complex:	
	a. Structure of MHC in man and mouse	1
	b. Structure and functions of MHC class–I and class–II molecules	1
	c. MHC antigen typing (microcytotoxicity and mixed lymphocyte reaction)	1
	7. Transplantation and Immunity;	
	a. Types of Grafts, Allograft rejection mechanisms	2
	b. Prevention of allograft rejection	1

	8. Hybridoma Technology and Monoclonal Antibodies;	
	a. Preparation, HAT selection and propagation of hybridomas secretingmonoclonal antibodies	2
	b. Applications of monoclonal antibodies	1

Semester VI

DSEC-MB 362 Immunology– II

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Credits	Topics	No. of Lectures
Credit I	**Cytokines, Adaptive / Acquired Immunity, Hypersensitivity, Autoimmunity and Autoimmune diseases and Immunodeficiency**	**18**
	1. Cytokines:	
	a. Concept- Cytokines, lymphokines, monokines, interleukines, chemokines, interferons and tumor necrosis factor	1
	b. Properties, Attributes and biological functions of cytokines	2
	2. Adaptive / Acquired Immunity (Third line of defense):	
	A. Humoral Immune Response	
	i. Primary and secondary response kinetics, significance in vaccination programs	2
	ii. Response of secondary lymphoid organs to antigen	1
	iii. Antigen processing and presentation (Major Histocompability class I and class II restriction pathways), cell-cell interactions and adhesion molecules, response to super-antigens, role of cytokines in activation and differentiation of B-cells	5
	B. Cell Mediated Immune Response	
	i. Activation and differentiation of T cells, role of cytokines in activation	2
	ii. Mechanism of Cytotoxic T lymphocytes (CTL) mediated cytotoxicity, Antibody-dependent cellular cytotoxicity (ADCC)	3
	iii. Significance of Cell Mediated Immune Response (CMI)	1
	iv. Immune response against tumors and foreign transplanted cells	1

Credit II	**Hypersensitivity, Autoimmunity and Autoimmune diseases and Immunodeficiency**	18
	3. Hypersensitivity	
	a. General principles of different types of hypersensitivity reactions	2
	b. Gell and Coomb's classification of hypersensitivity – mechanism withexamples for type I (Immediate), II, III and IV (delayed)	5
	4. Autoimmunity and Autoimmune diseases:	
	a. Immunological tolerance	1
	b. Types of autoimmune diseases	1
	c. Factors contributing development of autoimmune diseases	1
	d. Immunopathological mechanisms	1
	e. Diagnosis and treatment of autoimmune diseases: Myasthenia gravisand Rheumatoid arthritis	2
	f. Therapeutic immunosuppression for autoimmunity	1
	5. Immunodeficiency:	
	i. Complement deficiencies	2
	ii. Introduction to congenital immunodeficiency disorders: Common Variable Immune Deficiency (CVID) and acquired immunodeficiency: Immune mechanisms in AIDS	2

References: MB-352 Immunology- I and MB 362- Immunology-II

1. Abbas A. K. and Lichtman A. H. (2004). Basic Immunology- Functions and Disordersof Immune System. 2 nd Ed. Saunders. Elsevier Inc. PA. USA.
2. Aderem A., and Underhill D. M. (1999). Mechanisms of phagocytosis inmacrophages. Annu. Rev. Immunol. 17: 593-623.
3. Austin J. M. and Wood K. J. (1993). Principles of Molecular and CellularImmunology. Oxford University Press, London
4. Barret J. D. (1983). Text Book of Immunology. 4th edition, C. V. Mosby and Co. London.
5. Bendelac A. Savage P. B. and Teyton L. (2007). The biology of NKT cells. Annu Rev Immunol. 25: 297-336.
6. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms. Butterworth and Heinemann Ltd., Oxford

Semester V

DSEC-MB 353: Enzymology

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes

- To understand methods of active site determination, role of enzymes and its cofactors in microbial physiology.
- To learn to perform enzyme assay, purification and quantification of enzymes activity, enzyme kinetics in terms of initial, final velocity, mathematical expression of enzyme kinetic parameters.
- To correlate regulation of metabolism at enzymatic levels and apply, methodology for commercial applications of enzymes
- To learn mechanisms of transport of solutes across the membrane
- To get acquainted with mechanism of biosynthesis and degradation of bio molecules
- To comprehend basic concept of autotrophic mode of metabolism of prokaryotes

Credit No.	Topics	No. of lectures
	Enzymes:	18
Credit I	**1. Structure of enzymes:**	
	a. Methods to determine amino acid residues at active site (Physical method e.g. x-ray crystallography and chemical methods such as trapping of ES complex, use of inhibitors, use of pseudo-substrate,change of pH)	3
	b. Role of vitamins in metabolism: Occurrence, Structure and Biochemical functions of the following: i. Thiamine (Vitamin B1) and Thiamine Pyrophosphate ii. Vitamin D	2
	2. Enzyme assays:	
	a. Principles of enzyme assays and calculation of enzyme unit,specific activity	1
	b. Enzymes assays with examples by: i. Spectrophotometric methods ii. Radioisotope assay	2

	3. Principles and Methods of Enzyme purification:	
	a. Methods of cell fractionation	2
	b. Principles and methods of enzyme purification:	
	i. Based on molecular size	2
	ii. Based on charge	2
	iii. Based on solubility differences	2
	iv. Based on specific binding property and selective adsorption	1
	c. Construction of enzyme purification chart	1
Credit II	**Enzyme Kinetics, metabolic regulation and Immobilized Enzymes:**	**18**
	4. Enzyme Kinetics:	
	a. Concept and use of initial velocity	2
	b. Michaelis Menton equation for the initial velocity of single substrate enzyme catalyzed reaction. Brigg's Haldane modification of Michaelis Menton equation. Michaelis Menton plot, Lineweaver and Burk plot. Definition with significance of Km, Ks, Vmax	5
	5. Metabolic Regulations:	
	a. Enzyme compartmentalization at cellular level	1
	b. Allosteric enzymes	1
	c. Feedback mechanisms	2
	d. Covalently modified regulatory enzymes (Glycogenphosphorylase)	1
	e. Proteolytic activation of zymogens	1
	f. Isozymes - concept and examples	1
	g. Multienzyme complex e.g. Pyruvate dehydrogenasecomplex(PDH)	1
	6. Immobilization of enzymes:	
	Concept, methods of immobilization and applications	3

Semester VI

DSEC-MB 363: Metabolism

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Credit No.	Topics	No of lectures
Credit I	**Membrane transport and Bioenergetics**	**18**
	1. Membrane transport mechanisms:	6
	i. Passive transport - Diffusion, Osmosis, Facilitated transport	
	ii. Active transport - Active transport systems in bacteria	
	iii. Group translocation of sugars in bacteria	
	iv. Ionophores: Mechanism and examples	
	2. Bioenergetics:	
	i. Laws of thermodynamics- first and second law	1
	ii. Concepts of free energy, entropy, high energy compounds: Pyrophosphate, enolic phosphates, acyl phosphates, thioester compounds, and guanidinium compounds	4
	iii. Mitochondrial electron transport chain: components, arrangement of different components in the inner membrane, structure and function of ATP synthatase, inhibitors and uncouplers of ETC and oxidative phosphorylation, energetics of mitochondrial electron transport chain	7
Credit II	**Metabolic pathways and Autotrophy**	**18**
	3. Biosynthesis and Degradation:	
	a. Chemistry, concept of polymerization of macromolecules: Polysaccharides. (Starch, and peptidoglycan) and Lipids (Fatty acids, triglycerides and phospholipids)	6
	b. Degradation of macromolecules – Polysaccharides (starch), Lipids (fatty acids oxidation e.g. β oxidation), Proteins (urea cycle)	6
	4. Bacterial Photosynthesis: Photosynthetic bacteria with referenceto photosynthetic apparatus, energy generation, and CO_2 fixation	
	a. Cyanobacteria,	2
	b. Purple bacteria	2
	5 Chemolithotrophy: Concept and one example, Iron oxidizing bacteria	2

Semester V

DSEC -MB 354: Genetics

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes

- To exhibit a knowledge base in Genetics and Molecular Biology
- To understand the central dogma of Molecular Biology
- To construct genetic map of bacteria and fungi
- To get introduced to concept of recombination and bacteriophage Genetics
- To understand the concept cloning in bacteria
- To demonstrate the knowledge of common and advanced laboratory practices in Molecular Bi

Credit No.	Topics	No. of lectures
Credit I	**DNA Replication and Gene Expression**	**18**
	1. Process of prokaryotic DNA replication a. Single replicon b. Bidirectional movement of replication fork c. Ori C d. Pre-priming and Priming reaction. e. DNA polymerases, DNA synthesis of leading, lagging strand Okazaki fragments. f. Termination- Ter sequence, Tus protein	4
	2.Prokaryotic and Eukaryotic Transcription **Transcription in Prokaryotes** a. Structure of promoter b. Structure and function of RNA polymerase c. Steps of transcription: Initiation, Elongation and termination	3
	Transcription in eukaryotes with respect to protein coding Gene: a. Promoter, promoter proximal elements and enhancers b. Transcription regulatory proteins c. RNA polymerases d. Steps in transcription: Initiation, Elongation, Termination e. Post transcriptional modifications: 5' capping, 3' polyadenylation and introduction to RNA splicing	4

	3. Regulation of transcription: Concept and components of operon: Lac operon: Inducible operon	2
	4. Translation in prokaryotes and eukaryotes a. Structure and role of m-RNA, t-RNA and Ribosomes in Translation b. Role of Aminoacyl t-RNA synthetase in translation c. Steps in translation: Initiation, elongation, translocation and termination of protein synthesis d. Salient features of Eukaryotic translation	5
Credit II	**Gene transfer and mapping techniques**	**18**
	5. Gene transfer by Transformation a. Discovery of Transformation b. Natural transformation Systems- *Streptococcus pneumoniae* and *Haemophilus influenzae*. c. Factors affecting transformation i. Competence development ii. Size of DNA iii. Concentration of DNA	4
	6. Gene transfer by Conjugation a. Discovery of Conjugation, b. Properties of F plasmid, F^+, F^-, Hfr and F′ strains c. Process of conjugation between F^+ and F^-, Hfr and F^-, F 'and F-	4
	7. Gene transfer by Transduction a. Discovery of Transduction b. Generalized transduction mediated by P22 c. Specialized transduction mediated by lambda phage	4
	8. An introduction to Gene mapping a. Gene linkage and concept of genetic recombination b. Recombination mapping: Map unit, recombination frequency c. Mapping of genes by co-transformation d. Mapping of genes by co-transduction e. Mapping by interrupted mating experiment f. Numerical problems based on co-transformation, co-transductionand interrupted mating	6

Semester VI

DSEC -MB-364: Molecular Biology

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Credit No	Topics	No. of lectures
Credit I	**Genetic Recombination and Bacteriophage Genetics.**	**18**
	1. Gene linkage and crossing over a. Mendel's laws: Eukaryotic Cell cycle, Mitosis, Meiosis b. Holliday model for Homologous recombination, Role of Rec and Ruvproteins c. Genetic mapping by Tetrad analysis in *N. crassa* (Numerical Calculationsusing PD, TT and NPD) d. Genetic Mapping by Parasexual cycle in *A. nidulans*	9
	2. Bacteriophage Genetics a. Lytic cycle: Virulent phages, T-series phages, Concept and formation ofplaque, Lysogenic cycle: Temperate phage (λphage) b. Bacteriophage mutants: Plaque morphology (r type), Host range,Conditional lethal mutants (Ts and Am) c. Concept of Genetic Complementation and Cis-trans test of genetic function.(Intergenic- rII locus of T4 phage, Mechanism of Intragenic complementation.) d. Fine structure mapping of rII locus of T4 phage using Benzer's spot testsand deletion mapping	9
Credit II	**DNA damage and repair mechanisms, Recombinant DNA technology**	**18**
	3. DNA damage and Repair mechanisms a. DNA damage by hydrolysis, deamination, alkylation, oxidation,Radiation (X rays and UV rays) b. DNA repair by Photo reactivation c. DNA repair by Mismatch repair mechanism d. DNA repair by Excision repair mechanisms (BER/NER)	5

	4. Recombinant DNA Technology Tools and basics of recombinant DNA technology a. Introduction to recombinant DNA technology b. Restriction enzymes: Concept, Nomenclature, properties and types withexamples (Eco R1, Sma I, Pst I). c. Vectors: Features of an ideal vector i. Plasmids: pBR322 ii. Bacteriophage vectors: Lambda iii. Cosmids iv. High capacity vectors: YACs, BACs v. Expression vectors d. Joining of DNA molecules- DNA Ligases (*E. coli*and T4 phage), Use of Linker / Adaptor / Homopolymer tailing e. Methods to transfer recombinant DNA into bacterial host cells (Physical – Electroporation, Gene gun, Chemical –$CaCl_2$ mediated, liposome mediated) f. Methods of screening recombinants using selective markers and Blue-whitescreening	10
	5. Molecular techniques used in RDT a. Isolation of genomic DNA b. Principle and methodology of Agarose gel electrophoresis and its applications c. Concept, Methodology and applications of Southern, Northern and Western blotting	3

References: MB 354 Genetics and MB 364 Molecular Biology

1. Birge E. A. (2013). Bacterial and Bacteriophage Genetics. Springer, New York. ISBN: 9781475732580
2. Brooker R. J. (2012). Genetics: Analysis and Principles. 4th edition. McGraw- Hill Publication.
3. Brown T. A. (2006). Gene Cloning and DNA Analysis. Blackwell Publication. 5th Edition. ISBN: 1405111216
4. Brown T.A. (2016). Gene Cloning and DNA Analysis: An Introduction. 7thEd. Wiley BlackwellPublication, U.S.A. ISBN: 978-1-119-07254-6
5. Clokie M. R. J. and Kropinski A. M. (editors): Bacteriophage: Methods and Protocols.

Semester V

DSEC -MB 355 Fermentation Technology– I

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes

- To impart technical understanding of commercial fermentations.
- To apply classical, advanced strain improvement and isolation techniques for fermentationprocesses.
- To optimize and sterilize media used in fermentation industry for commerciallyeconomical and efficient fermentations.
- To recover the product using suitable methods and ensuring quality of the finished productby quality assurance tests.
- To acquaint fermentation economics, process patentability, process validation.
- To comprehend the large scale productions of commercially significant fermentation productsof classical and recent significance.

Credit No.	Topics	No. of lectures
	Upstream processes of fermentations	**18**
Credit I	**1. Strain Improvement:**	
	a. Objectives of strain improvement	1
	b. Methods for strain improvement:	
	i. Types of mutants used in strain improvement (altered cell permeability mutants, auxotrophs, analogue resistant mutants, revertants)	1
	ii. Selection of different types of mutants (replica plate method, filtration enrichment, penicillin enrichment method, gradient platetechnique)	2
	iii. Application of rDNA technology (significance, technique for commercial recombinant products like insulin)	1
	2. Media optimization	
	a. Objectives of media optimization	1
	b. Methods of media optimization:	
	i. Classical approach – One factor at a time, Full factorial design	1
	ii. Plackett and Burman Design (with example) (Numerical problems of PBD can be discussed using software)	2
	iii. Response Surface Methodology (RSM)	1

	3. Sterilization of Media:	
	a. Methods of sterilization	1
	b. Batch sterilization and Continuous sterilization (direct and indirectmethods)	1
	c. Concept and derivation of Del factor	1
	d. Filter sterilization of liquid media	1
	4. Scale-up and Scale-down:	
	a. Objectives of scale-up	1
	b. Levels of fermentation (laboratory, pilot-plant and productionlevel – flowsheet to explain scale up)	1
	c. Criteria of scale-up for critical parameters [Aeration (kLa Volumetric Mass transfer coefficient), Agitation (P/V ratio, N_{Re} Reynolds number, N_p Power number, N_{Fr} Froudes number), Sterilization and broth rheology (Newtonian and non Newtonian fluids - bacterial and mycelia fungal fermentations)]	1
	d. Scale-down (example of any one commercial fermentation)	1
Credit II	**Downstream processing and Quality assurance of fermentation products**	**18**
	5. Downstream processing of fermentation products: (method, principle, types, examples of fermentations, factors affecting, merits and demerits at large scale operation)	
	a. Cell disruption methods	1
	b. Filtration	1
	c. Centrifugation	1
	d. Liquid-liquid extraction	1
	e. Distillation	1
	f. Drying	1
	6. Quality assurance of fermentation products (as per IP, USP)	
	a. Methods of detection and Quantification of the fermentation product: physicochemical, biological and enzymatic methods	2
	b. Sterility testing (direct inoculation method, membrane filtration method)	1
	c. Bioburden test	1

	d. Microbial limit test	1
	e. Pyrogen testing: Endotoxin detection (LAL test)	1
	f. Ames test and modified Ames test	1
	g. Toxicity testing (Acute toxicity)	1
	h. Shelf life determination	1
	7. Fermentation economics:	
	a. Contribution of various expense heads to a process (Recurring and nonrecurring expenditures) citing any suitable example.	1
	b. Introduction to Intellectual Property Rights – Types of IPR (patenting in fermentation industry)	1
	c. Concept of validation(significance of SOPs)	1

Semester VI

DSEC - MB 365 Fermentation Technology – II

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Credit No.	Topics	No. of lectures
	Solid state and Submerged state fermentations and Large scale fermentations	18
Credit I	**1. Introduction to Solid State Fermentation and Submerged Fermentation:** Process, production strains, media, fermentor design, fermentation conditions, applications, merits and demerits	1
	2. Large scale production of (process with flow sheet, nature of the product, production pathway, applications, production strains, media, fermentation process, parameters, product recovery)	
	a. Primary Metabolites:	
	i. Vitamins (B12 and B2)	3
	ii. Amino acids - Glutamic acid, Lysine	3
	iii. Organic acids (Citric acid, Vinegar and Lactic acid)	4
	b. Secondary metabolites:	
	i. Bioethanol	1

	ii. Alcoholic Beverages - a. Beer (Lagering, Maturation, Types of beer) b. Wine (Aging, Malo-lactic acid fermentation, types of wine, wine defects, comparison of white and red wine) iii. Antibiotics [Penicillin (natural and semi synthetic) and Streptomycin]	3 3
Credit II	**Large scale production of enzymes, steroids, biomass based products, milk products, vaccines, immune sera and Modern trends in microbial production**	**18**
	3. Enzymes i. Amylase ii. Esterases iii. Proteases	 1 1 1
	4. Microbial transformation of steroids	2
	5. Biomass based products: i. Yeast: Baker's and Distiller's yeast ii. Probiotics: *Lactobacillus sporogenes*	 2 1
	6. Milk products: i. Cheese (Processed, soft, semi-hard, hard ripened types- bacterial and mold) ii. Yogurt (plain, flavoured, fruit, sundae style. Stirred type, set type, probiotic yoghurt)	 2 2
	7. Vaccines i. Polio – Inactivated Polio Vaccine, Oral Polio Vaccine ii. Tetanus – Tetanus toxoid (TT) iii. Rabies – HDCC, Chick embryo cell line, Vero cell line	 1 1 1
	8. Immune sera i. Anti tetanus serum (ATS) ii. Anti rabitic serum (ARS)	 1 1
	9. Modern trends in microbial production: Biosurfactant and bioemulsifier	 1

Semester V

DSEC - MB 356: Agricultural Microbiology

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcomes

- To understand plant growth improvement with respect to disease resistance, environment tolerance.
- To correlate stages of plant disease development, epidemiology, symptom based classification, control methods.
- To understand the importance of microorganisms in sustainable agriculture, biotechnological application of bio films, edible vaccines.
- To correlate Soil Micro biome and Role of microorganisms in soil health
- To determine the use of Microorganisms as tools in plant genetic engineering.

Credit No.	Topics	No. of lectures
		18
Credit I	**Plant Pathology** **1.** Plant growth improvement and Stages in development of a disease a. Plant growth improvement with respect to disease resistance b. Stages in development of a disease: Infection, invasion, colonization, dissemination of pathogens andperennation	3
	2. Classification of disease based on symptoms (with one example of the following): Canker, Downy mildew, Mosaic	3
	3. Plant disease epidemiology Concepts of monocyclic, polycyclic and polyetic diseases withone example of each, disease triangle and forecasting of plant diseases.	6
	4. Methods of plant disease control i. Eradication ii. Chemical control iii. Biological control (employing bacterial and fungal cultures) iv. Integrated pest management v. Genetic engineering for disease resistant plants	6

Credit II	**Microorganisms in sustainable Agriculture and tools in plant genetic engineering**	**18**
	5. Microorganisms in sustainable Agriculture	
	a. Soil Micro biome (plant Micro biome): Concept, Composition, functioning and methods to study plant Micro biome	3
	b. Conservation of soil health: Role of microorganisms in soil health	1
	c. Phytonutrient availability by soil microorganisms Mechanism of diazotrophy, Phosphate solubilization, Potassium mobilization, micronutrient availability	2
	d. Biofilm in plant surfaces, Biofilm formation; Biofilm in Phyllosphere and rhizosphere, Examples of plant- microbe interactions in biofilms, Biotechnological applications of plant biofilms	3
	6 Microorganisms in plant genetic engineering:	
	a. Concept of GM crops (Transgenic crops) w.r.t. to edible vaccines, insecticide resistance, herbicide resistance, improved varieties, new variants, disease resistance	2
	b. Tools and techniques:	
	i. Microorganisms as tools in plant genetic engineering (Shuttlevectors)	2
	ii Technology of BT resistant crops	1
	iii. Concept of edible vaccines	1
	iv Technique of use of plant viruses in genetic engineering	1
	c. RNAi Technology and antisense RNA technology in disease resistant plant varieties	2

References: MB 356 Agricultural Microbiology

1. Bahadur B., Venkat rajam M., Sahijram L. and Krishnamurthy K.V. (2012). Plant Biology and Biotechnology. Vol II: Plant Genomics and Biotechnology. Springer Publications.
2. Dube. H.C. and Bilgrami. K. S. (1976). Text book of modern pathology. Vikas Publishing House. New Delhi.

Semester VI

DSEC - MB 366: Food Microbiology

[2 Credits; 36 Lectures]

[1 credit=15hrs x 60 mins = 900mins/50mins=18 lectures]

Course Outcome

- To describe food safety problems and solutions in India and global scale.
- Identify and classify types of microorganisms in food processing and compare their Characteristics and behavior
- To learn food classification based on their perishability, intrinsic and extrinsic factors affecting the growth of microbes in foods, role of microorganisms in food fermentation.
- To acquire knowledge about food spoilage, food borne diseases, predisposition and preventive and control measures.
- To apply principles of sanitation, heat treatment, irradiation, modified atmosphere, antimicrobial preservatives and combination of method (hurdle concept) to control microbial growth with emphasis on HACCP guidelines.

Credit No	Topics	No. of lectures
	Introduction to properties of food and spoilage of food	**18**
Credit I	**1. Classification of food- Perishable, non-perishable, and stable.**	4
	Sensory characters of food-	
	a. Definition of food	
	b. Sensory or organoleptic factors- appearance factors-(size,shape, color, gloss, consistency, wholeness)	
	c. Textural factors-texture changes	
	d. Flavor factors (taste, smell, mouthfeel, temperature	
	2. Factors affecting Microbial growth in food	5
	a. Intrinsic factors- pH, water activity, O-R potential, nutrientcontent, biological structure of food, inhibitory substances in food.	
	b. Extrinsic factors-Temperature of storage, Relative humidity, concentration of gases.	
	3. Sources of food spoilage microorganisms	9
	a. Contamination and spoilage of perishable foods- vegetablesand fruits, Meat and meat products, Fish and other sea food,Egg and poultry products.	
	b. Contamination and spoilage of canned foods	
	c. Contamination and spoilage of- cereals and cereal products, sugar and sugar products, salad dressings, spices andcondiments.	

Credit II	**Food Preservation and food in relation to disease**	**18**
	4. Principles of food preservation a. Importance of TDP, TDT, D, F, Z values b. Use of low and high temperature for food preservation. c. Use of chemicals and antibiotics in food preservation, d. Canning e. Dehydration f. Use of radiation g. Tetra pack technology h. Food grade bio preservatives	10
	5. Microbial food poisoning and food infection a. Food poisoning -*Clostridium botulinum, Aspergillus flavus* b. Food infection-*Salmonella typhimurium, Vibrio parahaemolyticus*	4
	6. Concept of Prebiotic and Probiotic and fermented food- definition, Health effects, Quality assurance, Safety, side effects and risk. Potential applications of Prebiotic, Probiotic and fermented food	2
	7. Food sanitation and regulatory authorities (ISO, FDA, WHO)	2

References: MB 366 Food Microbiology

1. Alias A K., Paliyath G. and Bhat R. (2012). Progress in Food Preservation. United Kingdom: Wiley. ISBN: 9780470655856
2. Banwart G. J. (1989). Basic Food Microbiology. 2nd edition. Chapman and Hall. International Thompson Publishing.
3. Bozoglu T. F. and Erkmen O. (2016). Food Microbiology. 2 Volume Set: Principles into Practice. United Kingdom: Wiley. ISBN: 9781119237761
4. Coles R. and Kirwan M. J. (2011). Food and Beverage Packaging Technology. Germany: Wiley. ISBN: 9781444392173
5. Early R. (2012). Guide to quality management for the food Industry. Blackie Academic and Professional. ISBN-13: 978-1461358879
6. Frazier W. C., Westhoff D. C. and Vanitha N. M. (2013). Food Microbiology. 5th edition. McGraw Hill education, India.
7. Garbutt J. (1997). Essentials of Food Microbiology. Taylor and Francis. ISBN: 9780340677018
8. Gupta V. (2017). The food safety and standards act 9th edition. Commercial Law Publishers (India) Private Limited

Semester V

Practical Course-I

DSEC-MB – 357: Diagnostic Microbiology and Immunology

[2 Credits; 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No	Practical	No. of Practicals
1.	**Clinical microbiology:** **Physical, Chemical and Microscopic examination of Clinical samples -** Urine, stool and pus	2
2.	**Isolation, identification of following pathogens from clinicalsamples:** i. *Klebsiella* spp. ii. *Salmonella* spp. iii. *Pseudomonas* spp iv. *Streptococcus* spp. v. *Enterococcus* spp. (for identification use of keys as well as Bergey's Manual is recommended)	5
3.	**Agglutination tests:** Widal test (Slide test and Tube Test) and Rapid Plasma Reagin (RPR) test	1
4.	**Epidemiological survey:** Development of hypothesis, Data collection, organization, statistical analysis, graphical representation using computers and interpretation, Preparation of report	2
5.	**Hemogram:** a. Estimation of hemoglobin (Acid hematin and Cyan-methemoglobin method) b. ESR and PCV determination, c. White blood cell differential count from peripheral blood d. Counting of RBCs and WBCs using counting chamber e. Calculation of hematological indices	2

Semester VI

Practical Course-I

DSEC-MB – 367: Diagnostic Microbiology and Immunology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No.	Practicals	No. of Practicals
1.	**Study of permanent slides of following microbial pathogens:** a. *Entamoeba histolytica* b. *Giardia* spp. c. *Plasmodium* spp. d. *Mycobacterium* (tuberculosis and leprae) e. *Trichophyton* spp. f. *Epidermophyton* spp. g. *Microsporum* spp.	3
2.	**Isolation and identification of following yeast and fungalpathogens:** *Cryptococcus neoformans / Histoplasma capsulatum*	1
3.	**Antibiotic sensitivity testing of the bacterial pathogens (for Gram negative and Gram Positive)**	1
4.	**Immunohematology:** Cross-matching (Major and Minor) and Coomb's test (Direct andIndirect)	2
5.	**Immuno chromatographic test:** The qualitative differential detection of IgM and IgG antibodies to dengue virus in Human serum /Plasma **Or** **Advantage Mal Card visual immunoassay:** The qualitative diagnosis of *Plasmodium* spps	1
6.	**Immunoprecipitation:** Double diffusion (Ouchterlony) technique	1
7.	**Demonstrations of:** a. Serum protein separation by electrophoresis b. ELISA (Antigen/ Antibody detection) c. Egg inoculation technique	2
8.	**Visit to blood bank and preparation of visit report**	1

References: MB 357 and MB 367: Diagnostic Microbiology and Immunology

1. Abramson J. and Abramson Z. H. (2011). Research Methods in Community Medicine: Surveys, Epidemiological Research, Programme Evaluation, Clinical Trials. Sixth Edition. Wiley. ISBN: 978-0-470-98661-5
2. Baveja C. P. and Baveja V. (2019). Text and Practical Microbiology for MLT. 3rd Edition. Arya Publishing Company. ISBN-13: 9788178558387
3. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer. ISBN 978-0-387-24143-2
4. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part B: The Gammaproteobacteria. Garrity G. Brenner D. J., Krieg N.R., and Staley J. R. (Eds.). Springer. ISBN 978-0-387-24144-9
5. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part C: The Proteobacteria. Garrity G. Brenner D. J., Krieg N. R., andStaley J. R. (Eds.). Springer. ISBN 978-0-387-24145-6
6. Bergey's Manual of Systematic Bacteriology. (2009). Volume Three: The Firmicutes. Part C: The Proteobacteria. Vos, P., Garrity, G., Jones, D., Krieg, N.R., Ludwig, W., Rainey, F.A., Schleifer, K.-H., Whitman, W. (Eds.). Springer. ISBN 978-0-387-95041-9
7. Godkar P. B. (2020). Textbook of Medical Laboratory Technology Volume 1 and 2.3rd edition Bhalani Publishing House. ASIN: 9381496196. ISBN-13: 978- 9381496190
8. Greer D. L., Kane J., Summerbell R., Sigler L., Krajden S. and G. Land (Editors). (1999). Laboratory handbook of dermatophytes: a clinical guide and laboratory manual of dermatophytes and other filamentous fungi from skin, hair, and nails. Mycopathologia. 147: 113–114
9. Maheshwari N. (2017). Clinical Pathology Hematology and Blood Banking (For Dmlt Students). 3rd edition. Jaypee Brothers Medical Publishers. ISBN-13: 978- 9386261182
10. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume I: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13: 978-1259061233
11. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume II: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education

Semester VI

Practical Course-I

DSEC-MB – 367: Diagnostic Microbiology and Immunology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No.	Practicals	No. of Practicals
1.	**Study of permanent slides of following microbial pathogens:** a. *Entamoeba histolytica* b. *Giardia* spp. c. *Plasmodium* spp. d. *Mycobacterium* (tuberculosis and leprae) e. *Trichophyton* spp. f. *Epidermophyton* spp. g. *Microsporum* spp.	3
2.	**Isolation and identification of following yeast and fungalpathogens:** *Cryptococcus neoformans / Histoplasma capsulatum*	1
3.	**Antibiotic sensitivity testing of the bacterial pathogens (for Gram negative and Gram Positive)**	1
4.	**Immunohematology:** Cross-matching (Major and Minor) and Coomb's test (Direct andIndirect)	2
5.	**Immuno chromatographic test:** The qualitative differential detection of IgM and IgG antibodies to dengue virus in Human serum /Plasma **Or** **Advantage Mal Card visual immunoassay:** The qualitative diagnosis of *Plasmodium* spps	1
6.	**Immunoprecipitation:** Double diffusion (Ouchterlony) technique	1
7.	**Demonstrations of:** a. Serum protein separation by electrophoresis b. ELISA (Antigen/ Antibody detection) c. Egg inoculation technique	2
8.	**Visit to blood bank and preparation of visit report**	1

References: MB 357 and MB 367: Diagnostic Microbiology and Immunology

1. Abramson J. and Abramson Z. H. (2011). Research Methods in Community Medicine: Surveys, Epidemiological Research, Programme Evaluation, Clinical Trials. Sixth Edition. Wiley. ISBN: 978-0-470-98661-5
2. Baveja C. P. and Baveja V. (2019). Text and Practical Microbiology for MLT. 3rd Edition. Arya Publishing Company. ISBN-13: 9788178558387
3. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer. ISBN 978-0-387-24143-2
4. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part B: The Gammaproteobacteria. Garrity G. Brenner D. J., Krieg N.R., and Staley J. R. (Eds.). Springer. ISBN 978-0-387-24144-9
5. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part C: The Proteobacteria. Garrity G. Brenner D. J., Krieg N. R., andStaley J. R. (Eds.). Springer. ISBN 978-0-387-24145-6
6. Bergey's Manual of Systematic Bacteriology. (2009). Volume Three: The Firmicutes. Part C: The Proteobacteria. Vos, P., Garrity, G., Jones, D., Krieg, N.R., Ludwig, W., Rainey, F.A., Schleifer, K.-H., Whitman, W. (Eds.). Springer. ISBN 978-0-387-95041-9
7. Godkar P. B. (2020). Textbook of Medical Laboratory Technology Volume 1 and 2.3rd edition Bhalani Publishing House. ASIN: 9381496196. ISBN-13: 978- 9381496190
8. Greer D. L., Kane J., Summerbell R., Sigler L., Krajden S. and G. Land (Editors). (1999). Laboratory handbook of dermatophytes: a clinical guide and laboratory manual of dermatophytes and other filamentous fungi from skin, hair, and nails. Mycopathologia. 147: 113–114
9. Maheshwari N. (2017). Clinical Pathology Hematology and Blood Banking (For Dmlt Students). 3rd edition. Jaypee Brothers Medical Publishers. ISBN-13: 978- 9386261182
10. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume I: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education (India) Private Limited. ISBN-13: 978-1259061233
11. Mukherjee K. L. and Ghosh S. (2010). Medical Laboratory Technology, Volume II: Procedure Manual for Routine Diagnostic Tests. 2nd edition. McGraw Hill Education

Semesters V

Practical Course – II

MB 358: Enzymology and Genetics

[2 Credits; 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No.	Practical	No. of Practical
1.	Determination of absorption spectra and molar extinction co-efficient of two different dyes(by colorimetry /spectrophotometry)	1
2.	Qualitative analytical tests using flow charts for Proteins (tests for aromatic amino acids, sulfur containing amino acids,different amino acids) i. Carbohydrates (tests for monosaccharides, disaccharides, and polysaccharides)	2
3.	Preparation of buffers and calibration of pH meter	1
4.	Paper Chromatography i. Separation and Identification of amino acids from mixture by paper chromatography ii. Separation and Identification of sugars from mixture by paper chromatography	1
5.	Extraction and quantitative estimation of total carbohydrate /proteins from natural sample: i. Estimation of total carbohydrates from natural sources by Lane-Eynon method ii. Estimation of reducing sugar from natural sources by DNSA method iii.Estimation of proteins from natural sources by Folin Lowry method	3
6.	Isolation of genomic DNA from bacteria	1
7.	Determination purity of DNA and its quantification: a. Estimation of DNA by UV- spectrophotometric method, 260/280 ratio b. Estimation of DNA by the diphenylamine	1
8.	Bacterial Conjugation	1
9.	Chromosome Staining (G-banding) Giemsa staining of chromosome from eukaryotic cell extract	1

Semester V

Practical course-III

DSEC-MB 359 Fermentation Technology- I and Agricultural Microbiology

[2 Credits; 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No	Title of the Practical	No. of Practical
1.	Sterility Testing of pharmaceuticals (non-biocidal injectables): Direct inoculation method, membrane filtration method, using control test cultures as per IP guidelines (availability at the center).	2
2.	Minimum inhibitory concentration and minimum bactericidal concentration of antibacterial compounds (MIC and MBC)	2
3.	Antibiotic and growth factor assay (agar gel diffusion technique)	1
4.	Isolation and identification of *Xanthomonas* spp. from citrus canker	1
5.	Isolation of *Aspergillus niger* from black rot of onion	1
6.	Collection of plant disease specimens and study of symptoms/ Project based on digital record of plant diseases(Group Activity)	2
7.	Isolation of PGPR with phosphate solubilization potential/Vesicular-Arbuscular Mycorrhiza (VAM), Preparation of liquid bioinoculants	1
8.	Validation of commercial formulations of bioinoculants based on BIS standards, Pot studies to check effect of bioinoculants on plant growth	

References: MB 359 Fermentation Technology- I and Agricultural Microbiology

1. British Pharmacopeia. (2021). The Stationery Office Ltd (TSO), PO Box 29, Norwich, NR3 1PD. https://www.pharmacopoeia.com/Catalogue/Products
2. Indian Pharmacopeia. (2018 Addendum 2021). https://www.indianpharmacopoeia.in/index.php
3. USA Clinical Laboratory Standards Institute(CLSI) Guidelines 2021 on https://clsi.org/
4. Sterility Testing: https://www.who.int/medicines/publications/pharmacopoeia/TestForSterility-RevGenMethod_QAS11-413FINALMarch2012.pdf.
5. Microbiological assay of antibiotics: https://apps.who.int/phint/pdf/b/7.3.1.3.1-Microbiological-assay-of-antibiotics.pdf

Semester VI

Practical Course – II

DSEC-MB 368: Metabolism and Molecular Biology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No.	Practicals	No. of Practical
1.	Clinical Biochemistry - Estimations of i. Blood sugar ii. Blood urea iii. Serum cholesterol iv. Serum proteins and albumin	3
2.	Enzyme production, purification, quantification and Immobilization: i. Lab scale production of amylase using isolates ii. Precipitation of amylase from fermentation broth (salt/solvent) iii. determination of specific activity of crude and purified amylase iv. Immobilization of Amylase using calcium alginate	4
3.	Enrichment, Isolation and Enumeration of Bacteriophages (Principle , Methodology and Calculations of phage titer in PFU/ml)	2
4.	Isolation of Plasmid DNA and Agarose Gel Electrophoresis (Demonstration/hands on as per infrastructure availability)	1
5.	Study of Mitotic cell division from onion root tips	1
6.	Visit to a Biotechnology/ Biochemistry institute	1

References: MB 368 Metabolism and Molecular Biology

1. Ausubel F. M., Brent R., Kingston R. E., Moore D. D., Seidman J.G., Smith J. A. and Struhl K. (Editors.). (2003). Current Protocols in Molecular Biology. Copyright © John Wiley and Sons, Inc. ISBN: 047150338X
2. Bhatta P. and Sakya S. R. (2008). Study of mitotic activity and chromosomal behaviour in root meristem of *Allium cepa* L. treated with magnesium sulphate. Ecoprint. 15: 83-88. ISSN 1024-8668. Ecological Society (ECOS), Nepal. www.ecosnepal.com.
3. Birnboim H. C. and Doly J. (1979). A rapid alkaline extraction procedure for screening of recombinant plasmid DNA. Nucleic acid Research. 7(6):1513-1523.

Semester VI

Practical Course-III

DSEC-MB 369 Fermentation Technology- II and Food Microbiology

[2 Credits; 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Sr. No	Title of the practical	No. of practicals
1.	Lab Scale production of the fermentation products: a. Ethanol (fermentation, recovery by simple distillation, estimation of end product by CAN method and fermentation efficiency) **or** b. Citric acid (fermentation, recovery by acid base precipitation and estimation of product by titrometry)	2
2.	Solid state fermentation for production of any one fermentation product (*Trichoderma sp.* / mushrooms / enzymes)	1
3.	Isolation and identification of Probiotic microflora from natural sources or any commercial formulation.	2
4.	Study of SOPs for pharmaceutical industry a. disinfectant efficacy testing b. Physical monitoring of microbiology section c. Handling of biological indicators d. Microbiological testing of vials e. Identification of contaminant in sterile area	1
5.	Detection of aflatoxin	1
6.	Determination of TDP and TDT value	2
7.	Determination of TDR and D value	1
8.	HACCP guidelines for food industry (activity based)	1
9.	Visit to any food industry or a fermentation industry	1

References: MB 369 Fermentation Technology- II and Food Microbiology

1. Lab scale fermentations:
   - Casida L. E., Jr. (2019). Industrial Microbiology, New Age International

SEM V

Skilled Base Elective MB 3510 Marine Microbiology

2 Credit Course: 1.5 credit theory+0.5 credit Practical

Course Outcome:

- To impart the awareness of unseen and unexplored niche of marine ecosystem of microbes.
- To acquire advances in the knowledge of marine microbes and marine ecology.
- To learn the field research on marine processes and laboratory research on microorganisms.
- To comprehend the role of marine microbes in bioremediation and bioprospecting.
- To avail career opportunities in marine education, industry and research.

Theory Total Lectures: 21

Credit	Theory	No. of lectures
Credit 1.5	**1. Marine ecology and sampling**	
	a. Marine Habitats – estuaries, mangroves, coral reefs, salt marshes,coastal ecosystems, deep sea, hydrothermal vents, Polar habitat –Arctic, Antarctica, Southern Ocean	3
	b. Physiology of marine microorganisms – metabolic diversity, marineloop, marine snow, Role of marine microorganisms in biogeochemical cycles, nutrient cycling and hydrocarbon degradation	4
	c. Sampling methods– water sampling (Niskin sampler) and sedimentsampling (Grab sampler, box corer, gravity corer), Culturing methods – VBNC, biofilm, mats from vents and estuarine sample.	4
	2. Marine microbes, role in bioremediation and bioprospecting	
	a. Extremophilic microorganisms – econiches, different types withexamples and significance	2
	b. Archaea –biodiversity, stress response, adaptation and significance	3
	c. Marine mycology – econiche, types of marine fungi andsignificance	2
	d. Bioremediation – heavy metals, hydrocarbon pollutants – tar ball and oil spills	3

Skilled Based Elective MB 3510:

Marine Microbiology Practical

Total Lectures: 15 Practical 03 x 05 lectures=15 lectures

Credit	Practical	No. of Practicals
Credit 0.5	**1.** Physico-chemical analysis of sea water	1
	2. Isolation of marine bacteria/ fungi from different econiches – coastal waters, deep sea, estuarine waters, sediments	1
	3. Isolation of extremophilic bacteria – halophiles, thermophiles, acidophiles, alkalophiles, psychrophiles, osmophiles (any two of these)	1

References:

1. Alexopoulus C. J., Mims C. W. and Blackwell M. (1996). Introductory Mycology. Wiley ISBN: 978-0-471-52229-4.
2. Bathmann U. (2005). Ecological and biogeochemical response of Antarctic ecosystems to iron fertilization and implications on global carbon cycle, Ocean and Polar Research. 27(2): 231-235.
3. Bej A. K., Aislabie J. and Atlas R. M. (2009). Polar Microbiology. The ecology, biodiversity and bioremediation potential of microorganisms in extremely cold environments. Taylor and Francis. eBook. ISBN-9780429150913.
4. Belkin S. and Colwell R. R. (2005). Oceans and Health: Pathogens in the Marine Environment. Springer. ISBN 978-0-387-23709-1.
5. Boone D. R. Castenholz R. W. and Garrity G. M. (2001). Bergey's Manual of Systematic Bacteriology: The archaea and the deeply branching and phototrophic bacteria. Springer. ISBN- 978-0-387-98771-2.
6. Borse B. D., Bhat J. D., Borse K. N., Tuwar N. S. and Pawar N. S. (2012). MarineFungi of India (Monograph). 1st edition. Broadway Publishing House. Broadway Publishing. ISBN-13: 978-9380837383.
7. Bull A. T. (2004) Microbial Diversity and Bioprospecting. ASM Press. ISBN 1-55581-267- 268.
8. Caspers H. (1980). Phytoplankton Manual. Sournia A. Editors. Monographs oı Oceanographic Methodology 6. Paris: Unesco. ISBN 92-3-101572-9.
9. Clark R. B. And Clark R. L. (2001). Marine Pollution. Oxford University Press.
10. Gasol G. M. and Kirchman D. L. (2018). Microbial Ecology of the Oceans. 3rd Editioı Wiley-Blackwell. ISBN: 978-1-119-10718-7.

Semester V

Skilled Base Elective MB 3511 Dairy Microbiology

2 Credit Course: Total lectures: 36: Theory-21 L; Practical-15L

Course Outcome:

- To understand prospects of dairying at commercial marketing.
- To acquire skills of processing of milk and dairy products.
- To assess quality control in dairy industry.
- To comprehend production of dairy products of commercial significance with emphasis tolocal and global market demand.

Skilled Base Elective MB 3511 Dairy Microbiology Theory Total Lectures: 21

Credit No.	Theory	No of Lectures
Credit 1.5	**1. Definition, types, microflora and pathogens:** i. Definition of milk, Composition and physicochemical properties of Milk of different animals. Difference between colostrum and milk. ii. Types of milk: whole, toned, double toned, homogenized, and skimmed milk, dehydrated milk iii. Microflora associated with milk and its importance. iv. Sources of contamination of raw milk and relative importance in influencing quality of milk during production, collection, transportation, and storage, milk borne diseases.	8
	2. Processing Techniques and naturally occurring preservatives i. Bacteriological aspects of processing techniques like bactofugation, thermisation, pasteurization (in detail process is expected), sterilization and boiling. ii. Naturally occurring preservative systems in milk like LP system, immunoglobulins, Lysozyme, Lactoferrin etc.	4
	3. Spoilage of Milk i. Spoilage of Milk ii. Succession of microorganisms in milk leading to spoilage iii. Stormy fermentation, ropiness, sweet curdling iv. Color and flavor defects v. Preservation of Milk and Milk products by physical (irradiation) and Chemical agents, food grade bio preservatives (GRAS), Bacteriocins of LAB	5

	4. Microbiological aspects of quality control and qualityassurance in production of milk and milk products. i. Good Manufacturing Practices, ii. Sanitary standard operating procedures, iii. Total quality management and application of HACCP programin dairy industry. iv. Safety concern of biofilm formation on equipment surfaces and their control measures	4

Skilled Base Elective MB 3511

Dairy Microbiology Practical

Total Lectures: 15Total Practical 05 x 05 lectures=15 Lectures

Credit	Practicals	Number of Practicals
Credit 0.5	**1. Microbiological analysis of milk:** Enumeration of bacteria. (Standard Plate Count (SPC) and DirectMicroscopic Count) – raw milk and pasteurized milk	1
	2. Microbiological quality control tests for milk: i. Dye reduction tests (MBRT/Resazurin) ii. Mastitis test iii. Somatic cell count iv. Phosphatase test	1
	3. Microbiological quality of indigenous dairy products: i. Khoa ii. Kulfi iii. Shrikhand iv. Paneer v. Curd/ Buttermilk	1

References:

1. Banwart G. J. (1989). Basic Food Microbiology. 2nd edition. Food Science andNutrition. Springer. ISBN 978-1-4684-6453-5
2. Bullock D. (2019). Dairy Microbiology. ED-Tech Press. E-Book. ISBN:9781788821629
3. De Sukumar. (2001). Outlines of Dairy Technology. Oxford University Press. Delhi. ISBN-13 978-0195611946

Semester VI

Semester VI Skilled Base Elective MB 3610 Waste Management

2 Credit Course: Total lectures: 36: Theory-21 L; Practical-15L

Course Outcome:

- To understand waste management and it practicable applicability.
- To assess the magnitude and influence of hazardous content of waste, pollution of waters and waste water treatment technologies.
- To learn the design and working of treatment plants and methods used for liquid and solid waste treatment.
- To impart the understanding of kinetics of biological systems used in waste treatment.
- To learn the standards of waste management and competent authorities involved at National and international level.

Skilled Base Elective MB 3610 Waste Management Theory Total Lectures 21

Credit	Theory	
Credit	A. Liquid Waste Management	No. of Lectures
1.5	**1. Principles of Wastewater Treatment** i. The need for treatment of wastewater ii. General characteristics of liquid waste - pH, Color Turbidity, Odor, Electrical conductivity, COD, BOD, Total Solids, Total Dissolved Solids, Total Suspended Solids, Total Volatile Solids, Chlorides, Sulphates, Oil and Grease.	4
	2. Microbiology of Wastewater Role of microorganisms in wastewater treatment i. Aerobic and Anaerobic digestion models; attached / anchored andsuspended growth. ii. Removal of pathogenic microbes, indicator microbes, enumerationof different types of microbes	4
	3. Unit operations in wastewater treatment plant i. Collection system - Methods of collection, conservancy systems, water carriage system, sewerage system. ii. Screen chamber, Grit chamber, Oil and grease removal iii. Stabilization pond, Aerated lagoon iv. Activated sludge process, Trickling filter v. Rotating biological contactors, anaerobic digestion processes, fluidized bed reactor.	4

	Topic	No. of lectures
	B. Solid Waste Management and hazardous waste	
	4. Characterization of solid wastes: Dairy and e-waste	2
	5. Biomedical waste: Definition, Types, Processing	2
	6. Solid biodegradable waste processing: Composting, Vermicomposting, Biogas production	2
	7. Post-processing by-products of municipal solid waste treatment:leachate refused-derived fuel (RDF)	3

Skilled Base Elective MB 3610 Waste Management Practicals Total Lectures 15

Total Practicals 05 x 05 lectures= 15 lectures

Credit	Practicals	No. of Practicals
Credit 0.5	**1.** Determination of Solids in wastewater: Total Solids, Suspended Solids, Dissolved Solids, Volatile Solids, Fixed Solids, Settleable Solids	1
	2. Determination of Dissolved Oxygen, BOD and COD of waste water (before and after treatment) (MPCB Standards)	1
	3. Preparation of Project report based on a case study (Hotel/ Industry-Dairy, Food processing) Study of the source, generation rates and characteristics of hazardous wastes and their regulation, handling, treatment, and disposal. Special emphasis is placed on process design of waste handling, treatment and disposal systems.	1

References: Skilled Base Elective MB 3610 Waste Management

1. Chandrappa R. and Das D. B. (2012). Solid Waste Management-Principles andPractice. In Environmental Science and Engineering. Springer (Firm).
2. Dutta S., Neela Priya D., Chakradhar B. and Sasi Jyothsna T.S. (2019) Value Added By-products Recovery from Municipal Solid Waste in Waste Valorisation and Recycling. Springer, Singapore.
3. Masters G. M. (1994). Introduction to Environmental Engineering and Science. Prentice Hall of India (Private) Ltd., New Delhi.
4. Metcalf and Eddy (Eds.) 2003. Wastewater Engineering – Treatment and Reuse. 4th Edition. Tata Mac Graw Hill Publishing Co. Ltd. New Delhi.

Semester VI

Skilled Base Elective MB 3611 Nano-biotechnology

2 Credit Course: 1.5 credit theory+0.5 credit Practical

Theory-21 L; Practical-15L

Course Outcome

- To understand design, development and application of Nanomaterials and their application in Nanodevices.
- To learn fundamentals of nanotechnology as to Synthesis and characterization techniques of nanoparticles.
- To acquire knowledge of applications of nanomaterials in different disciplines of humanlife.
- To compare the merits of using nanotechnology with existing technologies.

Skilled Base Elective MB 3611 Nano-biotechnology Theory [total lectures 21]

Sr. No.	Topic	No. of Lectures
Credit 1.5	**1. Introduction to Nano-biotechnology:** a. Introduction to nanoscale, nanomaterials, nanoscience and nanotechnology b. Nanoscale bioassemblies c. Liposomes, viruses, DNA, polysaccharides and proteins (Protein nanotubes,nanofibers, peptide nanoparticles). d. Biomedical applications of bioassemblies e. Cell targeting, drug delivery, bioimaging and vaccine development.	6
	2. Microbial mediated metallic nanoparticles synthesis: a. Gold nanoparticles (AuNPs) b. Silver nanoparticles (AgNPs) c. Au-Ag alloy nanoparticles d. Oxide nanoparticles e. Magnetic nanoparticles f. Non-magnetic oxide nanoparticles g. Sulfide nanoparticles etc.	5
	3. Characterization techniques for nanomaterials: UV-visual spectroscopy, Fourier transform infrared (FTIR), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM) and dynamic light scattering (DLS).	6
	4. Applications of nanoparticles: Antibacterial agent, drug delivery, biosensor, animal industry and nanotechnology inwastewater treatment.	4

Skilled Base Elective: MB 3611 Nano-biotechnology. Practicals [total lectures 15]

Credit	Practical	No. of Practicals
Credit 0.5	**1.** Microbial synthesis of metallic nanoparticle synthesis (any two): silver, chromium, cobalt)	1
	2. Detection and Characterization of metallic nanoparticlesin colloidal solutions by: a. UV-Spectrophotometer b. FTIR analysis	1
	3. Application of nanoparticles- checking antimicrobialactivities against the microbial synthesized metallic nanoparticles (any two)	1

References: Skilled Base Elective: MB 3611 Nano-biotechnology.

1. Bujold K. E., Lacroix A., and Sleiman H. F. (2018). DNA Nanostructures at the Interface with Biology. Chem. 4: 495–521. Elsevier Inc.
2. Chokriwal A., Sharma M. M. and Singh A. (2014). Biological synthesis of nanoparticles using bacteria and their applications. American Journal of PharmTechResearch. 4(6):38-61.
3. Das R. K., Pachapur V. L., Lonappan L., Naghdi M., Pulicharla R., Maiti S. and Brar S. K. (2017). Biological synthesis of metallic nanoparticles: plants, animals andmicrobial aspects. Nanotechnology for Environmental Engineering. 2(1): 1-21.
4. Doll T. A. P. F., Raman S., Dey R. and Burkhard P. (2013). Nanoscale assembliesand their biomedical applications. J R Soc Interface.10: 20120740. http://dx.doi.org/10.1098/rsif.2012.0740
5. Gurunathan S., Kalishwaralal K., Vaidyanathan R., Venkataraman D., Pandian S. R. K., Muniyandi J., Hariharan N. amd Soo Hyun Eom. (2009). Biosynthesis, purification and characterization of silver nanoparticles using *Escherichia coli*. Colloids and Surfaces B. 74(1): 328–335.
6. Fariq A., Khan T. and Yasmin, A. (2017). Microbial synthesis of nanoparticles and their potential applications in biomedicine. J. Appl. Biomed. 15: 241–248
7. Li X., Xu H., Chen Z. S. and Chen G. (2011). Biosynthesis of nanoparticles by microorganisms and their applications. Journal of Nanomaterials. 2011.

Semester I
MB 111: Introduction to Microbial World

Credit	Topic	No. of Lectures (36)
Credit I	**1. Amazing world of Microbiology**	
	a. Development of microbiology as a discipline -Discovery of microscope and Microorganisms (Anton von Leeuwenhoek and Robert Hooke), Abiogenesis v/s biogenesis (Aristotle's notion about spontaneous generation, Francesco Redi's experiment, Louis Pasteur's & Tyndall's experiments)	4
	b. Golden Era of Microbiology	
	i. Contributions of - Louis Pasteur (Fermentation, Rabies, Pasteurization and Cholera vaccine-fowl cholera experiment) Robert Koch (Koch's Postulates, Germ theory of disease, Tuberculosis and Cholera-isolation and staining techniques of causative agent) Ferdinand Cohn (Endospore discovery)	4
	ii. Discovery of viruses (TMV and Bacteriophages), River's Postulates,Contribution of Joseph Lister (antiseptic surgery), Paul Ehrlich (Chemotherapy), Elie Metchnikoff (Phagocytosis), Edward Jenner (Vaccination) and Alexander Fleming (Penicillin) in establishment of fields of medical microbiology and immunology, Discovery of Streptomycin by Waksman	4
	iii. Contribution of Martinus W. Beijerinck (Enrichment culture technique, Rhizobium), Sergei N. Winogradsky (Nitrogen fixation and Chemo-lithotrophy) in the development of the field of soil microbiology	2
	c. Modern Era of Microbiology	
	Carl Woese classification based on 16S r RNA Signification and Application of Human Microbiome, Nano-biotechnology and Space Microbiology	2
	d. Nobel laureates in Life Sciences of 21st Century	2
	(Project Based Learning: Assignments should be given to student)	

Credit		
II	**2. Types of Microorganism and their differentiating characters**	
	a. Prokaryotes, Eukaryotes, three domain and five domain system of classification	2
	b. Bacteria (Eubacteria and Archaebacteria)	1
	c. Protozoa	1
	d. Fungi	1
	e. Algae	1
	f. Viruses, Viroids and Prions	1
	g. Actinomycetes	2
	3. Beneficial and Harmful effects of microorganisms:	1
	a. Medical Microbiology (Enlist diseases caused by various microorganisms, vaccines and antibiotics)	1
	b. Environmental Microbiology (Eutrophication, red tide, Sewage treatment, bioremediation)	2
	c. Food and Dairy Microbiology (Food spoilage, food borne diseases, Probiotics and fermented food)	1
	d. Agriculture Microbiology (Plant diseases and Biofertilizers and Bio-control agents)	1
	e. Industrial Microbiology (Production of antibiotics, enzymes, solvents and contaminants-bacteria and phages)	2
	f. Immunology (Normal flora, Three lines of defence)	2

References:

1. Ahmed M. and Basumatary S. K. (2019). Applied Microbiology. MJP Publisher, Chennai, Tamil Nadu. India.
2. Beck R. W. (2000). A Chronology of Microbiology in Historical Context. United Kingdom: ASM Press.
3. Bender K. S., Buckley D. H., Stahl D. A., Sattley W. M. And Madigan M. T. (2017). Brock Biology of Microorganisms. E-Book, Global Edition. United Kingdom: Pearson Education.
4. Dubey H. C. (2004). A textbook of fungi, bacteria and Viruses. Vikas Publishing House Private Limited. New Delhi, India
5. Dubey R. C. and D. K. Maheshwary. (2012). A textbook of Microbiology. S Chand and Company. New Delhi, India

23. Schlegel H. G. (2005). General Microbiology. Cambridge University Press, United States.
24. Sherwood L., Woolverton C. J. and Willey J. (2016). Prescott's Microbiology. Singapore: McGraw-Hill Education.
25. Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.
26. Subba Rao N. S. (2016). Advances in Agricultural Microbiology. Netherlands: Elsevier Science.
27. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: an Introduction. Twelfth edition. Pearson, London.
28. Verma D. K. (2019). Microbiology for Sustainable Agriculture, Soil Health, and Environmental Protection. United States: Apple Academic Press.
29. Woolverton C. J., Sherwood L. And Willey J. M. (2011). Prescott's Microbiology. United Kingdom: McGraw-Hill.

Semester I

MB 112: Basic Techniques in Microbiology

Credit	Topic	No. of Lectures (36)
I	**1. Units of measurement – Introduction to Modern SI units**	1
	2. Microscopy	3
	a. Bright field microscopy:	
	• Electromagnetic spectrum of light	
	• Structure, working of and ray diagram of a compound light microscope; concepts of magnification, numerical aperture and resolving power.	
	• Types, ray diagram and functions of – condensers (Abbe and cardioid) eyepieces and objectives	
	• Concept of aberrations in lenses - spherical, chromatic, comma and astigmatism	
	b. Principle, working and ray diagram of	2
	• Phase contrast microscope	1
	• Fluorescence Microscopy	3
	• Electron Microscopy – TEM, SEM	

	3. Staining Techniques: **a.** Definition of Stain; Types of stains (Basic and Acidic), Properties and role of Fixatives, Mordants, Decolourisers and Accentuators **b.** Monochrome staining and Negative (Relief) staining **c.** Differential staining - Gram staining and Acid-fast staining **d.** Special staining- Capsule, Cell wall, Spore, Flagella, Lipid granules, metachromatic granules	2 1 2 3
II	**4. Sterilization and Disinfection** **a. Sterilization** • Physical Agents - Heat, Radiation, Filtration • Checking of efficiency of sterilization (Dry and Moist) – Biological and Chemical Indicators **b. Disinfection:** • Chemical agents and their mode of action - Aldehydes, Halogens, Quaternary ammonium compounds, Phenol and phenolic compounds, • Heavy metals, Alcohol, Dyes, Detergents and Ethylene oxide. • Characteristics of an ideal disinfectant • Checking of efficiency of disinfectant - Phenol Coefficient (Rideal–Walker method)	3 4 4 4 1 2

References:

1. Debnath M., Prasad G. B. and Bisen P. S. (2012). Microbes: Concepts and Applications. Germany: Wiley.
2. Dokland T., Hutmacher D. W. and Schantz J. and Ng M. M. (2006). Techniques In Microscopy For Biomedical Applications. Singapore: World Scientific Publishing Company
3. Eliasa E. A., Samuelb O., Emmanuela N., Abrahama O. (2013). Evaluation of Efficacy of Disinfectants Using Standard Methods in Healthcare Facilities in Kogi state, Northcentral Nigeria. Asian Journal of Biomedical and Pharmaceutical Sciences. 03 (27): 34-38.
4. Hugo and Russell's Pharmaceutical Microbiology. (2008). Denyer S. P., Hodges N. A., Gorman S. P. and Gilmore B. F. (Editors). Germany: Wiley.
5. McDonnell G. E. (2020). Antisepsis, Disinfection, and Sterilization: Types, Action, and Resistance. United States: Wiley.

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F. Y. B. Sc. Microbiology Practicals Syllabus

Semester I Practical Course MB 113 (Implemented from 2019) Based on theory paper I (MB 111) and Paper II (MB 112)		
Expt. No.	**Topics**	**No. of Practicals**
1	a. Safety measures and Good Laboratory Practices in microbiology laboratory. b. Introduction, operation, precautions and use of common microbiology laboratory instruments: Incubator, Hot air oven, Autoclave, Colorimeter, Laminar air flow hood, Clinical centrifuge.	2
2	a. Construction (mechanical and optical), working and care of bright field microscope. b. Permanent slide observation: Algae, Fungi and Protozoa c. Wet mount slide preparation and its observation for: Bacteria, Algae, Fungi and Protozoa.	3
3	a. Introduction and use of common laboratory glass wares: Test tubes, culture tubes, suspension tubes, screw capped tubes, Petri plates, pipettes (Mohr and serological) micropipettes, Pasteur pipettes, Erlenmeyer flask, volumetric flask, glass spreader, Durham's tube, Cragie's tube and inoculating needles (wire loop, stab needles). b. Learning basic techniques in Microbiology: Wrapping of glassware, cotton plugging, cleaning and washing of glassware, biological waste disposal.	2
4	Basic staining techniques: a. Monochrome staining b. Negative staining c. Gram staining of bacteria	3
5	Observation of motility in bacteria using: Hanging drop method and swarming growth method.	2
6.	Checking of efficacy of chemical disinfectant: Phenol Coefficient by Rideal–Walker method.	2
	TOTAL	14

Semester II

MB 121: Bacterial Cell and Biochemistry

Credits	Topic	No. of Lectures (36)
I	**1. Bacterial Cytology**	1
	Microbial cell size, shape and arrangements	
	2. Structure, chemical composition and functions of the following components in bacterial cell:	
	a. Cell wall (Gram positive, Gram negative)	2
	b. Concept of Mycoplasma, Spheroplast, protoplast, L-form	1
	c. Cell membrane	2
	d. Endospore (spore formation and stages of sporulation)	1
	e. Capsule	1
	f. Flagella	2
	g. Fimbriae and Pili	1
	h. Ribosomes	1
	i. Chromosomal & extra-chromosomal material	2
	j. Cell inclusions (Gas vesicles, carboxysomes, PHB granules, metachromatic granules, glycogen bodies, starch granules, magnetosomes, sulfur granules, chlorosomes)	4
II	**3. Chemical Basis of Microbiology**	
	a. Atom, Biomolecules, types of bonds (covalent, co-ordinate bond, non-covalent) and linkages (ester, phospho-diester, peptide, glycosidic)	2
	b. Chemistry of Biomolecules: Structure, organization and functions	1
	4. Carbohydrates: Definition, classification	
	a. Monosaccharides: Classification based on aldehyde and ketone groups; structure of Ribose, Deoxyribose, Glucose, Galactose and Fructose.	1
	b. Disaccharides: Glyosidic bond, structure of lactose and sucrose.	1
	c. Polysaccharides: Structure and types Examples-Starch, glycogen, Peptidoglycan, chitin	2

	5. Lipids: Definition, classification	2
	a. Simple lipids – Triglycerides, Fats and oils, waxes.	
	b. Compound lipids – Phospholipid, Glycolipids	
	c. Derived lipids – Steroids, Cholesterol	
	6. Proteins: Definition, classification	
	a. General structure of amino acids, peptide bond.	1
	b. Types of amino acids based on R group	1
	c. Structural levels of proteins: primary, secondary, tertiary and quaternary	1
	d. Study of Hemoglobin, flagellin and cytoskeletal proteins	1
	7. Nucleic acids: Definition, classification	2
	a. DNA – structure and composition	
	b. RNA – Types (m-RNA, t-RNA, r-RNA), structure and functions.	
	8. Classification of Bacteria: Introduction to Bergey's Manual of Determinative and Systemic Bacteriology	2
	9. Classification of Viruses: ICTV nomenclature	1

References:

1. Atlas R. M. (1988, Digitized 2010). Experimental Microbiology: Fundamentals and Applications. United States: Macmillan.
2. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part A: Introductory Essays. Garrity G. editor. Springer. ISBN 978-0-387-24143-2
3. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part B: The Gammaproteobacteria. Garrity G. Brenner D. J., Krieg N. R., and Staley J. R. (Eds.). Springer. ISBN 978-0-387-24144-9
4. Bergey's Manual of Systematic Bacteriology. (2005). Volume Two: The Proteobacteria, Part C: The Proteobacteria. Garrity G. Brenner D. J., Krieg N. R., and Staley J. R. (Eds.). Springer. ISBN 978-0-387-24145-6
5. Bergey's Manual of Systematic Bacteriology. (2009). Volume Three: The Firmicutes. Part C: The Proteobacteria. Vos, P., Garrity, G., Jones, D., Krieg, N.R., Ludwig, W., Rainey, F.A., Schleifer, K.-H., Whitman, W. (Eds.). Springer. ISBN 978-0-387-

24. Tsai C. S. (2007). Biomacromolecules: Introduction to Structure, Function and Informatics. Germany: Wiley.
25. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: an Introduction. Twelfth edition. Pearson, London.
26. Yadav M. (2017). Microbiology. Discovery Publishing House, New Delhi, India. ISBN 13: 9788171417315

Semester II

MB 122: Microbial cultivation and growth

Credit	Topic	No. of Lectures (36)
I	**1. Cultivation of Microorganisms:**	
	a. Nutritional requirements and nutritional classification.	3
	b. Design and preparation of media: Common ingredients of media and types of media.	3
	c. Methods for cultivating photosynthetic, extremophilic and chemo-lithotrophic bacteria, anaerobic bacteria, algae, fungi, actinomycetes and viruses.	4
	d. Concept of Enrichment, Pure Culture, Isolation of culture by streak plate, pour plate, spread plate.	3
	e. Maintenance of bacterial and fungal cultures using different techniques.	3
	f. Culture collection centres and their role.	1
	g. Requirements and guidelines of National Biodiversity Authority for culture collection centres.	1
II	**2. Bacterial growth:**	
	a. Kinetics of bacterial growth (Exponential growth model)	3
	b. Growth curve and Generation time	2
	c. Diauxic growth	1
	d. Measurement of bacterial growth- Methods of enumeration:	4
	e. Microscopic methods (Direct microscopic count, counting cells using improved Neubauer, Petroff-Hausser's chamber)	1
	f. Plate counts (Total viable count)	

	g. Turbidometric methods (including Nephelometry)	**1**
	h. Estimation of biomass (Dry mass, Packed cell volume)	**1**
	i. Chemical methods (Cell carbon and nitrogen estimation)	**1**
	j. Factors affecting bacterial growth [pH, Temperature, Solute Concentration (Salt and Sugar)] and Heavy metals.	**4**

References:

1. Atlas R. M. (2005). Handbook of Media for Environmental Microbiology. United States: Taylor and Francis.
2. Atlas R. M. (2010). Handbook of Microbiological Media. Ukraine: Taylor and Francis.
3. Bisen P.S. and Varma K. (2009). Handbook of Microbiology. CBS Publishers and Distributors, New Delhi. India
4. Dubey H. C. (2004). A textbook of fungi, bacteria and Viruses. Vikas Publishing House Private Limited. New Delhi, India
5. Dubey R. C. and D. K. Maheshwary. (2012). A textbook of Microbiology. S Chand and Company. New Delhi, India
6. Dubey R. C. and Maheshwari D. K. (2012). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
7. Gunasekaran P. (2007). Laboratory Manual in Microbiology. New Age International Private Limited, New Delhi, India.
8. Kapoor K. K., Tauro P. and Yadav K. S. (2016). An Introduction to Microbiology. New Age International (P) Limited, New Delhi, India.
9. Klein D. A., Harley J. P. And Prescott L. (2001). Microbiology. United Kingdom: McGraw-Hill Higher Education
10. Parasher Y. K. (2006). Modern Microbiology. Campas Books International, New Delhi, India
11. Pelczar M. J. Jr., Chan E.C.S. and Krieg N. R. (2010). Microbiology: An Application based Approach. McGraw-Hill Education (India) Private Limited, New Delhi, India.
12. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume I. Himalaya Publishing House Private Limited, Pune, India.
13. Powar C. B. and Daginawala H. I. (2005). General microbiology Volume II. Himalaya Publishing House, Private Limited, Pune, India
14. Purohit S. S. (2006). Microbiology: Fundamentals and Applications. AGROBIOS, Jodhpur, Rajasthan, India

15. Singh R. P. (2012). Microbiology. Kalyani Publishers, New Delhi, India Stanier R. Y. (2003). General Microbiology. United Kingdom: Palgrave Macmillan Limited.
16. Tortora G. J., Funke B. R. and Case C. L. (2016). Microbiology: an Introduction. Twelfth edition. Pearson, London.
17. Yadav M. (2017). Microbiology. Discovery Publishing House, New Delhi, India. ISBN 13: 9788171417315

Semester II
Practical Course MB 123
based on theory paper I (MB 121) and Paper II (MB 122)

Expt. No.	Topics	No. of Practicals
1	**i.** Preparation of simple laboratory nutricnt media (Nutrient agar/broth, MacConkey's agar). **ii.** Checking sterilization efficiency of autoclave using a biological indicator (*B. stearothermophilus*) **iii.** Preparation of Winogradsky's column and observation of different types of microorganisms using bright field microscope.	1 1 1
2	**Special staining techniques:** **i.** Endospore staining **ii.** Capsule staining	2
3	**Isolation of bacteria:** Streak plate technique (Colony and cultural characteristics)	1
4	**Enumeration of bacteria from fermented food / soil / water by:** **i.** Spread plate method **ii.** Pour plate method	2
5	**Study of normal flora of skin:** **i.** Cultivating and observing different morpho-forms of bacteria from skin. **ii.** Study of effect of washing on skin with soap and disinfectant on it's microflora.	2
6	**To study the effect of different parameters on growth of *E. coli*:** **i.** pH, temperature, sodium chloride concentration **ii.** Study of oligodynamic action of heavy metal	3
7	**Preservation of cultures on:** Slants, soil and on grain surfaces; revival of these cultures and lyophilized cultures.	1
	TOTAL	**14**

S. Y. B. Sc. Microbiology Syllabus (Semester III)

MB-231: Medical Microbiology and Immunology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB–231	Medial Microbiology and Immunology	[36]
Credit I	**Medical Microbiology**	**(18)**
1	**Definitions:** Incubation period, Viability, Susceptibility, Pathogenicity, Virulence, Pathogenesis, Lab diagnosis, Epidemic, Sporadic, Endemic, Pandemic	2
2	**Study of following pathogens with respect to –** Classification, Morphological, Cultural and Biochemical characters, Antigenic structure, Viability characteristics, Pathogenicity, Pathogenesis, Symptoms, Laboratory diagnosis, Epidemiology, Prophylaxis and Chemotherapy: **Bacteria:** a) *Escherichia coli* b) *Staphylococcus aureus* **Fungi:** a) *Candida* b) *Dermatophytes*	10
3	**Introduction to Chemotherapy** i. Selective toxicity, Bioavailability, MIC, MBC, LD50 ii. Antagonism and synergism in drug administration iii. Antibiotic sensitivity iv. Antibiotic misuse/antibiotic overuse v. Concept of drug resistance (e.g. MRSA, ESBL)	6
Credit II	**Immunology**	**(18)**
4	**Immunity:** Definition, Types (Innate and acquired, active and passive, humoral and cell mediated)	2
5	**Formation of blood cells** (hematopoiesis): Myeloid and lymphoid lineages and differentiation process Lymphocyte types	4

Credit II	Immunology	(18)
6	**Antigens and antibodies: definition and concept**	2
7	**Immunohematology** i. ABO and Rh blood group systems ii. Bombay blood group iii. Biochemistry of blood group substances iv. Inheritance of ABH antigens v. Medico legal applications of blood groups	7
8	**Active and Passive Immunization** i. Active Immunization -Whole organism vaccines a) Attenuated vaccines b) Inactivated Vaccines ii. Passive Immunization Transfer of preformed antibodies iii. Latest Immunization schedule in India	3

References:

1. Kanungo Reba. (2017). Ananthanarayan and Paniker's Textbook of Microbiology. Tenth edition. The Orient Blackswan Publisher. ISBN-13: 978-9386235251
2. Collins C. H., Lyne P. M., Grange J. M. and Falkinham J. O. III. (Editors). (2004). Collins and Lyne's Microbiological Methods. 8th edition. Arnold, London; Oxford
3. Finch R., Greenwood D., Whitley R. and Norrby S. R. (2010) Antibiotic and Chemotherapy. 9th Edition. Elsevier. ISBN: 9780702040641
4. Dulbecco R., Eisen H. N. and Davis B. D. (1990). Microbiology. United States: Publisher -Lippincott. ISBN: 9780608072432
5. Dey N. C., Dey T. K. and Sinha D. (2013). Medical Bacteriology Including Medical

MB-232: Bacterial Physiology and Fermentation Technology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

Credit I	Bacterial Physiology	(18)
1	**Enzymes**	
	i. Introduction to Enzymes: Properties of enzymes, Nature of active site, Structure of active site, commonly occurring amino acids at active site. Ribozymes, coenzymes, apoenzymes, prosthetic group and cofactors.	2
	ii. Nomenclature and classification as per IUB (upto class level).	2
	iii. Models for catalysis– a) Lock and key b) Induced fit c) Transition state.	1
	iv. Effect of pH and temperature, substrate concentration and enzyme concentration, activators and inhibitors of enzyme	3
2	**Bacterial Physiology**	
	i. Definitions of Metabolism, catabolism, anabolism, respiration and fermentation	1
	ii. Metabolic pathways (with structures) a) Embden Meyerhof Parnas pathway (Glycolysis) b) Hexose monophosphate pathway c) Entner Doudoroff pathway d) Phosphoketolase pathway(Pentose and hexose) e) TCA cycle (with emphasis on amphibolism) and Glyoxylate by pass f) Gluconeogenesis and its significance	2 2 1 1 2 1

Credit II	Fermentation Technology	(18)
3	**Concept of fermentation technology** i. Microbial biomass- based fermentation (Biofertilizer, biopesticide and Probiotics) ii. Production of Primary metabolites (Organic acids, amino acids, vitamins and enzymes) iii. Production of Secondary metabolites (Antibiotics) iv. Production of recombinant products (insulin and growth hormones) v. Production of Fermented food products (Cheese, yoghurt) vi. Microbial biotransformation (Steroid transformation)	4
4	**Strains of industrially important microorganisms:** i. Desirable characteristics of industrial strain ii. Principles and methods of primary and secondary screening iii. Master, working and seed culture; development of inoculum iv. Preservation and maintenance of industrial strains.	5
5	**Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor):** Different parts and their working	2
6	**Monitoring of different fermentation parameters** (Temperature, pH, aeration, agitation, foam)	2
7	**Types of fermentations: Batch, continuous and dual**	2
8	**Media for industrial fermentations:** Constituents of media (Carbon source, nitrogen source, amino acids, vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers)	2
9	**Contamination: Sources, precautions and consequences**	1

References:

1. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms.Butterworth and Heinemann Ltd., Oxford
2. Casida L. E. J. R. (2016). Industrial Microbiology. New Age International Private Limited. ISBN- 9788122438024

MB-233: Practical Course based on

MB-231: Diagnostic Microbiology and Immunology
and
MB-232: Bacterial Physiology and Fermentation Technology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Semester III: Practical course based on MB 231and MB 232		
Expt. No.	**Topics**	**No. of Practicals**
1	Measurements of cell dimension by micrometry using 10x, 45x and 100x objectives	1
2	Blood grouping: ABO, Rh and Bombay blood group (anti H Lectin test)	1
3	**I. Biochemical characterization of bacteria:** a. Sugar utilization test b. Sugar fermentation test c. Triple Sugar iron agar d. IMViC e. Enzyme detection –Gelatinase, Catalase, Oxidase, Coagulase (free and bound) f. Oxidative-fermentative test [Baird Parker's modification of Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram Positive and Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram negative; Public Health England, 2019] **II. Isolation and identification of pathogens from clinical samples:** (*Escherichia coli*, *Staphylococcus aureus* and *Candida*) by a. Gram staining, motility (bacterial pathogens) and slide culture (*Candida* and dermatophytes) b. Cultural and Biochemical characteristics	8

Credit II	Fermentation Technology	(18)
3	**Concept of fermentation technology** i. Microbial biomass- based fermentation (Biofertilizer, biopesticide and Probiotics) ii. Production of Primary metabolites (Organic acids, amino acids, vitamins and enzymes) iii. Production of Secondary metabolites (Antibiotics) iv. Production of recombinant products (insulin and growth hormones) v. Production of Fermented food products (Cheese, yoghurt) vi. Microbial biotransformation (Steroid transformation)	4
4	**Strains of industrially important microorganisms:** i. Desirable characteristics of industrial strain ii. Principles and methods of primary and secondary screening iii. Master, working and seed culture; development of inoculum iv. Preservation and maintenance of industrial strains.	5
5	**Design of a Fermenter (typical CSTR Continuous stirred Tank Reactor):** Different parts and their working	2
6	**Monitoring of different fermentation parameters** (Temperature, pH, aeration, agitation, foam)	2
7	**Types of fermentations: Batch, continuous and dual**	2
8	**Media for industrial fermentations:** Constituents of media (Carbon source, nitrogen source, amino acids, vitamins, minerals, water, buffers, antifoam agents, precursors, inhibitors and inducers)	2
9	**Contamination: Sources, precautions and consequences**	1

References:

1. BIOTOL Series. (1993). Biotechnology by open learning series. Defense Mechanisms.Butterworth and Heinemann Ltd., Oxford
2. Casida L. E. J. R. (2016). Industrial Microbiology. New Age International Private Limited. ISBN- 9788122438024

MB-233: Practical Course based on

MB-231: Diagnostic Microbiology and Immunology
and
MB-232: Bacterial Physiology and Fermentation Technology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Semester III: Practical course based on MB 231and MB 232		
Expt. No.	**Topics**	**No. of Practicals**
1	Measurements of cell dimension by micrometry using 10x, 45x and 100x objectives	1
2	Blood grouping: ABO, Rh and Bombay blood group (anti H Lectin test)	1
3	**I. Biochemical characterization of bacteria:** a. Sugar utilization test b. Sugar fermentation test c. Triple Sugar iron agar d. IMViC e. Enzyme detection –Gelatinase, Catalase, Oxidase, Coagulase (free and bound) f. Oxidative-fermentative test [Baird Parker's modification of Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram Positive and Hugh and Leifson's oxidative- fermentative (OF) basal medium for Gram negative; Public Health England, 2019] **II. Isolation and identification of pathogens from clinical samples:** (*Escherichia coli*, *Staphylococcus aureus* and *Candida*) by a. Gram staining, motility (bacterial pathogens) and slide culture (*Candida* and dermatophytes) b. Cultural and Biochemical characteristics	8

4	**Primary screening of industrially important organisms:** a. Organic acid/ Antibiotic producing microorganisms by crowded plate technique b. Microorganisms producing industrially important enzyme-amylase	2
	Total	12

References:

Experiment 1. Measurements of cell dimension by micrometry:-

1. Dubey R. C. and Maheshwari D. K. (2002). Practical Microbiology. S. Chand and Company Limited, New Delhi, India
2. Gunasekaran P. (2007). Laboratory Manual In Microbiology. New Age International (P) Limited New Delhi, India
3. Muskan K. and Patil U. K. (2009). Essentials of Biotechnology. I. K. International Publishing House Private Limited, New Delhi, India.
4. Saxena J., Baunthiyal M. and Ravi I. (2015). Laboratory Manual of Microbiology, Biochemistry and Molecular Biology. Scientific Publishers, New Delhi, India

Experiment 2. Blood grouping:-

1. Godkar D. P. (2003).Textbook of Medical Laboratory Technology. Bhalani Publishing House, New Delhi, India.
2. Mukherjee K. L. (2013). Medical Laboratory Technology. Second Edtion. Volume III. McGraw-Hill Companies, India.

Experiment 3. I. a. Sugar utilization test:-

Minimal salt Medium (MSM with 1% sugar):

1. Mukred A. M., Hamid A. A., Hamzah A. and Wan Yusoff W. M. (2008). Enhancement of Biodegradation of Crude Petroleum-Oil in Contaminated Water by the Addition of Nitrogen Sources. Pakistan Journal of Biological Sciences, 11: 2122-2127.
2. Mahalingam B. L., Karuppan M. and Manickam V. (2013). Optimization of Minimal Salt Medium for Efficient Phenanthrene Biodegradation by Mycoplana sp. MVMB2 Isolated from Petroleum Contaminated Soil Using Factorial Design Experiments. CLEAN - Soil, Air, Water. 41(1): 51–59. Wiley-VCH Verlag GmbH and Co. KGaA, Weinheim

Experiment 3. I. b. Sugar fermentation test:-

Phenol Red Broth Base:.

1. Aneja K. R. (2007). Experiments in Microbiology, Plant Pathology and Biotechnology. New

S. Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-241: Bacterial Genetics

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB 241	Bacterial Genetics	[36]
Credit I	Topics	(18)
1	**Understanding DNA:** **i. Experimental evidence for nucleic acid as genetic material.** a. Discovery of transforming material (hereditary material): b. Griffith's experiment c. Avery and MacLeod experiment d. Gierer and Schramm e. Fraenkel-Conrat and Singer experiment (TMV virus) f. Hershay and Chase experiment	7
	ii. Types of nucleic acids (DNA and RNAs)	1
	iii. Structure of DNA a. Structure of Nitrogen bases, Nucleoside, Nucleotide and polynucleotide chain b. Bonds involved in DNA structure c. Different forms of DNA	2
2	**iii.Prokaryotic DNA replication** a. Models of DNA replication.(Conservative, semi-conservative and Dispersive) b. Meselson and Stahl's experiment (semi-conservative) c. Six basic rules of DNA replication d. Enzymes, proteins and other factors involved in DNA replication. e. Modes of DNA replication Rolling circle mechanism, theta and linear DNA replication	8

Credit II	Title	(18)
3	**i. Gene expression** a. Concept of Genetic code and its properties b. Concept of transcription and translation	2
4	**ii. Mutations and reversions** Concept of Mutation and Types of mutations: Nonsense, Missense ,Silent, Conditional lethal-temperature sensitive, Amber, Reverse, suppressor a. Spontaneous Mutation • Discovery of spontaneous mutation (Fluctuation test) • Mechanism of spontaneous mutation • Isolation of Mutants: Replica plate technique b. Concept of Induced Mutations • Base pair substitution (Transitions, Transversions), Insertions and deletions-Frame / Phase shift mutations • Physical Mutagenic agent: UV and Xray • Chemical mutagenic agents • Base analogues (2amino purine, 5bromouracil), • HNO2, Alkylating agents • Intercalating agents (EtBr, acridine orange)	10
5	**iii. Plasmid genetics** a. Types of plasmids b. Properties of Plasmid c. Plasmid replication d. Plasmid incompatibility e. Plasmid curing f. Plasmid amplification Concept	6

S. Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-242: Air, Water and Soil Microbiology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB-242	Air, Water and Soil Microbiology	[36]
Credit I	Air Microbiology and Water Microbiology	18
1	**i. Air Microbiology**	
	a. Air flora • Transient nature of air flora • Droplet, droplet nuclei and aerosols	1
	b. Methods of Air sampling and types of air samplers • Impaction on solids • Impingement in liquid • Sedimentation • Centrifugation	3
	c. Air sanitation: Physical and chemical methods	2
	d. Airborne infections	1
2	**ii. Water Microbiology**	
	a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water	1
	b. Recommended Bacteriological standards of Water Quality • Maharashtra Pollution Control Board (MPCB) Main Functions of MPCB Water quality standards for best designated usages • Central Pollution Control Board(CPCB) Main Functions of CPCB Designated Best Use Water Quality Criteria	1
	c. Water purification methods	2
	d. Water borne Infections	1

Credit II	Title	(18)
3	**i. Gene expression** a. Concept of Genetic code and its properties b. Concept of transcription and translation	2
4	**ii. Mutations and reversions** Concept of Mutation and Types of mutations: Nonsense, Missense ,Silent, Conditional lethal-temperature sensitive, Amber, Reverse, suppressor a. Spontaneous Mutation • Discovery of spontaneous mutation (Fluctuation test) • Mechanism of spontaneous mutation • Isolation of Mutants: Replica plate technique b. Concept of Induced Mutations • Base pair substitution (Transitions, Transversions), Insertions and deletions-Frame / Phase shift mutations • Physical Mutagenic agent: UV and Xray • Chemical mutagenic agents • Base analogues (2amino purine, 5bromouracil), • HNO2, Alkylating agents • Intercalating agents (EtBr, acridine orange)	10
5	**iii. Plasmid genetics** a. Types of plasmids b. Properties of Plasmid c. Plasmid replication d. Plasmid incompatibility e. Plasmid curing f. Plasmid amplification Concept	6

S. Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-242: Air, Water and Soil Microbiology

[2 Credits; 36 Lectures]

[1 credit=15 hrs x 60 mins = 900mins/50mins= 18 lectures]

MB-242	Air, Water and Soil Microbiology	[36]
Credit I	Air Microbiology and Water Microbiology	18
1	**i. Air Microbiology**	
	a. Air flora • Transient nature of air flora • Droplet, droplet nuclei and aerosols	1
	b. Methods of Air sampling and types of air samplers • Impaction on solids • Impingement in liquid • Sedimentation • Centrifugation	3
	c. Air sanitation: Physical and chemical methods	2
	d. Airborne infections	1
2	**ii. Water Microbiology**	
	a. Types of water: surface, ground, stored, distilled, mineral and de-mineralized water	1
	b. Recommended Bacteriological standards of Water Quality • Maharashtra Pollution Control Board (MPCB) Main Functions of MPCB Water quality standards for best designated usages • Central Pollution Control Board(CPCB) Main Functions of CPCB Designated Best Use Water Quality Criteria	1
	c. Water purification methods	2
	d. Water borne Infections	1

	e. Indicators of faecal pollution: *Escherichia coli*, *Bifidobacterium*, *Streptococcus faecalis*, *Clostridium perfringens*, New indicators: *Campylobacter* and *Pseudomonas*	2
	f. **Bacteriological analysis of water for potability** i. Bacteriological standards of potable water: Bureau of Indian standards (BIS) ii. World Health Organization(WHO) iii. Presumptive coliform count iv. Confirmed test v. Completed test vi. Eijkman test vii. Membrane filter technique	4
Credit II	**Soil Microbiology**	**18**
	a. Rhizosphere microflora and its role in the rhizosphere	1
	b. Role of microorganisms in composting and humus formation	2
	c. Biofertilizers: Bacterial, Cyanobacterial, fungal and their large-scale production	3
	d. Biocontrol agents: Bacterial, Viral, Fungal and their large-scale production	3
	e. Brief account of microbial interactions: Symbiosis, Neutralism, Commensalism, Competition, Ammensalism, Synergism, Parasitism and Predation	5
	f. Role of microorganisms in elemental cycles in nature: Carbon, Nitrogen	4

References:

1. Aithal S. C. and Kulkarni N. S. (2015). Water microbiology ~ an Indian perspective. Published by Himalaya Publishing House, IstEdition. ISBN: No.: 978-93-5202-129-1.
2. Dube H. C. and Bilgrami K. S. (1976). Textbook of modern pathology. Vikas publishing house. New Delhi.
3. Dubey R. C. and Maheswari D.K. Textbook of Microbiology. S. Chand Publishing. ISBN: 9788121926201

S.Y. B. Sc. Microbiology Syllabus (Semester IV)

MB-243: Practical Course based on

MB-241: Bacterial Genetics and MB-242: Air, Water and Soil Microbiology

[2 Credits: 78 Lectures]

[1 credit=15hrs x 130 mins = 1950 mins/50 mins=39 lectures]

78 L distributed as 60 L for performing practicals and 18 L for internal evaluation

12 Practicals x 5 lectures = 60 Lectures

Semester IV: MB-243: Practical course based on MB 241and MB 242		
Expt. No.	**Topics**	**No. of Practicals**
1	**Air sampling using an air sampler,** calculation of air flora from different locations with the knowledge of respective standards of bacterial and fungal counts.	1
2	**Air Flora:** a. Diversity determination. b. Simpson index and settling velocity determination	1
3	**Bacteriological tests for potability of water** a. MPN, Confirmed and Completed test. b. Membrane filter technique (Demonstration)	4
4	**Enrichment, Isolation, Preparation and Application of Bioinoculant** i. a) *Azotobacter* species and b) *Rhizobium* species or ii. Blue Green Algae (cyanobacteria)	2
5	a. Induction of mutations by using physical mutagen (e.g. U V rays) and chemical mutagen (e.g. HNO2) b. Isolation of mutants by any suitable method c. Demonstration of UV survival curve	3
6	Visit to Industry/ Drinking Water treatment plant	1
	Total	**12**

Kopargaon Taluka Education Society's

K.J. Somaiya College of Arts, Commerce & Science,

Kopargaon, Dist. Ahmednagar.

Department of Zoology
Cross cutting issues (w.e.f. from 2019)

List of Courses addresses crosscutting issues for U.G Course as per Syllabus

(CBCS 2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	F.Y.B. Sc. Zoology	ZO-111	Animal Diversity I	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
2	F.Y.B. Sc. Zoology	ZO-112	Animal Ecology	Climate change, environmental pollution, human-wildlife conflict, sustainable development
3	F.Y.B. Sc. Zoology	ZO-121	Animal Diversity II	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
4	F.Y.B. Sc. Zoology	ZO-122	Cell Biology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
5	S.Y.B. Sc. Zoology	ZO-231	Animal Diversity III	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development

6	S.Y.B. Sc. Zoology	ZO-232	Applied Zoology I	Biotechnology, bioinformatics, zoological research methods, zoological communication, zoological education and outreach
7	S.Y.B. Sc. Zoology	ZO-241	Animal Diversity IV	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
8	S.Y.B. Sc. Zoology	ZO-242	Applied Zoology II	Biotechnology, bioinformatics, zoological research methods, zoological communication, zoological education and outreach
9	S.Y.B. Sc. Zoology	EVS- 231	Environmental awareness	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
10	S.Y.B. Sc. Zoology	EVA- 241	Environmental awareness	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
11	T.Y.B. Sc. Zoology	ZO-351	Pest Management	Biodiversity, conservation, climate change, environmental pollution, sustainable development
12	T.Y.B. Sc. Zoology	ZO-352	Histology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
13	T.Y.B. Sc. Zoology	ZO-353	Biological Chemistry	Biotechnology, bioinformatics, zoological research methods
14	T.Y.B. Sc. Zoology	ZO-354	Genetics	Biotechnology, bioinformatics, zoological research

				methods, zoological ethics
15	T.Y.B. Sc. Zoology	ZO-355	Developmental Biology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
16	T.Y.B. Sc. Zoology	ZO-356	Parasitology	Biodiversity, conservation, climate change, environmental pollution, sustainable development
17	T.Y.B. Sc. Zoology	ZO-3510	Aquarium Management	Biodiversity, conservation, sustainable development
18	T.Y.B. Sc. Zoology	ZO-3511	Poultry Management	Biodiversity, conservation, sustainable development
19	T.Y.B. Sc. Zoology	ZO-361	Medical and Forensic Zoology	Biodiversity and conservation
20	T.Y.B. Sc. Zoology	ZO-362	Animal Physiology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
21	T.Y.B. Sc. Zoology	ZO-363	Molecular Biology	Biotechnology, bioinformatics, zoological research methods
22	T.Y.B. Sc. Zoology	ZO-364	Entomology	Biodiversity, conservation, climate change, environmental pollution, sustainable development
23	T.Y.B. Sc. Zoology	ZO-365	Techniques in Biology	Zoological research methods
24	T.Y.B. Sc. Zoology	ZO-366	Evolutionary Biology	Biodiversity, conservation, climate change, environmental pollution, sustainable development
25	T.Y.B. Sc. Zoology	ZO-3610	Environmental Impact Assessment	Biodiversity, conservation, climate change, environmental pollution, sustainable development

Head
Department of Zoology
K. J. Somaiya College of Arts, Commerce & Science, Kopargaon

K. J. SOMAIYA COLLEGE * Dept. of Zoology * KOPARGAON

Coordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K. J. Somaiya College
Kopargaon

List of Courses addresses crosscutting issues for P.G Course as per new syllabus (CBCS-2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	M. Sc. Zoology	ZOUT-111	Biochemistry and Biochemical Techniques	Biotechnology, bioinformatics, zoological research methods, zoological ethics
2	M. Sc. Zoology	ZOUT-112	Cell Biology and Developmental Biology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
3	M. Sc. Zoology	ZOUT-113	Genetics and English in Scientific Communication	Biotechnology, bioinformatics, zoological research methods, zoological communication
4	M. Sc. Zoology	ZODT-114	Freshwater Zoology	Biodiversity, conservation, climate change, environmental pollution, human-wildlife conflict, sustainable development
5	M. Sc. Zoology	ZOUT-121	Molecular Biology and Bioinformatics	Biotechnology, bioinformatics, zoological research methods
6	M. Sc. Zoology	ZOUT-122	Endocrinology and Parasitology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
7	M. Sc. Zoology	ZOUT-123	Comparative Animal Physiology and Environmental Biology	Biodiversity, conservation, climate change, environmental pollution, sustainable development
8	M. Sc. Zoology	ZODT-124	Metabolic Pathways	Biotechnology, bioinformatics, zoological research methods, zoological ethics

9	M. Sc. Zoology	ZOUT-231	Animal Physiology I	Biotechnology, bioinformatics, zoological research methods, zoological ethics
10	M. Sc. Zoology	ZOUT-232	Fundamental of Systematics and Economic Zoology	Biodiversity, conservation, climate change, environmental pollution, sustainable development
11	M. Sc. Zoology	ZOUT-233	Research methodology and Insect Physiology and Biochemistry	Biotechnology, bioinformatics, zoological research methods
12	M. Sc. Zoology	ZODT-234	Immunology	Biotechnology, bioinformatics, zoological research methods, zoological ethics
13	M. Sc. Zoology	ZOUT-241	Animal Physiology II	Biotechnology, bioinformatics, zoological research methods, zoological ethics
14	M. Sc. Zoology	ZOUT-242	Mammalian Reproductive Physiology and Aquaculture	Biodiversity, conservation, climate change, environmental pollution, sustainable development
15	M. Sc. Zoology	ZODT-243	Pest Control	Biodiversity, conservation, climate change, environmental pollution, sustainable development
16	M. Sc. Zoology	ZODT-244	Pollution Biology	Biodiversity, conservation, climate change, environmental pollution, sustainable development

Head
Department of Zoology
K. J. Somaiya College of Arts,
Commerce & Science, Kopargaon

Co ordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K.J.Somaiya College
Kopargaon

K. J. SOMAIYA COLLEGE ★ KOPARGAON ★
Dept. of Zoology

List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Zoology	Vermiculture and Vermicomposting	CC-007	2011	Biodiversity Conservation Climate change Environmental pollution Human-wildlife conflict Sustainable development

Head of Department

Head
Department of Zoology
K. J. Somaiya College of Arts,
Commerce & Science, Kopargaon

K. J. SOMAIYA COLLEGE * KOPARGAON * Dept. of Zoology

Co ordinator
IQAC, K J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal

Principal
K.J.Somaiya College
Kopargaon

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

F.Y.B.Sc. Zoology

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Cre
F.Y.B.Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5+
S.Y.B.Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English/Marathi	LA 241- English /Marathi	2+2
T.Y.B.Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 Pest Management	ZO-361 Medical & Forensic Zoology	2+2
DSEC	ZO-352 Histology	ZO-362 Animal Physiology	2+2
DSEC	ZO-353 Biological Chemistry	ZO-363 Molecular Biology	2+2
DSEC	ZO-354 Genetics	ZO-364 Entomology	2+2
DSEC	ZO-355 Developmental Biology	ZO-365 Techniques in Biology	2+2
DSEC	ZO-356 Parasitology	ZO-366 Evolutionary Biology	2+2
DSEC	ZO-357 Zoology Practical Paper 1	ZO-367 Zoology Practical Paper 1	2+2
DSEC	ZO-358 Zoology Practical Paper 2	ZO-368 Zoology Practical Paper 2	2+2
DSEC	ZO-359 Zoology Practical Paper 3	ZO-369 Zoology Practical Paper 3	2+2
SEC	ZO-3510 Aquarium Management	ZO-3610 Environmental Impact Assessment	2+2
SEC	ZO- 3511 Poultry Management	ZO-3611 Project	2+2

Detailed Syllabus of F.Y.B.Sc.

aper	Semester I Course Code & Course	Credits	No of Lectures	Marks (Internal + University)	Semester II Course Code & Course	Credits	No of Lectures	Marks (Internal + University)
I	ZO-111 Animal Diversity I	02	30	15+ 35= 50	ZO-121 Animal Diversity II	02	30	15+ 35 = 50
II	ZO-112 Animal Ecology	02	30	15+ 35 = 50	ZO-122 Cell Biology	02	30	15+ 35 = 50
III	ZO-113 Zoology Practical Paper	01	15 practical	15+ 35 = 50	ZO-123 Zoology Practical Paper	01	15 Practical	15+ 35 = 50

Course No.	Course Title	Total Number of lectures/practical per Term	Standard of passing		
			Internal marks	**University marks**	**Total marks**
ZO-111 (First term)	Animal Diversity–I	Three lectures/Week (Total 30 lectures per	15	35	50
ZO-121 (Second term)	Animal Diversity-II	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-112 (First term)	Animal Ecology	Three lectures/Week (Total30lecturesper term)	15	35	50
ZO-122 (Second Term)	Cell Biology	Three lectures/Week (Total30lecturesper term)	15	35	50
ZO-113 (First term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50
ZO-123 (Second Term)	Zoology Practical Paper	Practical sessionof3 hours. 15 Practicals	15	35	50

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F.Y.B.Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S.Y.B.Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English/Marathi	LA 241- English /Marathi	2+2
T.Y.B.Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 Pest Management	ZO-361 Medical & Forensic Zoology	2+2
DSEC	ZO-352 Histology	ZO-362 Animal Physiology	2+2
DSEC	ZO-353 Biological Chemistry	ZO-363 Molecular Biology	2+2
DSEC	ZO-354 Genetics	ZO-364 Entomology	2+2
DSEC	ZO-355 Developmental Biology	ZO-365 Techniques in Biology	2+2
DSEC	ZO-356 Parasitology	ZO-366 Evolutionary Biology	2+2
DSEC	ZO-357 Zoology Practical Paper 1	ZO-367 Zoology Practical Paper 1	2+2
DSEC	ZO-358 Zoology Practical Paper 2	ZO-368 Zoology Practical Paper 2	2+2
DSEC	ZO-359 Zoology Practical Paper 3	ZO-369 Zoology Practical Paper 3	2+2
SEC	ZO-3510 Aquarium Management	ZO-3610 Environmental Impact Assessment	2+2
SEC	ZO- 3511 Poultry Management	ZO-3611 Project	2+2

Detailed Syllabus of F.Y.B.Sc.

Paper	Semester I Course Code & Course	Credits	No of Lectures	Marks (Internal + University)	Semester II Course Code & Course	Credits	No of Lectures	Marks (Internal + University)
I	ZO-111 Animal Diversity I	02	30	15+ 35= 50	ZO-121 Animal Diversity II	02	30	15+ 35 = 50
II	ZO-112 Animal Ecology	02	30	15+ 35 = 50	ZO-122 Cell Biology	02	30	15+ 35 = 50
III	ZO-113 Zoology Practical Paper	01	15 practical	15+ 35 = 50	ZO-123 Zoology Practical Paper	01	15 Practical	15+ 35 = 50

Course No.	Course Title	Total Number of lectures/practical per Term	Standard of passing		
			Internal marks	**University marks**	**Total marks**
ZO-111 (First term)	Animal Diversity–I	Three lectures/Week (Total 30 lectures per	15	35	50
ZO-121 (Second term)	Animal Diversity-II	Three lectures/Week (Total 30 lectures per term)	15	35	50
ZO-112 (First term)	Animal Ecology	Three lectures/Week (Total30lecturesper term)	15	35	50
ZO-122 (Second Term)	Cell Biology	Three lectures/Week (Total30lecturesper term)	15	35	50
ZO-113 (First term)	Zoology Practical Paper	Practical session of 3 hours. 15 Practicals	15	35	50
ZO-123 (Second Term)	Zoology Practical Paper	Practical sessionof3 hours. 15 Practicals	15	35	50

Animal Diversity I & II

Objectives:

1. To understand the Animal diversity around us.
2. To understand the underlying principles of classification of Animals.
3. To understand the terminology needed in classification.
4. To understand the differences and similarities in the various aspects of classification.
5. To classify invertebrates and to be able to understand the possible group of the invertebrate observed in nature to understand our role as a caretaker and promoter of life.

Expected Outcomes:

1. The student will be able to understand classify and identify the diversity of animals.
2. The student understands the importance of classification of animals and classifies them effectively using the six levels of classification.
3. The student knows his role in nature as a protector, preserver and promoter of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity –I

Course Code-ZO-111

Semester I

(2 credits-30 lectures)

No.	Title & Contents	Number of lectures
1.	**Principles of Classification:** Taxonomy & Systematics	**(05)**

1.1 Taxonomy: Basic terminology and Introuction

- Alpha, Beta and Gamma levels of taxonomy, Micro-taxonomy
- Macro taxonomy: Phenetics (numerical taxonomy, Cladistics (Phylogenetic systematics), Evolutionary taxonomy (evolutionary systematics)
- Classical taxonomy and experimental or neo taxonomy (biochemical taxonomy and Cytotaxonomy)
- Significance of Taxonomy

1.2 Systematics: definition introduction

1.3 Linnaean system of classification (Six level classification: Phylum, class, order, family, genus, species)

1.4 Concept of Species: Biological & Evolutionary

1.5 Introduction to Binomial Nomenclature.

1.6 Introduction to Five kingdom system.

2. **General Features of kingdom Animalia** **(02)**

2.1 General characters of Kingdom Animalia, Grades of organization

2.2 Symmetry.

3. **Kingdom Protista (Phylum: Protozoa)** **(07)**

3.1 Introduction to Phylum Protozoa

3.2 Salient features of Phylum Protozoa

3.3 Classification of Phylum Protozoa up to classes with two examples of each class (names only).

Class Rhizopoda (e.g :*Entamoebahistolytica, Arcella*),

Class Mastigophora (e.g: *Euglena viridis, Trypanosomagambiense*),

Class Ciliata (e.g*Paramoeciumcaudatum, Opalinaranarum*),

Class Sporozoa (e.g*Plasmodium vivax*, *Toxoplasmagondii*)

3.4 Locomotion in Protozoa: Amoeboid, Ciliary and Flagellar with suitable examples

3.5 Type Study: ***Paramecium caudatum***: Classification, Habit and Habitat, External morphology, Feeding and digestion, Excretion, Reproduction (binary fission and Conjugation)

3.6. Economic importance of Protozoa (three harmful and one useful protozoan)

3.6.1-**Harmful Protozoa**:

Plasmodium vivax (malarial parasite),

Entamoebahistolytica (Amoebic dysentery),

Trypanosomagambiense (Gambian sleeping sickness).

3.6.2- **Useful Protozoa**:

Trichonympha

4. **Origin of Metazoa** **(01)**

4.1 Introduction Origin and importance of Metazoa

5. **Phylum Porifera** **(06)**

5.1. Introduction to Phylum Porifera

5.2 Classification of Phylum Porifera up to classes with two examples of each class (names only, no description of specimens).

Class Calcarea (e.g.: *Leucosolenia, Sycon (Scypha)*

Class Hexactinellida (e.g: *Euplectella* (venus flower basket), *Hyalonema* (glass sponge))

Class Demospongiae (e.g: *Chalina* (Mermaid's gloves, *Spongilla* (fresh water sponge))

5.3 Canal system in sponges: Ascon, Leucon and Rhagon type.

5.4 Skeleton in sponges: Spicules, its types:

Microscleres&Megascleres,

Monoaxon – monactinal, diactinal, Amphidiscs, Triaxon, Polyaxon,

Spongin fibres.

5.5 Regeneration in sponges.

5.6 Economic importance of Phylum Porifera.

6. **Phylum: Cnidaria** **(05)**

6.1 Introduction to Phylum Cnidaria

6.2 Salient features of Phylum Cnidaria

6.3 Classification of Phylum Cnidaria up to class level with given examples each class (names of examples only)

Class Hydrozoa e.g.: Hydra, *Physalia* (Portuguese man of war)

Class Scyphozoae.g: *Aurelia* (Jelly fish), *Leucernaria* (trumpet shaped Jellyfish)

Class Anthozoa: e.g; Metridium (Common sea anemone0

6.4 Polymorphism in Hydrozoa: Polyps & Medusa (polyp types: gastrozooids, dactylozooids, gonozooids) and functions

6.5 Economic importance of Cnidarians with reference to Corals and Coral reefs.

7. **Phylum Platyhelminthes** **(04)**

7.1 Introduction to Phylum Platyhelminthes

7.2 Salient features of Phylum Platyhelminthes

7.3 Classification of Phylum Platyhelminthes up to classes with two examples each class (names of examples only).

Class: Turbellaria (e.g: *Dugesia, Bipallium*)

Class: Trematoda (e.g*: Fasciola hepatica, schistosomahaematobium*)

Class Cestoda: (*Taeniasolium* (pork tape worm),*Echinococcusgranulosus* (dog tapeworm)

7.4 Parasitic adaptations in Platyhelminthes: structural and physiological.

7.5 Economic importance of Platyhelminthes

Course Title: Animal Ecology

Course Code: ZO 112

Semester I (2 Credits-30 Lectures)

Learning outcomes for the course:

- The learners will be able to Identify and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics and its impact on ecosystem and biosphere due to the dynamics in population.
- To understand anticipate, analyse and evaluate natural resource issues and act on a lifestyle that conserves nature.
- The Learner understands and appreciates the diversity of ecosystems and applies beyond the syllabi to understand the local lifestyle and problems of the community.
- The learner will be able to link the intricacies of food chains, food webs and link it with human life for its betterment and for non-exploitation of the biotic and abiotic components.
- The working in nature to save environment will help development of leadership skills to promote betterment of environment.

ZO 112: Animal Ecology

(2 Credits-30 Lectures)

No.	Topic & Content	Number of lectures
1.	**Introduction to Ecology** 1.1 Concepts of Ecology, Environment, Population, Community, Ecosystem, Biosphere, Autecology and synecology.	(02)
2.	**Ecosystem** 2.1 Types of ecosystems: Aquatic (Freshwater, estuarine, Marine and terrestrial (Forest, Grassland and Desert) 2.2 Structure and Composition of Ecosystem (Abiotic components and biotic components. 2.3 Food chain: Detritus and grazing food chains, Food web, Energy flow through the ecosystem, Ecological pyramids: Number, Biomass, and Energy. 2.4 concept of Eutrophication in lakes and rivers.	(08)
3	**Population** 3.1Characteristic of population: Density, Natality, Mortality, Fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion. 3.2Exponential and logistic growth, 3.3 Population regulation – density-dependent and independent factors. Population interactions, Gause's Principle with laboratory and field interactions, 3.4 Quadrate, line and belt transect methods.	(08)
4.	**Community** 4.1Community characteristics: species richness, dominance, diversity, abundance, vertical stratification, Eco tone and edge effect; Ecological succession with one example.	(07)
5.	**Animal interactions** 5.1Introduction to Animal interactions 5.2 Types of Animal interactions with at least to suitable examples of each 5.2.1-Competition: Interspecific and intraspecific	(05)

5.2.2- Beneficial Associations:

Commensalism (remora fish on shark, Cattle egrets on livestock),

Mutualism (Termite and Trichonympha, bees and flowers, cleaning symbiosis in fish by prawns.

5.3 Antagonistic associations: Parasitism (Ascaris and man, lice and humans), Prey predation (Lion and deer).

Course Title: Zoology Practical Paper

Course Code: ZO113

Semester I **(1.5 Credits-45 Hours)**

Animal Diversity –I

1. Museum Study of phylum Protozoa: Euglena, Paramecium, Amoeba, Plasmodium sp.
2. Museum study of Phylum Porifera: *Sycon*, *Euplectella*,*Chalina*, Spongilla.
3. Museum study of phylum Cnidaria: *Hydra, Physalia, Aurelia, Metridium*.
4. Museum Study of phylum Platyhelminthes: *Planeria, Faciola hepatica, Taeniasolium*
5. Study of Paramecium: Culture, External morphology, Conjugation and Binary fission.
6. Study of permanent slides: Spicules and Gemmules in Sponges, T.S. of *Sycon*, T.S. of Hydra, Taeniasolium: Scolex, Gravid proglottid.
7. Identification of any three museum specimen with help of taxonomic identification key.
8. Visit to Zoological survey of India/ Museum/National Park.

Animal Ecology:

1. Estimation of Dissolved oxygen from given water sample.
2. Estimation of Water Alkalinity from given water sample.
3. Study of animal community structure by quadrate method (Field or Simulation).
4. Determination of density, frequency and abundance of species by quadrat method.
5. Study of microscopic fauna of freshwater ecosystem (from pond).
6. Estimation of water holding capacity of given soil sample.
7. Estimation of dissolved and free carbon dioxide from water sample.
8. Study of Eutrophication in lake/river.

Course Title: Animal Diversity –II

Course Code: ZO-121:

Semester II **(2 credits-30 lectures)**

No.	Title & Contents	Number of lectures
1.	**Phylum Aschelminthes** 1.1 Introduction to phylum Aschelminthes 1.2 Salient features of Phylum Aschelminthes 1.3 Classification of Phylum Aschelminthes (Class Nematoda only with two examples – *Ascarislumbricoides* (common round worm), *Wuchereriabancrofti* (Elephantiasis)). 1.4 Economic importance of class Nematoda.	(04)
2.	**Phylum Annelida** 2.1 Introduction to Phylum Annelida 2.2 Salient features of Phylum Annelida. 2.3 Classification of Phylum Annelida up to classes with examples of following classes (names of examples only). Class Polychaeta (e.g: *Nereispelagica (neries*/ sand worm, *Aphroditaaculeata* (=Aphrodite/ seamouse) Class Oligochaeta (e.g.: *Pheritimaposthuma* (earthworm), Class Hirudinea (e.g: *Hirudinaria granulosa* common cattle leech) 2.4 Economic importance of Annelida with reference to earthworms as friends of farmers and in their role in vermicomposting.	(06)
3.	**Phylum Arthropoda** 3.1 Introduction to Phylum Arthropoda 3.2 Salient features of Phylum Arthropoda 3.3 Classification of Phylum Arthropoda with specific classes and mentioned examples (names only) Class:Crustacea:*Palaemonpalaemon* (Prawn) *Brachyura* spp. crabs) Class: Chilopoda: *Scolopendra* sp. (centipede) Class: Diplopoda: *Julus* sp. (millipede)	(06)

Class Insecta*: Periplanetaamericana* (American Cockroach), *Anopheles stephensii* (mosquito).

Class: Arachnida- Spiders, *Buthussp (*scorpion)

3.4 mouth parts in insects: Mandibulate (cockroach), Piercing and sucking (female Anopheles mosquito), chewing and lapping type (honey bee)

3.5 Economic importance of Arthropoda

Useful Insects: Honey bee, Lac insect, Silkworm.

Harmful insects: Female Anopheles mosquito, Red cotton bug, Rice weevil

4.	**Phylum Mollusca** 4.1 Introduction to Phylum Mollusca 4.2 Salient features of Phylum Mollusca 4.3 Classification of Phylum Mollusca with specific classes and mentioned examples (names only) Class Gastropodae.g*Pila globosa* (apple snail) Class Pelecypodae.g*Lamellidensmarginalis*(Bivalve) Class Polyplacophorae.g*Chiton* Class: Cephalopodae.g: *Octopus vulgaris* (common octopus), *Sepia officinalis* (common Cuttle fish) 4.4 Economic importance of Mollusca.	(06)
5.	**Study of Phylum Echinodermata** 5.1 Introduction to Phylum Echinodermata 5.2 Salient features of Phylum Echinodermata. 5.3 Classification of Phylum Echinodermata with specific classes and mentioned examples (names only) Class Asteroidea (*Asteriasrubens* sea stars or starfish) Class: Holothuroidea. *Holothuria sp*. sea cucumbers) Class: Echinoidea*(Echinus esculentis*common sea urchins)	(08)

Class: Crinoidea (sea lilies or feather stars)

5.4 **Type study:** ***Asteriasrubens*** **(Sea Star):** Classification, Habit Habitat, External Morphology, Digestive system, Water vascular System and autotomy and regeneration

5.5Pedicillaria in Echinodermata: straight, crossed, valvate, tridactylous, globigerous.

5.6 Economic importance of Echinidermata.

Course Title: Cell biology

Course Code: ZO122:

Semester II(2 credits-30 lectures)

Learning outcomes for Cell Biology

- The learner will understand the importance of cell as a structural and functional unit of life.
- The learner understands and compares between the prokaryotic and eukaryotic system and extrapolates the life to the aspect of development.
- The dynamism of bio membranes indicates the dynamism of life. Its working mechanism and precision are responsible for our performance in life.
- The cellular mechanisms and its functioning depends on endo-membranes and structures. They are best studied with microscopy.

ZO122: Cell biology

(2 credits-30 lectures)

No.	Title & Contents	Number of lectures
1.	**Introduction:**	
	1.1 Introduction cell biology,	**(04)**
	1.2 Cell as basic unit of life.	
	1.3 Importance of Cell Biology and its applications in industry.	
	Overview of Cells	
	1.3 Introduction to Prokaryotic and Eukaryotic cells.	
	1.4 Structure and function of Prokaryotic *(E. coli)*	

1.5 Structure and function of Eukaryotic cells (Animal and Plant Cell)

2	**Techniques in Cell Biology:**	**(04)**
	3.1 Introduction	
	3.2 Microscopy: Basic Principle, Simple, Compound and applications of Electron Microscope.	
	3.3 Stains and dyes: Types of Stain: Acidic, basic and neutral.	
	Dye (Preparation and chemistry of dyes not expected)	
	3.4 Micrometry.	
3	**Plasma Membrane:**	**(06)**
	4.1Introduction	
	4.2 Structure of plasma membrane: Fluid mosaic model.	
	4.3Transport across membranes: Active and Passive transport, Facilitated transport, exocytosis, endocytosis, phagocytosis – vesicles and their importance in transport.	
	4.4 Other functions of Cell membrane in brief Protection, cell recognition, shape, storage, cell signalling.	
	4.5 Cell Junctions: Tight junctions, gap junctions, Desmosomes.	
4	**Nucleus: Structure and function**	**(04)**
	5.1Introduction to Nucleus	
	5.2 Structure of Nucleus: Nuclear envelope, Nuclear pore complex, Nucleoplasm, Nucleolus	
	5.3 Chromatin: Eu-chromatin and Hetro-chromatin, nature and differences.	
	5.4 Functions of nucleus	
5.	**Endomembrane System**	**(04)**
	6.1 Introduction	
	6.2 Structure, location and Functions: Endoplasmic Reticulum, Golgi apparatus, Lysosomes and vacuoles.	
7.	**Mitochondria and Peroxisomes**	**(03)**

7.1 Introduction

7.2 Mitochondria: ultrastructure and function of mitochondrion.

7.3 Peroxisomes

Cell Division **(05)**

7.1 Introduction

7.2 Cell cycle (G1, S, G2, M phases),

7.3 Mitosis.

7.4 Meiosis.

Course Title: Zoology Practical Paper

Course Code: ZO123

Semester II (1.5 Credits-45 Hours)

Animal Diversity –II

1. Museum study of Phylum Aschelminthes: *Ascarislumbricoides*,
2. Museum study of phylum Annelida: *Neries*, Earthworm, Leech.
3. Museum study of phylum Arthropoda: Prawn, Cockroach, Centipede, Millipede, Crab
4. Museum study of phylum Mollusca: *Pila*, *Chiton*, Bivalve, Octopus.
5. Museum study of phylum Echinodermata: Sea Star, Sea urchin, Brittle Star, sea cucumber.
6. Study of permanent slides: Mouthparts of Insects -Mandibulate, Piercing and sucking, Chewing and Lapping.
7. Types of Shells in Mollusca. *Pila*, Bivalve, Chiton, Sepia.
8. Economic importance of honey bees, Lac insects silk worms, red cotton bug, Anopheles mosquito
9. Earthworm: vermicomposting bin preparation and maintenance.
10. Visit to a vermicomposting unit/ field for insect pest collection and its identification

Cell Biology

1. Study of Microscope: Simple and Compound
2. Micrometry: Measurement of microscopic objects
3. Study of cell: Preparation of temporary mount of human buccal epithelial cells.
4. Preparation of blood smears to observe the blood cells
5. Temporary preparation of mitotic cell from onion roots

6. Study of Cell organelles (any three) by using microphotographs

Recommended Reference Books

Animal Diversity – I and II

1. Anderson, D.T (Ed) 1988: Invertebrate Zoology, Oxford University Press.
2. Barnes, R.D. (1982). Invertebrate Zoology, V Edition. Holt Saunders International Edition.
3. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). The Invertebrates: A New Synthesis, III Edition, Blackwell Science
4. Barrington, E.J.W. (1979). Invertebrate Structure and Functions. II Edition, E.L.B.S. and Nelson
5. Boradale, L.A. and Potts, E.A. (1961). Invertebrates: A Manual for the use of Students. Asia Publishing Home.
6. Brusca, R.C andBrusca, G. J (2003): Invertebrate (2nd ed.) Sinauer Associates Inc., Publishers Sunderland.
7. Hadzi, J (1963): The Evolution of Metazoa, Macmillan Newyork.
8. Hyman, L. H (1940): Invertebrates Vol I, Protozoa through ctenophore.
9. Hyman. L. H (1955): The Invertebrates Vol: IV, Echinodermata, the coelomate bilateria, Mcgraw Hill, Newyork.
10. Modern Text-Book of zoology, Vertebrates. By Kotpal, RL., Rastogi and Co., Meerut.
11. Nigam H.C., Zoology of Chordates, Vishal Publication, Jalandhar-144008.
12. Phylum Protozoa to Echinodermata (series) by Kotpal, RL. Rastogi and Co., Meerut
13. Parker T.J and W.A Haswell (1972): A text book of Zoology, Vol –I (7th edition by Marshall and Williams) Mcmillan Press ltd.
14. Jordan, E.L. and P.s.Verma Invertebrate Zoology, S. Chand and Co., Ltd. Ram Nagar, New Delhi.
15. Russel Hunter: - A Biology of higher invertebrates, MacMillon Co. Ltd. London

Animal Ecology

1. Colinvaux, P. A. (1993). Introductionto Ecology. II Edition. Wiley, John and Sons, Inc.
2. Krebs, C. J. (2001). Ecology: The Experimental Analysis of Distribution and Abundance, 6th Edition, ©2009, Pearson
3. Odum, E.P., (2008). Fundamentals of Ecology. Indian Edition. Brooks/Cole
4. Robert Leo Smith Ecology and field biology Harper and Row publisher
5. Ricklefs, R.E., (2000). Ecology. V Edition. Chiron Press
6. Sharma P.D. (2002) Ecology and Environment, Himalaya Publication

Cell Biology

1. Karp, G. (2010). *Cell and Molecular Biology: Concepts and Experiments*. VI EditionJohn Wiley and Sons. Inc.
2. De Robertis, E.D.P. and De Robertis, E.M.F. (2006). *Cell and Molecular Biology*. VIIEdition. Lippincott Williams and Wilkins, Philadelphia.
3. Cooper, G.M. and Hausman, R.E. (2009). *The Cell: A Molecular Approach*. V Edition.ASM Press and Sunderland, Washington, D.C.; Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). *The World of the Cell*. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Bruce Albert, Bray Dennis, Levis Julian, Raff Martin, Roberts Keith and Watson James (2008). *Molecular Biology of the Cell*, V Edition, Garland publishing Inc., New York and London
6. Inside the Cell (2005); US Department of Health Sciences, National Institute of Health, Natinal institute of General Medicine Sciences.
7. Lodish, H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell. (2010).
8. Molecular Cell Biology, Eds. 3, Scientific American & W. H. Freeman. New York.
9. Powar C B.: Cell Biology, Himalaya Publication, Meerut

Note: Latest editions of the recommended books may be referred.

SavitribaiPhule Pune University

(Formerly University of Pune)

Three Year B.Sc. Degree Program in Zoology

(Faculty of Science & Technology)

S.Y.B.Sc. Zoology

(w.e.f. June 2020)

As per

Choice Based Credit System

Syllabusimplemented from

Academic Year 2020-2021

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of animal biol
It includes an interesting range of highly diverse topics. A zoology student needs to
understanding of many areas of the subject to keep pace with advancements in Life Sciences.
This under-graduate degree program has been designed by the Board of Studies in Zoology
SavitribaiPhule Pune University with a substantial component of what is needed from zoologists
skilled career and what zoologists need to pursue for post-graduation and further academic studie
follows the guidelines laid down by the University Grants Commission, New Delhi. This ne
designed curriculum is a perfect blend of the classical aspects in Zoology and the advanced and m
specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Animal Ecolo
Animal Cell biology, Applied Zoology, Pest Management, Histology, Biological Chemist
Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Animal Physiolo
Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology.
In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have b
added in the second year i.e. Semester III and Semester IV of the undergraduate course. In the th
year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** and Sk
Enhancement Courses **[SEC]** have been offered. The students, therefore, have an opportunity to t
courses in Environment Awareness, Language communication: English/Marathi, Aquariu
Management, Poultry Management and Environmental Impact Assessment. In Semester VI t
students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspective
the subject as he progresses towards completion of the degree program. Field trips, Educational vis
and the Project work have been included for the student to experience the applications of the theo
learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciate: anim
diversity, few applications of Zoology, the structure, functions and life processes at cellular, tissu
organ and system level, significance of evolution, and basic concepts of human health. The stude
would also gain an insight into laboratory and field work through the practical course, field work a
the project.

While presenting this new syllabus to the teachers and students of F. Y. B. Sc. Zoology, I a
extremely happy to state that efforts have been made to seek inputs of all the stake holders to make
more relevant.

The new course that will be effective from the academic year 2019- 2020 and will follow the Choi
Based Credit System in a Semester mode. It has been primed keeping in view the distincti
requirements of B. Sc. Zoology students. The contents have been drawn-up to accommodate t
widening prospects of the discipline of Life Sciences. They reflect the changing prerequisites of t
students. This program has been introduced with 132 credits for the subject group while 08 credits
earn from any of the 08 groups offering a range of curricular, cocuricular and extracurricul
activities. This pattern has been specially aimed towards the overall development of the student
The calculation of credits and CGPA will be as per the guidelines of the University. The B. S
Zoology program provides an appropriate blend of classical and applied aspects of the subject. Th

newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.

The Syllabus is been designed with the following aims

- To create awareness amongst students for the basic and applied areas of Zoology
- To orient students about the importance of abiotic and biotic factors of environment and their conservation.
- To provide an insight to the aspects of animal diversity.
- To inculcate good laboratory practices in students and to train them about proper • handling of lab instruments.

Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credits
F. Y. B. Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO - 111 Animal Diversity I	ZO-121 Animal Diversity II	2 + 2
CC	ZO - 112 Animal Ecology	ZO-122 Cell Biology	2 + 2
CC	ZO - 113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5 +1.5
S. Y. B. Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO - 231 Animal Diversity III	ZO - 241 Animal Diversity IV	2 + 2
CC	ZO - 232 Applied Zoology I	ZO - 242 Applied Zoology II	2 + 2
CC	ZO - 233 Zoology Practical Paper	ZO - 243 Zoology Practical Paper	2 + 2
AECC	EVS 231- Environment Awareness	EVA 241- Environment Awareness	2 + 2
AECC	LA 231 - English/Marathi	LA 241 - English /Marathi	2 + 2
T. Y. B. Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO - 351 Pest Management	ZO - 361 Medical & Forensic Zoology	2 + 2
DSEC	ZO - 352 Histology	ZO - 362 Animal Physiology	2 + 2
DSEC	ZO - 353 Biological Chemistry	ZO - 363 Molecular Biology	2 + 2
DSEC	ZO - 354 Genetics	ZO - 364 Entomology	2 + 2
DSEC	ZO - 355 Developmental Biology	ZO - 365 Techniques in Biology	2 + 2
DSEC	ZO - 356 Parasitology	ZO - 366 Evolutionary Biology	2 + 2
DSEC	ZO- 357 Zoology Practical Paper 1	ZO - 367 Zoology Practical Paper 1	2 + 2
DSEC	ZO- 358 Zoology Practical Paper 2	ZO - 368 Zoology Practical Paper 2	2 + 2
DSEC	ZO- 359 Zoology Practical Paper 3	ZO - 369 Zoology Practical Paper 3	2 + 2
SEC	ZO - 3510 Aquarium Management	ZO- 3610 Environmental Impact Assessment	2 + 2
SEC	ZO - 3511 Poultry Management	ZO - 3611 Project	2 + 2

Paper	Semester III Course Code & Course	Credits	No of Hours	Marks (Internal + University)	Semester IV Course Code & Course	Credits	No of Hours	Marks (Internal + University)
I	ZO - 231 Animal Diversity III	02	30	15+ 35= 50	ZO - 241 Animal Diversity IV	02	30	15+ 35 = 50
II	ZO - 232 Applied Zoology I	02	30	15+ 35 = 50	ZO - 242 Applied Zoology II	02	30	15+ 35 = 50
III	ZO - 233 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50	ZO - 243 Zoology Practical Paper	02	14 Practicals	15+ 35 = 50
AECC	EVS 231- Environment Awareness	02	30	15+ 35 = 50	EVA 241- Environment Awareness	02	30	15+ 35 = 50
AECC	LA 231- English/ Marathi	02	30	15+ 35 = 50	LA 241- English/ Marathi	02	30	15+ 35 = 50

Animal Diversity III & IV

Objectives –

1. To understand the origin and advancement of higher vertebrates (tetrapoda).
2. To understandgeneral characters of different groups of higher vertebrates.
3. To classify vertebrates and to become able to understand the possible group of vertebrates observed in nature.
4. To understand different behaviours and adaptations in higher vertebrates
5. To understand affinities among different groups of higher vertebrates.

Learning Outcomes for the course -

1. The students will be able to understand, classify and identify the diversity of higher vertebrates.
2. The students will able to understand the complexity of higher vertebrates
3. The students will be able to understand different life functions of higher vertebrates.
4. The students will be able to understand the linkage among different groups of higher vertebrates.
5. The student will become aware regarding his role and responsibility towards nature as a protector, to understand his role as a trustee and conservator of life which he has achieved by learning, observing and understanding life.

Course Title: Animal Diversity - III

Course Code: ZO – 231,

Semester - III **(2 credits – 30 Hours)**

No. Title & Contents **Number of Lectures**

1. Introduction to Phylum Chordata – (03)

1.1 Origin & Ancestry of Chordates.

1.2 Comparative account of fundamental characters of Chordates with Non Chordates.

1.3 Salient features of Phylum Chordata.

1.4 Classification of Phylum Chordata upto classes – Pisces, Amphibia, Reptilia, Aves, Mammalia.

2. Introduction to Group – Protochordata. (03)

2.1 Salient features of Protochordata.

2.2 Salient features of subphylumswith two example each - Names only.

Hemichordata – *Balanoglossus*and*Rhabdopleura*, Urochordata - *Herdmania*and*Salpa*,

Cephalochordata –*Branchiostoma*(Amphioxus) and*Asymmetron*.

3. Introduction to subphylum – Vertebrata (02)

3.1 Salient features of Vertebrata.

3.2 Introduction and General characters of sections with two examples - Names only.

Agnatha–*Petromyzon&Myxine*&Gnathostomata–Frog&*Labeo*.

4. Introduction to Class – Pisces (04)

4.1 Salient features of Class – Pisces.

4.2 Introductaionand Salient features of sections with two examples - Names only.

Class – Chondrichthyes–*Scoliodon*and *Chimaera*&Osteichthyes – *Labeo*and*Catla*

4.3 Types of Scales in Fishes.

4.4 Types of Fins in Fishes.

5. Introduction to Class – Amphibia (03)

5.1 Salient features of Class – Amphibia.

5.2 Introduction to order – Apoda–*Ichthyophis*, Urodela–*Salamandra*(Salamander) and& Annura - *Rana*.

5.3 Parental care in Amphibia.

6. Study of *Scoliodon* (15)

Scoliodon – 6.1 - Systematic position, Geographical distribution, Habit, Habitat 01

6.2 - External characters 01

6.3 - Digestive System, Food and feeding mechanism. 02

6.4 - Respiratory System – Structure of Holobranch only. 02

6.5- External & Internal Structure of heart, Working of heart. 02

6.6 - Nervous System – Brain only. 03

6.7 - Male urinogenital system & Female reproductive System. 03

6.8- Yolk sac placenta. 01

Applied Zoology I and II

Objectives :

1. To understand the basic life cycle of the honeybees, beekeeping tools and equipments.
2. To learnfor managing beehives for honey production and pollination.
3. To understand the basic information about fishery, cultural and harvesting methods of fishes.
4. To understand fish preservation techniques.
5. To understand the biology, varieties of silkworms and the basic techniques of silk production and harvesting of cocoons.
6. To learn the different silkworm species and their host plants.
7. To study types of agricultural pests and Major insect pests of agricultural importance.
8. To study Pest control practices.

Learning Outcomes of the course:

1. The learner understands the basics about beekeeping tools, equipment, and managing beehives.
2. The learner understands the basic information about fishery, cultural and harvesting methods of fishes and fish preservation techniques.
3. The learner understands the biology, varieties of silkworms and the basic techniques of silk production.
4. The learner understands the types of agricultural pests, Major insect pests of agricultural importance and Pest control practices.

Course Title - Applied Zoology I

Course Code - ZO - 232

Semester III **2 Credits - 30 lectures**

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1) Sericulture:

1.1 An introduction to Sericulture, Study of different types of silk moths, their distribution, Taxonomic position and varieties of silk produced in India : Mulberry Tassar, Eri and Muga silk moths. 1

1.2 ExternalMorphology and life cycle of *Bombyxmori*. 0

1.3 Cultivation of mulberry : 0

a) Varieties for cultivation,

b) Rain fed and irrigated mulberry cultivation- Fertilizer schedule, Pruning methods and leaf yield.

1.4 Harvesting of mulberry : **a)** Leaf plucking, **b)** Branch cutting, 02

c) Whole shoot cutting.

1.5 Silk worm rearing : 01

a) Varieties for rearing,

b) Rearing house,

c) Rearing techniques,

d) Important diseases and pests.

1.6 Preparation of cocoons for marketing. 03

1.7 Post harvest processing of cocoons : 01

a) Stiffling, sorting, storage, deflossing and riddling,

b) Cocoon cooking, reeling equipment and rereeling, washing and polishing.

1.8 Biotechnological and biomedical applications of silk. 03

2) Agricultural Pests and their control: 02

2.1 An introduction to Agricultural Pests, types of pests (agricultural, store grain, veterinary). 14

2.1 Major insect pests of agricultural importance (Marks of identification, life cycle, nature of damage and control measures). 01

a) Jowar stem borer,

b) Red cotton bug, 06

c) Brinjal fruit borer,

d) Mango stem borer,

e) Blister beetle,

f) Rice weevil,

g) Pulse beetle,

h) Tick.

2.3 Non insect pests: Rats, Crabs, Snails, and Squirrels 01

2.4 Pest control practices in brief: Cultural control, Physical control, Mechanical control, Chemical control, Biological control, Pheromonal control, Autocidal control and Concept of IPM in brief. 04

2.5 Plant protection appliances: Shoulder type Rotary duster, Knapsack sprayer, Cynogas Pump. 02

Course Title: Zoology Practical Paper

Course Code: ZO – 233

Semester - III **(2 credits – 60 Hours)**

Animal Diversity - III

1. Museum study of Group Protochordata : *Balanoglossus, Herdmania, Petromyzon*. (D)
2. Museum study of Class Pisces: Labeo, *Scoliodon, Hippocampus*. (D)
3. Museum study of Class Amphibia :*Salamandra, Rana, Ichthyophis*. (D)
4. Study of types of scales in fishes: Placoid scale, Cycloid scale, Ctenoid scale & Ganoid scale. (D)
5. Study of types of tail fins in fishes: Homocercal, Heterocercal &Diphycercal. (D)
6. Study of external characters & digestive system of locally available fish. (E) - Compulsory
7. Study of brain of locally available fish. (D)
8. Temporary preparation of scales & its identification from locally available fish. - (E) Compulsory
9. Compulsory field visit to study pond ecosystem with reference to Pisces and amphibians, report writing and submission. **(2 P)**

Sericulture –

1. Study of external morphology and life-cycle of *Bombyx mori*. (D)
2. Study of five equipments in Sericulture. (E) - Compulsory
3. Preparation of a map showing distribution of silk moth and rearing/ sericulture practices in India. (E)
4. Compulsory submission of Photographs/ sketches of Mulberry, Tassar, Eri and Muga silkmoths. (E)

Agricultural Pests and their control -

1. Study of following insect pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Jowar stem borer,
   b) Red cotton bug,
   c) Brinjal fruit borer,
   d) Mango stem borer.
2. Study of following pests with respect to marks of identification, nature of damage, economic importance and control measures. (D)
   a) Blister beetle,
   b) Rice weevil,
   c) Pulse beetle,
   d) Tick.
3. Study of any two non insect pests corresponding to theory course. (D)
4. Compulsory submission of at least five Insect Pests/ Photographs/ Sketches. (E)
5. Study of pest control appliances (as per theory course). (D)
6. Compulsory field visit to Sericulture farm/ Agricultural farm, report writing and submission. **(2 P).**

Minimum 14 practicals must be conducted with at least Seven practicals from each paper.

Course Title: Animal Diversity - IV

Course Code: ZO – 241

Semester - IV **(2 credits – 30 Hours)**

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1. Introduction to class –Reptilia (04)

1.1 Salient features of class Reptilia with one example (name only) – *Chelone*, *Calotes*.

1.2 Venomous and Non-venomous snakes – Cobra, Russell's viper, Rat snake, Grass snake.

1.3 Snake venom, symptoms, effect and cure of snake bite, first aid treatment of snakebite.

1.4 Desert adaptations in reptiles in brief.

2. Introduction to class –Aves (05)

2.1 Salient features of class Aves with two examples (names only) – Sparrow, Parrot.

2.2 Flight adaptations in birds.

2.3 Types of Beaks and feet in birds.

2.4 Migration in birds – Altitudinal, Latitudinal.

3. Introduction to class - Mammalia. (04)

3.1 Salient features of class Mammalia with two examples (names only) – Rat, Rabbit.

3.2 Egg laying mammals.

3.3 Aquatic adaptations in mammals.

3.4 Flying adaptations in mammals.

3.5 Cursorial and fossorial adaptation in mammals

4. Study of Rat (17)

4.1 Systematic position, habit and habitat. 01

4.2 External characters. 01

4.3 Digestive system, food and feeding. 02

4.4 Respiratory system. 02

4.5 Blood vascular system – Structure of Heart. 02

4.6 Nervous system – Central Nervous system only. 03

4.7 Sense organs – Structure and functions of Eye & Ear. 03

4.8 Reproductive system. 03

Course Title - Applied Zoology II

Course Code - ZO-242

Semester IV **2 Credits- 30 lectures**

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1. Apiculture: 16

1.1 An introduction to Apiculture, Systematic position, Study of habit, habitat and nesting behaviour of *Apisdorsata*, *Apisindica*, *Apis florae* and *Apismellifera*. 02

1.2 Life cycle, Colony organization and Division of labour. 02

1.3 Bee behaviour and communication (Round Dance and Wag-Tail Dance) . 02

1.4 Bee keeping equipments :

a) Bee box (Langstroth type),

b) Honey extractor,

c) Smoker,

d) Bee-veil,

e) Gloves,

f) Hive tool,

g) Bee Brush, 02

h) Queen excluder. 02

1.5 Bee keeping and seasonal management.

1.6 Bee products (composition and uses) :

a) Honey,

b) Wax,

c) Bee Venom,

d) Propolis,

e) Royal jelly, 02

f) Pollen.

1.7 Diseases and enemies of Bees :

a) Bee diseases - Protozoan (Nosema), Bacterial (American foul brood), Viral (Sac brood), Fungal (Chalk brood).

b) Bee pests - Wax moth (Greater and Lesser), Wax beetle.

c) Bee predators - GreenBee eater, King crow, Wasp, Lizard. 02

1.8 Bee pollination and management of bee colonies for pollination. 02

2. Fisheries : 14

2.2 An introduction to fisheries and its types (in brief) : Freshwater fisheries, Marine fisheries, Brackish water fisheries. 02

2.3 Habit, habitat and culture methods of following freshwater forms : 03

a) Rohu (*Labeo rohita*) ,

b) Catla (*Catla catla*) ,

c) Mrigal (*Cirrhinus mrigala*).

2.3 Harvesting methods of following marine forms: 03

a) *Harpodon*,

b) Mackerel,

c) Pearl oyster.

2.4 Crafts and Gears in Indian Fishery: 02

a) Crafts – Catamaran, Machwa, Dinghi.

b) Gears – Gill net, Dol net, Rampani net, Cast net.

2.5 Fishery byproducts: 02

a) Fish meal,

b) Fish flour,

c) Fish Liver oil,

d) Fish manure,

e) Fish fin soup.

2.6Fish preservation technique: 02

a) Chilling,

b) Freezing,

c) Salting,

d) Drying,

e) Canning.

Course Title: Zoology Practical Paper

Course Code: ZO – 243

Semester - IV **(2 credits – 60 Hours)**

Animal Diversity - IV

1. Museum study of Class Reptilia: Venomous & Non-venomous snake – Two each. (D)
2. Identification of Venomous & Non-venomous snakes with the help of pictorial taxonomic keys. – (D) -Compulsory
3. Museum study of Class Aves: Crow, *Kingfisher*& Duck. (D)
4. Study of types of beaks &feets in birds – Any two each. (D)
5. Museum study of Class Mammalia: Rat, Shrew & Bat. (D)
6. Study of external characters & digestive system of Rat. (D)
7. Study of Heart of Rat. - (D) -Compulsory
8. Study of brain of Rat. (D)
9. Study of reptilian / avian diversity in and around the campus (**2 P**) - (E) -Compulsory
10. Compulsory visit to Zoo / Wildlife sanctuary / Bird sanctuary, report writing and submission. (**2 P**)

Apiculture –

1. Study of external morphology, life cycle and polymorphism in Honey Bee. (D)
2. Temporary mountingof mouth parts, legs, wings and sting apparatus of worker bee. (E)
3. Study of Bee keeping Equipment: Bee box, Honey extractor, Smoker, Bee-veil, queen excluder. (D)- Compulsory
4. Study of Bee products: Honey, Wax, Venom, Royal jelly, Pollen. (D)
5. Estimation of carbohydrates from Honey in different samples. (D)- Compulsory
6. Study of Bee enemies: Wax moth, Bee eater, ant. (D)

Fisheries –

1. Identification, Classification and study of habit, habitat and economic importance of **a)** Rohu (*Labeo rohita*), **b)** Catla (*Catla catla*), **c)** Mrigal (*Cirrhinus mrigala*). (D)
2. Identification, Classification and study of habit, habitat and economic importance of **a)** Prawn, **b)** Crab, **c)** Lobster, **d)** Pearl Oyster. (D)
3. Study and maintenance of Aquarium. (D) - Compulsory

4. Study of crafts: **a)** Catamaran, **b)** Machwa, **c)** Dinghi (Photographs/models/line drawings). (D)
5. Study of gears in fishing: **a)** Gill net, **b)** Dol net, **c)** Rampani net, **d)** Cast net. (Photographs/models/line drawings). (D)
7. Study of nutritional value of fish: Biochemical estimation of fish muscle proteins by using Biuret method. (E) - Compulsory
7. Compulsory study tour/field visit to Apiculture institute / Fish farm/ Aquarium. (E) **(2 P).**

Minimun 14 practicals must be conducted with at least Seven practicals from each paper.

Recommended Reference Books

Animal Diversity – III & IV

1. Text Books of Zoology, Invertebrates Vol- II, 1992, T.J.Parker and W.A. Haswel, Edited by Marshall and Williams,CBS publications and distribution, New Delhi.
2. Integrated Principles of Zoology, Eleventh Edition, Hickman CP, Roberts LS & Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
3. Modern Text Book of Zoology, Vertebrates. R. L. Kotpal, 3rd edn. Rastogi Publications, Meerut.
4. Chordate Zoology, 1982, P.S.Dhami and J.K.Dhami, R. Chand and Co., New Delhi.
5. Biology, Campbell nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.
6. Young, J. Z. (2004). The Life of Vertebrates. III Edition. Oxford university press.
7. Pough H. Vertebrate life, VIII Edition, Pearson International.
8. Integrated Principles of Zoology, Eleventh Edition, Hickman C. P., Roberts L. S.& Larson A. International Edition ISBN 0–07–118077–X, The McGraw-Hill Companies, Inc.,
9. Arora M.P. Chordates I. Himalya Publications.
10. Organic Evolution. R.S. Lull. Light & Life Publishers.
11. Jordan E. L.&Verma P. S. 2003. Chordates Zoology. S. Chand & Company Ltd. New Delhi.
12. Biology, Campbell Nand Reece. 7th Edn. Pearson Education in South Asia, Delhi.

Applied Zoology I & II

1. Principal of Sericulture, 1994. HisaoArguo, Oxford & Co.
2. An Introduction of Sericulture, 1995. G.Ganga, J. Sulochana, Oxford & IBH Publication Co. Bambay.
3. FAQ Manual of Sericulture. Vol I - Mulberry Cultivation, Vol II - Silkworm Rearing. Central Silk Board, Bangalore.
4. Mane, P.C., Chaudhari R. D. et al. Highly sensitive label-free bio-interfacial colorimetric sensor based on silk fibroin-gold nanocomposite for facile detection of chlorpyrifos pesticide. Scientific Reports2020,10, 4198. https://doi.org/10.1038/s41598-020-61130-y
5. Entomology & Pest Management. Pedigo L. P. Prentice Hall, India 1996.
6. General & Applied Entomology, Nayar K. K. & T. N. Ananthkrishnan& B. V. Davis, Tata McGraw Hill Publication, New Delhi.
7. Insects. M. S. Mani, National Book Trust, India, 2006.
8. Insects & Mites of Crops in India. M. R. G. K. Nair – by ICAR, New Delhi.
9. The Science of Entomology. W. S. Romosor and J. G. Stoffolano, McGraw Hill Publication, 1988.

10. Agricultural Insect Pests of India and their Control, Dennis S. Hill, Cambridge University Press.
11. Applied Entomology. Vol. I & II. K. P. Srivastava. Kalyani Publication, Ludhiana, New Delhi.
12. Principles of Insect Pest Management. G. S. Dhaliwal and Ramesh Arora, Kalyani Publications, Ludhiana.
13. Pest Management and Pesticides: Indian Scenario. Editor- B. Vasantaraj David, Namrutha Publications, Madras (Chennai).
14. Concepts of Insect Control. Ghosh M. R. Wiley Eastern Ltd. New Delhi.
15. Destructive and useful Insects, their habit and Control, 1973. C.L. Metcalf and W. P. Flint, Tata McGraw Hill Publications, New Delhi.
16. A Text Book of Entomology, 1974. V. K. Mathur and K. D. Upadhayay, Goel Printing Press, Barani.
17. Imm's general Text Book of Entomology, Vol I & II, Richard and Davis Owen.
18. Biology of Insects, 1992. S. C. Saxena. Oxford and IBH Publishing Co., New Delhi, Bombay, Calcutta.
19. Bee and Bee Keeping, 1978, Roger A. Morse, Conell University Press, London.
20. The Behaviour& Social Life of Honey Bees, C. R. Ribbandas, Dover Publication inc. New York.
21. Fishes. Mary Chandy. National Book Trust India, 2005.
22. Economic Zoology, Shukla Upadhyay, Rastogi Publication, Meerut, India, 1998.
23. Fisheries Developments, K. K. Trivedi, Oxford and IBH Pub. Co.
24. Marine Fishes in India, 1990, D.V. Bal & K. Virabhdra, Tata McGraw Hill Publication.
25. Fishery Management, 1990, S. C. Agarwal, Avinash Publication House, New Delhi.

Note – Use latest editions of the books.

Savitribai Phule Pune University

(Formerly University of Pune)

Three Year B. Sc. Degree Program in Zoology
(Faculty of Science & Technology)

T. Y. B. Sc. Zoology

Choice Based Credit System Syllabus

To be implemented from
Academic Year 2021 - 2022

Preamble:

Zoology is one of the major subjects of Basic Sciences and deals with all aspects of anim biology. It includes an interesting range of highly diverse topics. A zoology student needs to gai understanding of many areas of the subject to keep pace with advancements in Life Sciences. This under-graduate degree program has been designed by the Board of Studies in Zoology o Savitribai Phule Pune University with a substantial component of what is needed from a zoologis as a skilled career and what zoologists needs to pursue for post-graduation and further academ studies. It follows the guidelines laid down by the University Grants Commission, New Delhi This newly designed curriculum is a perfect blend of the classical aspects in Zoology with th advanced and more specialized areas.

This degree offers Discipline Specific Core Courses **[CC]** in Animal Systematics, Anim Ecology, Animal Cell biology, Applied Zoology, Pest Management, Histology, Biologica Chemistry, Genetics, Developmental Biology, Parasitology, Medical & Forensic Zoology, Anim Physiology, Molecular Biology, Entomology, Techniques in Biology and Evolutionary Biology. In addition to the Core Courses, Ability Enhancement Compulsory Courses **[AECC]** have bee added in the second year i.e. Semester III and Semester IV of the undergraduate course. In th third year i.e. Semester V and Semester VI, Discipline specific Elective Courses **[DSEC]** an Skill Enhancement Courses **[SEC]** have been offered. The students, therefore, have a opportunity to take courses in Environment Awareness, Language & communication, English Marathi, Aquarium Management, Poultry Management and Environmental Impact Assessment. I Semester VI the students also have a course dedicated to Project work.

The syllabus has been framed in such a way that the student gains each year, a broader perspectiv of the subject as he progresses towards completion of the degree program. Field visits Educational visits and the Project work have been included for the student to experience th applications of the theory learnt in the classroom.

After completion of the program, it is expected that students will understand and appreciat animal diversity, few applications of Zoology, the structure, functions and life processes a cellular, tissue, organ and system level, significance of evolution, and basic concepts of huma health. The students would also gain an insight into laboratory and field work through th practical course, field work and the project.

While presenting this new syllabus to the teachers and students of T. Y. B. Sc. Zoology, I am extremely happy to state that efforts have been made to seek inputs of all the stake holders i make it more relevant.

The new course will be effective from the academic year 2021- 2022 and will follow the Choic Based Credit System in a Semester mode. It has been primed keeping in view the distinctiv requirements of B. Sc. Zoology students. The contents have been drawn-up to accommodate th widening prospects of the discipline of Life Sciences. They reflect the changing pre requisites o the students. This graduate program has been introduced with 132 credits for the subject group while 08 credits to earn from any of the 08 groups offering a range of curricular, co-curricular an extracurricular activities. This pattern has been specially aimed towards the overall developmen of the students.

The calculation of credits and CGPA will be as per the guidelines of the University. The B. Sc. Zoology program provides an appropriate blend of classical and applied aspects of the subject. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills. The Syllabus has been revised with the following aims -

- To foster curiosity in the students for Zoology,
- To create awareness amongst students for the basic and applied areas of Zoology,
- To orient students about the importance of abiotic and biotic factors of environment and their conservation,
- To provide an insight to the aspects of animal diversity,
- To inculcate good laboratory practices in students and to train them about proper handling of lab instruments.

Board of Studies in Zoology
Savitribai Phule Pune University

1. Course Structure:

Course Structure with Credit Distribution of the Undergraduate Science Program in Zoology

Course	Course Code and Name of the Course		Credit
F. Y. B. Sc.	**SEMESTER I**	**SEMESTER II**	
CC	ZO-111 Animal Diversity I	ZO-121 Animal Diversity II	2+2
CC	ZO-112 Animal Ecology	ZO-122 Cell Biology	2+2
CC	ZO-113 Zoology Practical Paper	ZO-123 Zoology Practical Paper	1.5+1.5
S. Y. B. Sc.	**SEMESTER III**	**SEMESTER IV**	
CC	ZO-231 Animal Diversity III	ZO-241 Animal Diversity IV	2+2
CC	ZO-232 Applied Zoology I	ZO-242 Applied Zoology II	2+2
CC	ZO-233 Zoology Practical Paper	ZO-243 Zoology Practical Paper	2+2
AECC	EVS 231-Environment Awareness	EVA 241-Environment Awareness	2+2
AECC	LA 231-English / Marathi	LA 241- English / Marathi	2+2
T. Y. B. Sc.	**SEMESTER V**	**SEMESTER VI**	
DSEC	ZO-351 - Pest Management	ZO-361 - Medical & Forensic Zoology	2+2
DSEC	ZO-352 - Histology	ZO-362 - Animal Physiology	2+2
DSEC	ZO-353 - Biological Chemistry	ZO-363 - Molecular Biology	2+2
DSEC	ZO-354 - Genetics	ZO-364 - Entomology	2+2
DSEC	ZO-355 - Developmental Biology	ZO-365 - Techniques in Biology	2+2
DSEC	ZO-356 - Parasitology	ZO-366 - Evolutionary Biology	2+2
DSEC	ZO-357 - Zoology Practical Paper 1	ZO-367 - Zoology Practical Paper 1	2+2
DSEC	ZO-358 - Zoology Practical Paper 2	ZO-368 - Zoology Practical Paper 2	2+2
DSEC	ZO-359 - Zoology Practical Paper 3	ZO-369 - Zoology Practical Paper 3	2+2
SEC	ZO-3510 - Aquarium Management	ZO-3610 - Environmental Impact Assessment	2+2
SEC	ZO- 3511 - Poultry Management	ZO-3611 - Project	2+2

2. Detailed Syllabus of T. Y. B. Sc.

Following is the syllabus of each course along with the course outcomes:

SR.NO.	SEMESTER	COURSE NUMBER AND NAME	CREDITS
1	V	ZO 351 - Pest Management	2
2	V	ZO 352 - Histology	2
3	V	ZO 353 - Biological chemistry	2
4	V	ZO 354 - Genetics	2
5	V	ZO 355 - Developmental Biology	2
6	V	ZO 356 - Parasitology	2
7	V	ZO 357 - Zoology Practical Paper 1	2
8	V	ZO 358 - Zoology Practical Paper 2	2
9	V	ZO 359 - Zoology Practical Paper 3	2
10	V	ZO 3510 - Aquarium Management	2
11	V	ZO 3511 - Poultry Management	2
12	VI	ZO 361 - Medical & Forensic Zoology	2
13	VI	ZO 362 - Animal Physiology	2
14	VI	ZO 363 - Molecular Biology	2
15	VI	ZO 364 - Entomology	2
16	VI	ZO 365 - Techniques in Biology	2
17	VI	ZO 366 - Evolutionary Biology	2
18	VI	ZO 367 - Zoology Practical Paper 1	2
19	VI	ZO 368 - Zoology Practical Paper 2	2
20	VI	ZO 369 - Zoology Practical Paper 3	2
21	VI	ZO 3610 - Environmental Impact Assessment	2
22	VI	ZO 3611 - Project	2

T. Y. B. Sc.

SEMESTER - V

Course Title: Pest Management
Course Code: ZO 351
Credits - 02

Course Objectives: **ZO 351 - Pest Management**

After you complete your study of this unit, you should be able to:

- Explain why identification of the pest is the first step in developing an effective pes control strategy.
- Explain the differences between continuous pests, sporadic pests, and potential pests.
- Explain what is meant by prevention, suppression, and eradication of pests.
- Describe "thresholds" and why they are an important consideration in developing a pes control strategy.
- Describe "monitoring" as it relates to pest control and explain why it is important to pes control strategy.

Course Outcomes:

1. Define pest management.
2. Describe the economic, ecological, and sociological benefits of IPM.
3. Distinguish positive and negative impacts of pesticide use.
4. Understand problems resulting from misuse, overuse, and abuse of chemical pesticides.
5. Define and describe pesticide resistance and how it develops.
6. Identify ecological and biological characteristics important in development of pes populations.
7. Identify 10 tactics commonly used in IPM and be able to distinguish them.
8. Understand society's role in IPM decisions.
9. Describe different groups of pests and compare them to weeds and plant pathogens.
10. Analyse and compare management tactics to determine the best approach to reducing pes populations, weeds, and disease presence.
11. Locate appropriate, scientifically valid sources of information on specific tactics to manage insect pests, weeds, and diseases.
12. Know and how to develop an IPM program.

Title & Contents **Number of lectures**

1. **Pest:** **2 L**
   1.1. Definition.
   1.2. Types of pests.
   1.3. Types of damages caused by the pest.
2. **Pest management using Regulatory control:** **4 L**
   2.1. Quarantine.
   2.2. Eradication.

   2.3. Control districts.
   2.4. "Crop-free" periods.
3. **Pest management using Cultural control:** **4 L**
   3.1. Sanitation.
   3.2. Tillage.
   3.3. Crop rotation.
   3.4. Cropping systems.
4. **Pest management using Biological control:** **4 L**
   4.1. Ecological considerations.
   4.2. Biological control of insects.
   4.3. Biological control of plant disease.
   4.4. Biological control of weeds.
5. **Biotechnology approaches in pest management:** **4 L**
   5.1. Introduction.
   5.2. Recent advance in use of fungi and viruses.
   5.3. Methodology in Biotechnology.
   5.4. Somaclonal variability.
   5.5. Concept of Genetic engineering and Transgenic plants.
6. **Integrated pest management (IPM):** **5 L**
   6.1. Principles and its components.
   6.2. Advantages and disadvantages.
   6.3. Biological control - Predators, Parasitoids, Entomopathogens, Weed killers and their mass production.
7. **Insecticides:** **4 L**
   7.1. Classification of insecticides based on mode of entry.
   7.2. Action and chemical nature.
   7.3. Insecticides formulations and their uses.
   7.4. Safe handling of insecticides.
8. **Insecticide residue:** **3 L**
   8.1. Methods of residue detection – Organochlorine, Organophosphates, Synthetic Pyrithroides, Systemic.
   8.2. Problems in fruits, vegetables, medicinal plants.
   8.3. Maximum permissible residue limits (MRLs).

Reference Books -

1. Handbook of Pest Management in Agriculture by Pimentel.
2. Principles of Insect Pest Management by Dhaliewal and Arora.
3. Agricultural Pest of India & South East Asia by A. Satwal.
4. Pathological Problems of Economics Crop Plants & their Management by Paul Khurana, S. M., 1998.

5. Integrated Diseases Management and Plant Health by Gupta V. K. & Sharma R. C.
6. Diseases of Millets by Ramkrishnan T. S., I. C. A. R. Publ. New Delhi.
7. Fungal diseases of Rice in India by Padmanabhan S. Y., I. C. A. R. Publ., New Delhi.
8. Analysis of Pesticides Residues by H. A. Moye (JW)
9. Advance in Pest Control Research by R. L. Methcalf (JW)
10. Chemistry of pesticides by K. H. Buchel (JW).
11. Progress in Pesticides Biochemistry and Toxicology Vol. I, II & III by D. H. Hutsonand T. R. Robert.
12. Evaluation of Pesticides in Ground Water by W. Y. Garnett, R. C. Honeycatt and others.
13. Chemistry of Pesticides by Edward
14. Insecticide Biochemistry and Physiology by C. F. Wilkinson.

Course Title: Histology
Course Code: ZO 352
Credits: 02

ZO 352 - Histology

Objectives –

1. To understand the histological aspects of mammalian organs.
2. To study the important features of different types of tissues in organ system.
3. To understand the classification of various types of basic tissues.
4. To study structure & functions of various tissues in organ system.
5. To understand histological structure of various glands and its functions.

Learning Outcomes for the course –

1. The students will be able to understand, classify and identify the different types of tissue.
2. The students will understand the complexity of various tissues in an organ.
3. The students will be able to learn structure & functions of various tissues.
4. The students will understand the various diseases related to organs.
5. The student will be able to know the role of glands in mammals.

Title & Contents

	Number of lectures
1. Introduction: Definition and Scope of Histology.	1 L
2. Definitions and Review of Types of Tissues: 2.1 Epithelial tissue. 2.2 Connective tissue. 2.3 Nervous tissue. 2.4 Muscular tissue.	3 L
3. Histological study of following mammalian organs: 3.1 Skin (V. S.). 3.2 Tooth (V. S.).	5 L

3.3 Tongue (C. S.) with reference to mucosa papillae and taste buds.

4. Histological study of Alimentary canal and Liver: 4.1 Oesophagus (T. S.). 4.2 Stomach (T. S.). 4.3 Duodenum (T. S.). 4.4 Rectum (T. S.). 4.5 Liver (C. S.).	6 L
5. Histological study of Respiratory organs: 5.1 Trachea (T. S.). 5.2 Lung (C. S.).	2 L
6. Histological study of Excretory organs: 6.1 Kidney (L. S.). 6.2 Juxtaglomerular complex.	3 L
7. Histological study of Reproductive organs: 7.1 Testis (T. S.) with reference to Seminiferous Tubules and Cells of Leydig. 7.2 Ovary (C. S.).	4 L
8. Histology of Endocrine glands: 8.1 Pituitary gland. 8.2 Thyroid gland. 8.3 Adrenal gland. 8.4 Pancreas (C. S.) including both exocrine and endocrine components.	6 L

Reference Books: -

1. A Text Book of Histology, 2014, 5th Edn. Krishna Garg, Indira Bahl & Mohini Kaul CBS Publication & Distributors, Delhi.
2. Histology, 1987, 9th Edn., Arthur W. Ham, David H. Cormack, J. B. Lippincott Co. Philadelphia.
3. Histology, 1977, 4th Edn., R. O. Greep and L. Weiss, McGraw Hill Int. Book Co., New York.
4. Hand Book of Histo-pathogical & Histo-chemical Techniques, 1983, 3rd Edn. reprint, Butterworth & Co. (Publishers) Ltd, UK.

Course Title: Biological Chemistry
Course code: ZO 353
Credits: 02

ZO 353 - Biological Chemistry

Objectives –

1. To understand the basic concepts and significance of biochemistry.
2. To understand the basic concepts pH and Buffers
3. To understand the chemical structures of carbohydrate, and their biological and clinical significance.
4. To understand the structure and importance of proteins and lipids
5. To understand the variations in enzyme activity and kinetics.

Learning Outcomes for the course -

1. Learners shall be able to understand basic concepts and significance of biochemistry
2. The students will learn about the pH and Buffers.
3. The students will learn about the chemical structures of carbohydrate, and their biological and clinical significance.
4. The students will be able to understand, interpret structure and importance of proteins, carbohydrates and lipids
5. Learners will be able to comprehend variations in enzyme activity and kinetics.

Title & Contents

	Number of lectures
1. Introduction of Biochemistry: Importance of Biochemistry in Life Sciences.	1 L
2. p^H and Buffers: 2.1 Concept of p^H. 2.2 Concept of p^H scale, biological significance of p^H 2.3 Concept of acid and base, Ionization of acids and bases. 2.4 Derivation of Henderson-Hassel Balch equation & its applications. 2.5 Buffer - Definition, Concept, Functions, Types of buffer and Buffering Capacity.	3 L
3. Carbohydrates: 3.1 Definition, Classification & Biological importance of Carbohydrates. 3.2 Isomerism in carbohydrates - Structural and Stereoisomerism. 3.4 Significance of Gluconeogenesis, Glycogenolysis and Glycogenesis. 3.3 Clinical Significance - Hypoglycemia and Hyperglycemia.	7 L
4. Amino acids and Proteins: 4.1 General Structure of amino acids and Peptide bond. 4.2 Essential and non-essential amino acids. 4.3 Types of proteins, protein structures (primary, secondary, tertiary and quaternary structures with suitable example), Forces responsible for their stability. 4.5 Biological importance of proteins – Biocatalysts, Carrier proteins Contractile proteins, Hormonal role of proteins.	6 L
5. Enzymes: 5.1Nomenclature, Types and properties of enzymes. 5.2 Regulatory and non-regulatory enzymes. 5.3 Enzyme inhibition. 5.4 Factors influencing enzyme activity (pH, temperature, substrate concentration). 5.5 Introduction of isoenzymes and cofactor. 5.6 Clinical significance of enzymes - PKU and AKU.	10 L
6. Lipids:	3 L

6.1 Introduction.
6.2. Fatty acids - Types and nomenclature (saturated and unsaturated).
6.3 Clinical significance (obesity, atherosclerosis, myocardial infarction).
6.4 Biological importance of lipids.

Reference books

1. Principles of Biochemistry, 1993, Lehninger A. L. Nelson D. L. & Cox M. M. W. H. Freeman Company, USA.
2. Biochemistry, 1995 5th Edn. Zuby G. W, C. Brown Communications USA.
3. Harpers Biochemistry, 1996 26th Edn. p Murray R. K., Granner D. K., Mayes P. A. & Rodwell V. W. Prentice Hall international USA.
4. Outline of Biochemistry, 1995 5th Edn, Conn E. E., Stumph P. K. Bruening G & Doi R. H. John Wiley & Sons, USA.
5. Principals of Biochemistry, 1993, 1st Edn., Pattabhiraman T. N. Gajanan Book publishers and distributors Bangalore.
6. Clinical Biochemistry, 1994, B. P. Godkar, Bhalini Publishing House, Mumbai.
7. Biochemistry, 1995 5th Edn., Stryer San Francisco, W. H. Freeman & Co.
8. Biochemistry, 1990, 8th Edn., D. Voet & J. Voet, John Willey, New York
9. David T. Plummer: An Introduction to Practical Biochemistry, IIIrd edition (1988)

Course Title: Genetics
Course code: ZO 354
Credits: 02

ZO 354 - Genetics

Title & Contents

	Number of lectures
1. Introduction to genetics: 1.1 Classical and Modern concept of Gene, Cistron, Muton, Recon. 1.2 Mendel's laws of Inheritance.	3 L
2 Exceptions to Mendelian Inheritance: 2.1 Incomplete dominance. 2.2 Co-dominance. 2.3 Multiple alleles: Concept, characteristics and importance of multiple. alleles, ABO & Rh - blood group system and its medico legal importance. 2.4 Lethal alleles.	6 L
3. Gene Mutation: 3.1 Definition. 3.2 Types of mutations: spontaneous, induced, somatic, gametic, forward, reverse. Types of point mutation - deletion, insertion, substitution, transversion, transition. 3.3 Mutagenic agents a) UV radiation and ionising radiation. b) Base analogs, alkylating and intercalating agents.	6 L

4. Sex-determination: 4 L

4.1 Introduction.
4.2 Types of sex determination: -XX-XY, ZZ-ZW, XX-XO and Parthenogenesis, Hypodiploidy.
4.3 Gynandromorphism.

5. Population Genetics: 3 L

5.1 Basic Concepts in population genetics: Mendelian population, gene pool, gene / allele, Frequency, chance mating (Panmictic mating).
5.2 Hardy Weinberg law and its equilibrium.

6. Human Population Genetics: 4 L

6.1 Karyotype.
6.2 Genetic disorders, Structural & numerical alterations of chromosomes (chromosomal aneuploidy - Down, Patau, Edward, Turner and Klinefelter syndromes).

7. Sex linked inheritance in human: 2 L

7.1 Colour – blindness.
7.2 Hacmophilia.
7.3 Hypertrichosis.

8. Application of genetics: 2 L

8.1 Genetic counselling.
8.2 Diagnostics & breeding technology.

Reference Books -

1. Principles of Genetics, 1997, P. D. Snustad, M. L. Simmons J. B. Jenkins, John Wiley & Sons, USA
2. Genetics, 2014, 9th Edn., Verma P. S. and Agarwal V. K., S. Chand and Co., New Delhi.
3. Genetics, 2014, 4th Edn. Gupta P. K., Rastogi Publications, Meerut.
4. Principles of Genetics, Gardner, E. J. *et al.* (2006), John Wiley and Sons Inc.
5. Genetics: A Molecular Approach, 3rd Edn, Russell, P. J., Benjamin Cummings.
6. Principles of Genetics 8th Edition, Gardner, E. J., Simmons, M. J., Snustad, D. P. (2008). John Wiley and Sons Inc.
7. Principles of Genetics. 5th Edn. Snustad, D. P. and Simmons, M. J. (2009). John Wiley and Sons Inc.
8. Concepts of Genetics, 10th Edn. Benjamin Cummings. Klug, W. S., Cummings, M. R. and Spencer, C. A. (2012).
9. An Introduction to Genetic Analysis, 11th Edn. Carroll S. B.; Doebley J., Griffiths, A. J. F. and Wessler, S. R. (2018) W. H. Freeman and Co. Ltd.

Course Title: Developmental Biology
Course code: ZO 355
Credits: 02

ZO 355 - Developmental Biology

Title & Contents	Number of lectures
1. Fundamentals of Developmental Biology: 1.1 Definition and scope. 1.2 Concepts in Developmental Biology: Growth, Differentiation, Dedifferentiation, Cell determination, Cell communication, Morphogenesis, Induction and Regeneration.	3 L
2. Theories of Developmental Biology: 2.1 Preformation. 2.2 Pangenesis. 2.3 Epigenesis. 2.4 Axial gradient. 2.5 Germplasm.	3 L
3. Gametogenesis: 3.1 Spermatogenesis & Structure of sperm with respect to human. 3.2 Oogenesis & Structure of ovum with respect to human. 3.3 Types of eggs.	5 L
4.Fertilization: 4.1 Concept and types. 4.2 Chemotaxis. 4.3 Sperm penetration: Acrosome reaction, Capacitation & Decapacitation. 4.4 Activation of ovum: Fertilization cone. 4.5 Prevention of polyspermy: Fast block & Slow block. 4.6 Significance of fertilization.	6 L
5. Cleavage and Blastula: 5.1 Planes and symmetry of cleavage. 5.2 Types of cleavage. 5.3 Significance of cleavage. 5.4 Definition and types of Blastula.	5 L
6. Gastrulation: 6.1 Definition and Concept. 6.2 Basic cell movements in gastrulation: Epiboly, Emboly, Convergence, Invagination, Ingression & Involution with reference to frog. 6.3 Concept of Organizer : Primary, Secondary and Tertiary.	3 L
7. Chick Embryology: 7.1 Structure of Hen's egg.	6 L

7.2 Fertilization and cleavage in Chick.
7.3 Formation of primitive endoderm.
7.4 Primitive streak development.
7.5 Head process and regression of Primitive streak.

References:

1. An Introduction to Embryology (2012), 5th Edition., Balinsky B. L., Fabian B. C. Brooks Cole Pub. Co., USA
2. Developmental Biology (2013), 10th Edn. Gilbert S. F., Sinauer Associates Inc.
3. Developmental Biology: Patterns, Principle and Problems (1982), Saunders J. W., Prentice Hall Coll Div.
4. Principles of Development (2007), 3rd edition, Lewis Wolpert, Oxford University Press Publisher

Course Title: Parasitology
Course code: ZO 356
Credits: 02

ZO 356 - Parasitology

Objectives:

1. To understand the basic terminologies in parasitology.
2. To understand the concepts of animal association with examples.
3. To understand the morphology and life cycle of common parasites (Protists and Platyhelminthes).
4. To understand the phenomenon of Host-parasite relationship.
5. Explain the importance of arthropod vectors with examples.

Learning outcomes:

1. The students will be able to learn about basics and scope of parasitology.
2. The students will be able to learn the types of host and parasite with examples.
3. The students will be able to learn about the morphology, life cycle, pathogenicity and treatment of common parasites (Protists and Platyhelminthes).
4. The students will be able to learn about host -parasite relationships and their effects on host body.
5. The students will be able to learn about the arthropod parasites and their role as vector.

Title & Contents **Number of lectures**

1. **Introduction, Scope and Branches of Parasitology:** **2 L**
   1.1. Definition: host, parasite, vector, commensalisms, mutualism and parasitism.
   1.2. Branches of parasitology.
2. **Types of Parasites and Hosts:** **3 L**
   2.1 Ectoparasites.

2.2 Endoparasites and its subtypes.
2.3 Types of hosts - Intermediate, definitive, paratenic and reservoir.

3. **Host - Parasite relationship:** **3 L**
   3.1 Host specificity.
   3.2 Types of host specificity: structural specificity, physiological specificity and ecological specificity.
   3.3 Effects of parasite on host.
4. **Study of Parasitic Protists:** **9 L**
   4.1 *Entamoeba histolytica* - Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
   4.2 *Plasmodium vivax* - Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
5. **Study of Parasitic worms:** **9 L**
   5.1 *Ascaris lumbricoides* - Study of Morphology, Life Cycle, Prevalence.
   5.2 Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
   5.3 *Taenia solium* (Tapeworm) - Study of Morphology, Life Cycle, Prevalence, Epidemiology, Pathogenicity, Diagnosis, Prophylaxis and Treatment.
6. **Study of Parasitic Arthropoda:** **4 L**
   Morphology, pathogenicity and control measures of –
   6.1 Soft tick.
   6.2 Head louse.
   6.3 Rat flea.
   6.4 Bed bug.

Reference Books:

1. Parasitology: K. D. Chatterjee.
2. Parasites: ecology, diseases, and management (2013).
3. Parasitic Helminths: Targets, Screens, Drugs, and Vaccines, 201.
4. Parasitism: The Diversity and Ecology of Animal Parasites (2014) Tim Goater, Timothy M. Goater, Cameron P. and Esch, Gerald W. Cambridge University Press.
5. Principles of Veterinary Parasitology (2016), 1st Edn, Dennis E. Jacobs, Mark Fox, Lynda M. Gibbons, Carols Hermosilla, John Wiley & Sons.
6. Veterinary Parasitology (2013), Hany M. Elsheikha, Jon S. Patterson, CRC Press Taylor & Francis Group
7. Textbook of medical parasitology – C. K. Jayaram Panikar.
8. Textbook of medical parasitology – Arora & Arora.
9. Textbook of medical parasitology – S. C. Parija.
10. Veterinary Parasitology, 2013 - (Taylor, M. A.).
11. Encyclopedia of parasitology, 2008.
12. The Biogeography of Host-Parasite Interactions by Serge Morand, Boris R. Kransov, Oxford University Press.
13. Textbook of medical microbiology – Rajesh Bhatia & Itchpujani.

14. Textbook of medical microbiology – Arora & Arora.
15. Biological Control of Parasites, 2012.
16. Biology of Malaria Parasites, 2012.
17. Sherris medical microbiology: Ryan.
18. Medical microbiology: Jawetz Melnick & Adelbergs.
19. Current concepts in parasitology, 2012.
20. Textbook of Parasitology, Ashok Kumar, Discovery Publishing.
21. Introduction to parasitology: With special reference to the parasites of man, A.C. Chandler- John Wiley & Sons.
22. A text book of Parasitology – D. P. Karyakarte & A. S. Damle.

For Practical papers of both V and VI semester, minimum 6 practicals should be conducted from each section, thus a minimum of 12 practicals should be conducted per practical paper. (C) stands for compulsory.

Course Title: Zoology Practical Paper I
Course code: ZO 357
Credits: 02

Course Title : Zoology Practical Paper - I
Section I: Practicals in Pest Management

1. To study the plant protection appliances. D
2. Studies on beneficial insects. (C) D
3. Study of pests and diseases of honeybees. (C) D
4. Applications of IPM components in various crops. D
5. Separation of the pesticides or plant products by TLC and Column chromatography. - 2 P(C) E
6. Detection of pesticides residues in food stuffs. (C) E
7. Rearing of pest species (Any 2 species). (C) D
8. Study of life cycle of Red cotton bug and Lemon butterfly. D
9. Study of the detection of damage caused by pests. D
10. Plant disease, its intensity & calculation of VI (Virulence Index) of at least two diseases. D

Section II: Practicals in Histology

1. Study of the different types of tissues with the help of permanent slides – Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue. D
2. Study of permanent histological slides of T. S. of skin, V. S. of tooth and C. S. of tongue. D
3. Study of permanent histological slides of digestive parts – T. S. of Stomach, T. S. of Duodenum, T. S. of Rectum, C. S. of Liver. D

4. Study of permanent histological slides of glands - T. S. of Pituitary gland, T. S. of Thyroid gland, T. S. of Adrenal gland, C. S. of Pancreas. D
5. Study of permanent histological slides of reproductive organs- T. S. of Testis, C. S. of Ovary. D
6. Study of human blood smear to observe different types of blood cells. (C) E
7. Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Striated Muscle Fibre. (C) E
8. Temporary mounting of tissues of any mammal (freshly dissected or preserved) - Smooth Muscle Fibre. (C) E

Course Title: Zoology Practical Paper - II
Course code: ZO 358
Credits: 02

ZO 358 - Zoology Practical Paper - II
Section I: Practicals in Biological Chemistry

1. To determine the enzyme activity - salivary amylase/ urease/ invertase. E
2. To determine specific activity of an enzyme. E
3. Detection of carbohydrates (monosaccharides, disaccharides and polysaccharides) with the help of suitable tests. (C) E
4. Isolation of starch from potato and digestion of starch by salivary amylase. (C) E
5. Preparation of buffer of desired pH and molarity. (C) E
6. Protein estimation by Lowry *et al.* method. (C) E
7. Isolation of Caesin from milk by adjusting iso-electric point. (C) E
8. Preparation of Acid, Alkali & it's standardisation. E
9. Principle, Working & Measurement of pH of any three samples. E

Section II: Practicals in Genetics

1. Study of monohybrid ratio by providing hypothetical data and deducing applicability of Mendelian laws (Two examples). (C) D
2. Study of Dihybrid ratio by providing hypothetical data and deducing applicability of Mendelian laws (Two examples). (C) D
3. Study of genetic traits in human beings (tongue rolling, widow's peak, ear lobes, colour-blindness and PTC tasters/ non-tasters). D

4. Study of blood groups in human (ABO and Rh). (C) D
5. Study of Hardy - Weinberg law with suitable recording of genetic traits. D
6. Study of human karyotypes and numerical alterations (simulated & theoretical sample data) (Down syndrome, Klinefelter syndrome and Turner syndrome). D
7. Temporary preparation of polytene chromosomes from suitable material. (C) E
8. Study of structural chromosome aberrations (dicentric, ring chromosomes and inversions in polytene chromosomes) from prepared slides / photographs. D
9. Study of external characters, life cycle and Rearing of *Drosophila*. (C) D
10. Study of *Drosophila* mutants. D

Course Title: Zoology Practical Paper III
Course code: ZO 359
Credits: 02

ZO 359 - Zoology Practical Paper - III

Section I: Practicals in Developmental Biology

1. Study of ultrastructure of Sperm and Ovum of Mammal. D
2. Study of eggs with the help of slide / Photograph / chart / Model (Insect, *Amphioxus*, Frog and Hen). (C) D
3. Study of cleavage and its types with the help of Slide / Photograph / Chart / Model. D
4. Study of blastulae (*Amphioxus*, Frog and Hen). D
5. Study of gastrulae (*Amphioxus*, Frog and Hen). D
6. Study of whole mount slides of chick embryology – 24 hrs, 33 hrs and 48 hrs. (C) D
7. Study of T. S. and V. S. of chick embryo of Brain & Heart with the help of slide / Photograph / chart / Model – 24 hrs & 33 hrs. D
8. Temporary preparation of chick embryo. (C) E
9. Ex-ovo culture of chick embryo. D

Section II : Practicals in Parasitology

1. Study of parasitic association with their example -
   a) Commensalism.
   b) Parasitism. D
2. To study the life cycle, pathogenecity, diagnosis and treatment of *Entamoeba histolytica* and *Plasmodium vivax* through permanent slides or microphotographs. D
3. To study the life cycle, pathogenecity, diagnosis and treatment of *Ascaris lumbricoides* and *Taenia solium* through specimen, permanent slides or microphotographs. (C) D

4. Study of following parasites with its role as vector - Soft tick, *Pediculus humanus*, *Xenopsylla cheopis* and *Cimex lectularius* through permanent slides or photographs. (C) D
5. Study of effects of parasites on host body. D
6. Study of the pathogenecity and control measures of - Tick (soft tick and hard tick) and Mite *(Sarcoptes scabiei)*. D
7. Study of parasites from the gut of cockroach. (C) E
8. Collection & submission of various parasites. (C) E

Course Title: Aquarium Management
Course Code: ZO 3510
Credits: 02

ZO 3510: Aquarium Management

Title & Contents	Number of lectures
1. Introduction to Aquarium Fish Keeping:	**4 L**
1.1 The potential scope of Aquarium Fish Industry as a Cottage Industry.	
1.2 Exotic and Endemic species of Aquarium Fishes.	
1.3 Nutritional value of fish.	**6 L**
2. Biology of Aquarium Fishes:	
2.1 Common characters and sexual dimorphism of Aquarium fishes - Guppy, Molly, Sword tail, Gold fish, Angel fish, Blue morph, Anemone fish, Butterfly fish and Fighter fish.	**4 L**
3. Food and feeding of Aquarium Fishes:	
3.1 Use of live fish feed organisms.	
3.2 Preparation and composition of formulated fish feeds.	
3.3 Overview on types of fish food.	**4 L**
4. Fish Transportation:	
4.1 Live fish transport: a) Fish handling. b) Fish packing. c) Fish forwarding techniques.	
4.2 Causes of mortality in transport.	**3 L**
5. Maintenance of Aquarium:	
5.1 General Aquarium Maintenance - budget for setting up an Aquarium.	
5.2 Fish Farm as a Cottage Industry, Rules & regulations of fish rearing.	
5.3 Common diseases of Aquarium fish.	**4 L**
6. Physico-chemical parameters of water for fish culture:	
6.1 Acidity, Alkalinity, Calcium, Nitrate, Ammonia, Total hardness.	**2 L**
7. Fish preservation:	
7.1 Fish preservation and processing.	

7.2 Fish preservation techniques.

8. Fish breeding: 3 L

8.1 Types of fish breeding -
a) Natural fish breeding.
b) Induced fish breeding.

Course Title: Poultry Management
Course Code: ZO 3511
Credits: 02

ZO – 3511 Poultry Management

Objectives:

1. To understand the basics of Poultry Farming and its important.
2. To understand breeding management of broilers and layers of chickens.
3. To understand housing management and equipment of Poultry farming.
4. To understand food, feeding and digestion mechanism of chickens.
5. To understand the poultry diseases and their control.
6. To understand the economic importance of poultry products.

Expected Outcome:

1. The students will be able to understand the Poultry farming practices.
2. The students will able to understand the poultry breeding techniques.
3. The students will be able to understand poultry rearing techniques.
4. The students will be able to understand feeding requirement and food ingredients.
5. The students will be able to understand the poultry disease and their pathogens.
6. The students will be able to understand market value of poultry products.

Title & Contents

	Number of lectures
1. Introduction to Poultry Farming: 1.1 Definition of Poultry, Importance of Poultry Farming and Poultry Development in India. 1.2 Present and future prospects.	2 L
2 Breeding Management: 2.1 Male and female reproductive system of chicken. 2.2 Breeds and strains of broilers and layers of chicken. 2.3 General aspects of breeding for better egg production and body weight gain. 2.4 Selection and culling. 2.5 Artificial insemination.	5 L

3 Housing Management: 3.1 Establishment of poultry farm. 3.2 Housing and equipment. 3.3 Incubation and hatching of eggs. 3.4 Broiler and layer management. 3.5 Lighting schedule for poultry. 3.6 Transport strategy of Poultry birds.	5 L
4 Feeding Management: 4.1 Digestive system and Digestion Mechanism of chicken. 4.2 Feed ingredients. 4.3 Feed processing. 4.4 Formulation of feed *viz.*, Starter, Grower, Layer, Finisher and Breeder ration, Feed conversion ratio (FCR), Nutritional deficiency conditions.	6 L
5 Health Management: 5.1 Vaccination schedule for poultry birds. 5.2 Common poultry diseases, i. e. Ranikhet, Marek, Chicken pox, Gumboro, Infectious bronchitis and Chronic Respiratory Disease (CRD). 5.3 Control of internal and external parasites.	5 L
6 Poultry Products: 6.1 Preservation and storage of eggs. 6.2 Grading of eggs and AGMARK standard of egg. 6.3 Egg powder. 6.4 Slaughtering and processing of chicken. 6.5 Poultry By Products – Feathers and Poultry Manure.	4 L

Reference Books

1. Commercial Chicken Meat and Egg Production (2007), 5th Edn,Bell D. Donald and Weaver D. William Jr., Springer India Pvt. Ltd., Noida.
2. Poultry Science (2015) 3rd Edn, Ensmiger. M. E., International Book Distribution Co., Lucknow, India.
3. Modern Poultry Farming (2003), 1st Edn, Hurd M. Louis, International Book Distributing Company, Lucknow.
4. Handbook of Poultry Production and Management (2007), 2nd Edn., Jadhav N. V., and Siddique M. F., Jaypee Brothers Medical Publishers Pvt. Ltd., New Delhi.
5. Successful Poultry Management (2007), 2ndEdn, Jull A. Morley, Biotech Books, New Delhi.
6. Poultry Husbandry (2008) 2nd Edn, Jull A. Morley, J. V. Publishing House, Jodhpur, Rajasthan.
7. Broiler Breeder Production (2001), 1stEdn, Leeson. S., and Summers J. D. International Book Distributing Company, Lucknow.
8. Poultry and Ratite Nutrition (2013), 1stEdn, Pathak N. N., Narendra Publishing House, New Delhi, India.
9. Simply Poultry Science (2011) 1st Edn, Rajini Asha R., Alfa Publications, New Delhi.

10. Poultry Production (2011) 3rd Edn, Singh, R. A., Kalyani Publishers, New Delhi.
11. Textbook of Poultry Science (2015) 1stEdn, Sreenivasaiah., P. V. Write & Print Publications, New Delhi.
12. Encyclopedia of Broiler Breeder Production: Production, Feeding and Management Techniques (2013) Vol. 1, 2 & 3, Youn Michael, Anmol Publications Pvt. Ltd., New Delhi

Note: Latest editions of the recommended books may be referred.

SEMESTER - VI

Course Title: Medical & Forensic Zoology
Course Code: ZO 361
Credits: 02

ZO 361 - Medical & Forensic Zoology

Objectives:

1. To understand the scope, need and History of Forensic Science.
2. To understand the role of different institutes & allied institutes of Forensic Science.
3. To understand the various branches of Forensic Sciences from Life Sciences.
4. To understand human physiology, post mortal investigations.
5. To understand knowledge of handling different types of evidences and their examinations.

Expected Outcome

1. The students will be able to understand the basics principles of Medical and Forensic Zoology.
2. The students will able to understand scientific methods in crime detection.
3. The students will be able to understand the advancements in the field of Medical and Forensic Zoology.
4. The students will be able to understand modern tools, techniques and skills in forensic investigations.
5. The students will be able to describe the fundamental principles and functions of forensic science and its significance to human society.

Title & Contents

	Number of lectures
1. Introduction to medical zoology and its importance :	**2 L**
2. Medico-legal Autopsy: 2.1 Death and its Causes- External examination of deceased body – Internal Examination - Determination of time since death and cause of death. 2.2 Injuries – Classification - Medico-legal aspects of injuries. 2.3 Post-mortem changes - collection of post-mortem samples and Preservation.	**6 L**
3. Urine Analysis: 3.1 Physical characteristics, abnormal constituents, renal failure, renal calculi, dialysis.	**3 L**

4. Non infectious Diseases: 4.1 Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Diabetes (Type I and II), Hypertension, Hypotension, Obesity, Atherosclerosis, Myocardial Infraction.	**2 L**
5. Infectious Diseases: 5.1 Causes, Types, Symptoms, Complications, Diagnosis and Prevention of Tuberculosis and Hepatitis.	**2 L**
6. Introduction to Forensic Zoology: 6.1 Definition, Scope and Application of Forensic Zoology. 6.2 Forensic Laboratories in India. 6.3 Basic Principles of Forensic Science with Examples.	**3 L**
7. Forensic Medicine: 7.1 Introduction to Forensic Medicine: Definitions of Forensic Medicine. 7.2 Medical Jurisprudence. 7.3 Medical evidence documentations.	**3 L**
8. Forensic Analysis: 8.1 Examination of Biological Materials: Examination of Hair, Fibres, Diatoms, plants materials, human tissues. 8.2 Examination of Body Fluid: Blood, Semen and Saliva. 8.3 Forensic Importance of Insects: Insects of forensic importance - indicators of time of death stages of insect development & comparative decomposition of human body - colonization - Evidence collection of insects – Territorial & Aquatic Insects. 8.4 DNA Fingerprint Technique and Examination of Biological Traces: Liquid blood, blood stains, & swabs, semen, Seminal stains, tissues, Bones, Hairs, Teeth, Saliva, Skeletal remains. 8.5 Toxicological Investigations: Poisons – Definition, Forms of Poison – Physical, Chemical & Mechanical state. Introduction with examples of – Neurotoxic Poisons – Cerebral & Spinal, Cardiovascular Poisons, Asphyxiants, Miscellaneous poisons – Pesticides, Pharmaceutical drugs, Petroleum poisons, Food poisons, Radioactive poisons.	**9 L**

Reference Books

1. Godkar P. B and Godkar D. P, Textbook of Medical Laboratory Technology, II Edition, Bhalani Publications
2. Textbook of Microbiology: R. Ananthanarayan, C. K. Jayaram Panikar, University Press.
3. A textbook of Microbiology: P. Chakraborty
4. Text book of pathology: Robbins & Cotran, Vol. 1 & 2, Tenth Edition, Elsevier Publication.
5. Pathologic basis of disease: M. K. Singh & Vinay Kumar, Vol. 1 & 2, 10th edition, Elsevier.
6. Pathologic basis of disease: Bhende & Deodhare Part I & II.
7. Text book of General pathology: Robbins & Cotran, Vol. 1 & 2, 10th edition, Elsevier publications.
8. Pathologic basis of Disease: Robbins & Cotran, Vol. 1 & 2, 10th edition, Elsevier publications.
9. Essentials of medical pharmacology: K. D. Tripathi, 8th edition, Jaypee brothers publishers.
10. Review of pharmacology: K. D. Tripathi, Jaypee brothers publishers.

10. Essentials of medical microbiology: Apurba S. Sastry & Sandhya Bhat, Jaypee brothers.
11. W. G. Eckert and S. H. James, Interpretation of Bloodstain Evidence at Crime Scenes, CRC Press, Boca Raton (1989).
12. The essentials of forensic medicine & toxicology: K. S. Narayan Reddy.
13. A textbook of Clinical pharmacology: Roger H. J., Spector R. G., Trounce J. R., Hodder & Stoughton publishers.
14. Pharmacology & Pharmacotherapeutics : Satoskar R. S., Bhandarkar S. D., Popular Prakashan, Mumbai.
15. The synopsis of forensic medicine & toxicology: K. S. Narayan Reddy.
16. Textbook of pathology: Harsh Mohan.
17. G. T. Duncan and M. I. Tracey, Serology and DNA typing in, Introduction to Forensic Sciences, 2nd Edition, W. G. Eckert (Ed.), CRC Press, Boca Raton (1997).
18. T. Bevel and R. M. Gardner, Blood stain Pattern Analysis, 3rd Edition, CRC Press, Boca Raton (2008).
19. Arti Nigam and Archana Ayyagari, Lab manual in Biochemistry, immunology and biotechnology, Mc Graw Hill Publishing Company ltd.
20. Fundamentals of Forensic Science, Second Edition, Max M. Houck and Jay A Siegel, Academic Press.
21. Forensic Science, Third Edition, Stuart H James and Jon. J. Nordby.
22. Forensic Science in India and the World, Deepak Ratna and Mohd. Zaidi, Alia Law Agency, Allahabad.
23. Forensic Science in India - A Vision for 21st Century, B. B. Nanda and Dr. R. K. Tewari, Select Publishers.
24. Cell Biology, Sixth Edition International Students Edition, Gerald Karp, Wiley Publications, 2010.
25. Human Physiology: From Cells to Systems, Lauralee Sherwood, Cengage Learning, 2008.
26. Forensic Biology, Richard Li, CRC Press.
27. Human Anatomy Vol. 1,2,3,4, Chaurasia B. D.
28. Text Book of Medical Jurisprudence, Forensic Medicine and Toxicology by Parikh C. K.
29. Forensic Science: An introduction to Scientific and Investigative Techniques by S. H James, J. J. Nordby.
30. Parikh C. K., Medical Jurisprudence.

Course Title: Animal Physiology
Course Code: ZO 362
Credits: 02

ZO 362 - Animal Physiology

Course Objectives:

1. To acquaint students with the principles and basic facts of Animal Physiology and with some of the laboratory techniques and equipment used in the attainment of physiological data. The importance will be on mammalian.
2. The course will focus on organ-system physiology, emphasis will be placed on nutritive, circulatory, respiratory, excretory, muscular, nervous, reproductive and endocrine physiology. Where appropriate, basic chemical and physical laws will be reviewed in order to enhance and to promote student understanding.
3. Furthermore,
4. The laboratory module of the course is designed to support the topics discussed in theory lecture, as well as to acquaint students with some of the laboratory techniques and equipment used in the gaining of physiological facts.

Learning Outcomes:

Upon successful completion of this course, the students will be able to describe, identify, and/or explain:

1. The various physiological organ-systems and their importance to the integrative functions of the human body.
2. Understand Concept of energy requirements
3. Various aspects of Digestive physiology.
4 Circulatory system with medical conditions
5. Understand Respiratory mechanism and gases transport.
6. Eliminations of waste materials from the body.
7. Develop understanding in Structure and functions of muscles
8. Understand formation of gametes and function of endocrine glands.

Title & Contents	Number of lectures
1. Nutrition and digestion:	**5 L**
1.1 Nutritional requirement & balanced diet.	
1.2 Digestion and absorption of carbohydrates, proteins and lipids.	
1.3 Vitamins - outline of fat soluble and water-soluble vitamins; Sources, deficiency and diseases.	**5 L**
2. Respiration:	
2.1 Mechanism of respiration: Regulation of ventilation in lungs, exchange of gases at respiratory surface.	
2.2 Respiratory pigments in animals: Haemoglobin, Hemocyanin, Hemerythrin, Chlorocruorin.	
2.3 Transport of gases : O_2 and CO_2 transport.	**5 L**
3. Circulation:	
3.1 Blood: Definition and its constituents, functions of blood.	
3.2 Heart: Structure of human heart, Pace maker, Cardiac Cycle.	
3.3 Origin and conduction of heart beat.	**5 L**
4. Excretion:	
4.1 Structure of Uriniferous tubule.	
4.2 Mechanism of urine formation.	
4.3 Normal and abnormal constituents of urine, Elementary idea of dialysis.	**3 L**
5. Muscles:	
5.1 Structure of smooth, skeletal and cardiac muscles.	
5.2 Mechanism of muscle contraction by Sliding filament theory.	**7 L**
6. Reproduction and Endocrine Glands:	
6.1 Physiology of male reproduction, hormonal control of spermatogenesis.	
6.2 Physiology of female reproduction, hormonal control of menstrual cycle.	

6.3 Structure and functions of pituitary, thyroid, parathyroid, pancreas and adrenal glands.

Reference Books

1. Textbook of Medical Physiology, Guyton A. C. & Hall J. E., 2006, 11th Edition, Hercourt Asia Pvt. Ltd. / W. B. Saunders Company
2. Principles of Anatomy & Physiology, 2006, 11th Edition, Tortora G. J. & Grabowski S., Joh Wiley & sons, Inc.
3. Haematology: De Gruchi.
4. Human physiology, Vol. I & II, 1980, 12th Edn. Dr. C. C. Chatterjee, Medical Applied Agency, Kolkata
5. Text book of Animal Physiology, 2008, 2nd Edn. Nagabhushanam, S. V. S. Rana, S. Kalavathy, Oxford University Press, India.
6. Animal Physiology: Adaptation and Environment, 1997, Schmidt-Nielsen, Knut, Cambridge University Press.
7. General and Comparative Physiology, 1983, 3rd Edn., Hoar W. S., Prentice Hall, UK.7.
8. Medical Physiology, 2006, Asis Das, Books and Allied Pvt. Ltd., Kolkata.
9. Endocrinology, 2005, Lohar P. S., M J P Publishers, Chennai.
10. Vander, Sherman, Luciano's Human Physiology: The Mechanisms of Body Function, 2003, 9th Edn., Eric P. Widmaier, Hershel Raff, Kevin T. Strang, Mc Graw H.
11. Tortora, G. J. and Derrickson, B. H. (2009) Principles of Anatomy and Physiology (12th edition) John Wiley and Sons, Inc.
12. Widmaier, E. P., Raff, H. and Strang, K. T. (2008) Vander's Human Physiology (9th edition) McGraw Hill.
13. Human Anatomy and Physiology, (1998) Marieb, E. (4th edition) Addison-Wesley.
14. Experimental Physiology, (2007) Kesar, S. and Vashisht, N., Heritage Publishers.

Course Title: Molecular Biology
Course Code: ZO 363
Credits: 02

ZO 363 - Molecular Biology

Objectives:

1. The course aims to provide students with an introduction of the underlying molecular mechanisms of various biological processes in cells and organisms.
2. To understand the Structure of DNA and RNA, DNA and RNA as genetic material
3. To understand the Central Dogma of Molecular Biology
4. To understand the concept of gene regulation
5. To understand the DNA Damage and Repair
6. The course aims to develop basic understanding of structure-function relationships of nucleic acids and proteins.

Learning outcomes:

1. Learner shall get an insight into molecular mechanisms of various biological processes in cells and organisms
2. Learner shall get an insight into the Structure of DNA and RNA, DNA and RNA as genetic material
3. The course shall prepare learner to get insight into the Central Dogma of Molecular Biology

4. Learner shall also understand the concept of gene regulation
5. Learner shall get an insight into the DNA Damage and Repair

Title & Contents	Number of lectures
1. Nucleic Acids and Chromatin:	**7 L**
1.1 Structure of RNA & DNA.	
1.2 Types of RNA.	
1.3 DNA as genetic material - evidences (Griffith's, Avery *et al.*, Hershey and Chase experiment), RNA as genetic material - TMV 4.	
1.4 Structure of Chromatin, packaging of DNA, Heterochromatin, Euchromatin.	**15 L**
2. Central Dogma of Molecular Biology:	
2.1 **DNA Replication** - Semiconservative (Messelson and Stahl experiment), Basic mechanism of replication in prokaryotes and eukaryotes.	
2.2 **Transcription** -	
2.2.1 Basic mechanism of transcription in prokaryotes and eukaryotes, RNA polymerase enzyme in prokaryotes.	
2.2.2 RNA modifications and processing (splicing - mRNA, modifications at 3'and 5' end).	
2.3 **Translation** - Genetic code, properties of genetic code, Basic mechanism of Translation in *E. coli* and eukaryotic cells.	**1 L**
3. Lac operon:	**3 L**
4. DNA repair mechanism: Photo repair, dark repair, base excision repair.	**4 L**
5. Recombinant DNA Technology: Introduction, restriction enzymes, cloning vector, PCR (polymerase chain reaction), DNA finger printing.	

Reference Book:

1. Molecular biology of cell, 3rd and 4th edition, Albert's B. D. Lewis J. Raff M. Roberts K. and Watson.
2. Gene, Vol. V, VI, VII, VIII and IX, Lewin B., Oxford University Press, Oxford.
3. Molecular biology of the Gene, 1993, Watson J. Hopkins, Roberts Steitz & Weiner, Benjami Cummings.
4. Text Book of Molecular Biology, 1994, K. Sivrama Sastry G. Padmanabhan and C. Subramanyam : MacMillan, India.
5. Cell and Molecular biology, 1996, G. Karp, John Willey & Sons, U.S.A.

6. Principles of Genetics, 1997, P. D. Snustad, M. L. Smmons, J. B. & Jenkins, John Willey & Sons, U.S.A.
7. Cell and Molecular biology, De Robertis and De Robertis, 8th & 9th Edition, Saunders Publications.

Course Title: Entomology
Course Code: ZO 364
Credits: 02

ZO 364 - Entomology

Objectives:

1. To understand the scope of Entomology and general characters of Insects.
2. To study the morphology and anatomy of Insects.
3. To learn the concept of social organization in Insects.
4. To understand metamorphosis in Insects.
5. To study the economically important insects and Pest management of harmful insects.

Course outcomes:

At the end of this course, Students will -

1. Understand basic concepts in Entomology and its scope.
2. Learn morphology and anatomy of Insects.
3. Understand the concept of social organization in Insects.
4. Understand the development process of Insects.
5. Identify disease causing insect vectors.
6. Will be able to design and implement pest controlling methods against pests.

Title & Contents

	Number of lectures
1. Fundamentals of Entomology: 1.1 Definition and scope of Entomology. 1.2 General Classification of Insects. 1.3 General Characters of Insects.	2 L
2. Insect Morphology: 2.1 Insect Integument and its derivatives. 2.2 Insect Head, Head Orientations, Head articulations, Insect antennae and Mouth parts. 2.3 Insect Thorax, Insect Wing and modifications, Insect Leg and Modifications – a) Cursorial – Cockroach, b) Fossorial – Mole cricket, c) Saltorial – Grasshopper, d) Raptorial – Praying mantis, e) Pollen basket – Honey bee. 2.4 Insect Abdomen, Genital and Pre – genital appendages of Grasshopper.	7 L

3. Insect Anatomy (Grasshopper): 3.1 Digestive System. 3.2 Circulatory System. 3.3 Nervous System. 3.4 Respiratory System. 3.5 Reproductive System.	4 L 3 L
4. Insect Ecology: 4.1 Definition of Insect Ecology. 4.2 Abiotic Factors (Photoperiod, Temperature and Humidity) and Biotic Factors (Food, Foraging and Nesting). 4.3 Mimicry in insects with suitable examples.	2 L
5. Insect Metamorphosis: 5.1 Definition. 5.2 Types and examples of Metamorphosis.	6 L
6. Insects as social groups: 6.1 Definition & significance of Eusociality, Intraspecific and Interspecific relationships among insects. 6.2 Social organization in Wasps and Termites.	3 L
7. Economic Importance of Insects: 7.1 Insects in Research. 7.2 Insects in Medicines and Cosmetics. 7.3 Insects as Vectors. 7.4 Insects as food.	

References

1. Social Insects: Their Origin and Evolution, 2006, W. M. Wheeler, Discovery Publishing House, Delhi.
2. Lives of Social Insects, 1968, P. P. Larson, M. W. Larson, World Pub. Co.
3. Modern Entomology, 2nd edition - By D. B. Tembhare, Himalaya Publication House, Bombay.
4. Principles of Insect Morphology - By R. E. Snodgrass, Tata Mc-Graw Hill Bombay.
5. The Insect: Structure & Function - By R. F. Chapman, E. L. B. S., & E. U. P. London.
6. General Entomology, 2nd edition - By M. S. Mani Oxford & IBH Publishing Company, New Delhi.
7. A Text book of Entomology - By H. H. Ross, John Wiley and Sons, Ins. New York.
8. An Introduction to Entomology - By J. H. Comstock, Ithaca, New York.
9. General & Applied Entomology - By K. K. Nayar, T. N. Anathakrishnan & B.V. David, Tata McGraw-Hill, New Delhi.

Course Title: Techniques in Biology
Course Code: ZO 365
Credits: 02

ZO 365 - Techniques in Biology

Title & Contents	Number of lectures
1. Microscopy:	
1.1 Definitions - Resolving Power, Limit of Resolution and Magnification, Numerical Aperture.	3 L
1.2 Basic principle of microscopes - Light, Fluorescence, Phase Contrast, Stereo Microscope, SEM and TEM.	
2. Microtomy: Tissue fixation and Processing	
2.1 Methods of tissue fixation: Chemical fixation and physical fixation.	8 L
2.2 Procurement of tissue and importance of fixation of tissues.	
2.3 Dehydration, clearing, impregnation, embedding and block making.	
2.4 Types of microtomes.	
2.5 Section cutting: steps and precautions, common faults in section cutting, reasons & remedies.	
2.6 Mounting and spreading of ribbons.	
2.7 General procedure for staining of sections.	
2.8 Demonstration of Nucleic acid (Feulgen Reaction).	
3. Haematological Techniques:	
3.1 Total count of RBCs, WBCs and Differential count of WBCs and their significance.	2 L
3.2 Bleeding time, clotting time and their significance.	
4. Immunological Techniques:	
4.1 Antigen-Antibody Interactions – Immunodiffusion.	3 L
4.2 Principle & Working of ELISA.	
4.3 Raising Monoclonal Antibodies.	
4.4 Application of Immunological techniques in disease diagnosis.	
5. Types of PCR & DNA Barcoding :	
6. Methods in Biodiversity:	
6.1 Introduction to sampling and sample size.	2 L
6.2 Biodiversity Indices - Species richness, Simpson Diversity Index, Shannon Diversity Index.	4 L
6.3 Measuring Biodiversity- Quadrat sampling, Transect sampling, Insect survey - Active (sweep netting, aquatic nets) and Passive methodology (Pit fall traps, Light traps).	
7. Instruments in Field Biology:	
7.1 Binoculars, GPS, Basic digital camera techniques: Camera lens - prime	3 L

and kit lens, Aperture mode, Shutter mode, Megapixels, Telephoto lens, macro lens.

7.2 Adapters for camera and microscopes, Mobile's camera. 3 L

8. Laboratory techniques:

8.1 Microphotographic techniques - CCD and CMOS camera, digital camera.

8.2 Software for image analysis - Image J and GIMP.

References:

1. *Welch*, P. S. 1948. *Limnological* Methods. Blakiston Philadelphia. 381 pp.
2. Wetzel, R. G. 1983. *Limnology*. 2nd Ed. Saunders Coll. Philadelphia.
3. Wilson, E. O. (1992). *The Diversity of Life*. Cambridge, Mass, Belknap Press of Harvard University Press.
4. Krebs C. J., 2009. Ecology. Benjamin-Cummings Publishing Company or Pearson International Edition
5. Eugene P. Odum and Gary W. Barrett. Fundamentals of Ecology Brooks / Cole; 5th Revised edition.
6. Suzanne Bell, Keith Morris. An Introduction to Microscopy. CRC press.
7. *Kato*, M. The Biology of Biodiversity. Springer.
8. Robert Smith and Thomas M. Smith Ecology and Field Biology.
9. Bikram Grewal *et al.*, A Photographic Field Guide to the Birds of India, Pakistan, Nepal, Bhutan, Sri Lanka, and Bangladesh. Princeton University Press.

Course Title: Evolutionary Biology
Course Code: ZO 366
Credits: 02

ZO 366 - Evolutionary Biology

Objectives:

1. To provide comprehensive overview of Concept of Evolution.
2. To explain Origin of Life especially Prokaryotes as well as Eukaryotes in detail.
3. To explore salient features of various theories of evolution comprising of Lamarckism, Darwinism and Neo-Darwinism.
4. To impart detailed understanding of Analogy, Homology, Paleontological Evidences, Embryological Evidences and Molecular Phylogeny.
5. To provide adequate information about Geological Time Scale and Neutral Theory of Molecular Evolution.
6. To develop comprehensive knowledge regarding various Sources of Variations and their role in evolution.
7. To give detailed explanation of key concepts of Population Genetics in terms of Hardy-Weinberg Law, Genetic Drift and Types of Natural Selection.
8. To provide adequate knowledge about Micro-evolutionary changes, Speciation and Adaptive Radiation.
9. To give detailed outline of Extinctions and its types.
10. To impart descriptive knowledge regarding Origin and Evolution of Man.

11. To provide glimpse of Phylogenetic Trees and highlight their construction along with interpretation.

Learning outcomes

After completing the course, the student should be able to

1. Students will be able to learn most of the essential aspects of Evolutionary Biology in detail which will help them in acquiring better understanding regarding the subject.
2. Explain important processes, principles and concepts and critically evaluate theories and empirical research within evolutionary biology
3. Apply evolutionary theory and concepts to address empirical and theoretical questions in evolutionary biology.
4. Independently investigate evolutionary questions using literature and analyses of empirical data.
5. Communicate the principles, theories, problems and research results associated with questions that lie within the evolutionary framework to students

Title & Contents **Number of lectures**

1. Introduction: **4 L**
1.1 Concept of Evolution.
1.2 Origin of life.
1.3 Origin of eukaryotic cell (Origin of mitochondria, plastids & symbionts).

2. Evidences of Evolution: **5 L**
2.1 Analogy and Homology.
2.2 Embryological Evidences of Evolution.
2.3 Evolutionary & Paleontological Evidences.

3. Historical Review of Evolutionary Concept: **3 L**
3.1 Theories of Evolution.
3.2 Lamarckism.
3.3 Darwinism and Neo Darwinism.
3.4 Mutation Theory.
3.5 Modern Synthetic theory.

4. Sources of Variations: **4 L**
4.1 Variation and Mutations.

5. Isolation **5 L**

6. Speciation: **4 L**
6.1 Types of speciation (Allopatric & Sympatric).
6.2 Mechanism of speciation.
6.3 Patterns of speciation.
6.4 Factors influencing speciation.

7 Population Genetics: **2 L**
7.1 Hardy-Weinberg Law & Genetic Drift.
7.2 Types of Natural Selection. **4 L**

8 Origin of Man:
8.1 Evolution of Man (Evolution of anthropoids including man) - Kenyapithecus to *Homo sapiens*. **2 L**

9 Zoogeographical Realms With reference to fauna: **2 L**

10 Extinctions:
10.1 Extinction - An Overview.

Reference Books

1. Mark Ridley. Evolution. 3rd Edition. Blackwell Publishing. (2004).
2. Mathur, Tomar, Singh. Evolution and Behaviour. Rastogi Publication, Merrut.
3. Mohan P. Arora. Evolutionary Biology, Himalaya Publishing House, Bombay.
4. P. S. Vermin and V. K. Agarwal. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Revised Edition. S. Chand Publication (2004).
5. Strickberger. Evolution. Prentic Hall. (2002).
6. Theodore H., Jr Eaton. Evolution. 1st Edition. W. W. Norton Publication. (1970).
7. Organic Evolution, Richard Swann Lull, Light & Life Publishers.
8. Introductions to Evolution, Paul Amos Moody, Kalyani Publishers, New Delhi.
9. Organic Evolution, 1991 T.S. Gopal krishanan, Itta Sambashivarab Publ. House.
10. Evolutionary Biology, 1990, Mohan P. Arora, Himalaya Publi. House, Delhi.
11. Evolution, 1968, E. O. Dodson, Reinhold Publ. Crop., New York.
12. The major features of evolution, 1953, Simpson G. G. Columbia, New York.
13. The origin of species, 1959, Charles Darwin, New American Library, New York.

Course Title: Environmental Impact Assessment
Course Code: ZO 3610
Credits: 02

ZO 3610 - Environmental Impact Assessment

Title & Contents **Number of lectures**

1. Environment: **2 L**
1.1 Definition.
1.2 Divisions.
1.3 Importance. **3 L**

2. Pollution:
2.1 Definition and types.
2.2 Impact on wildlife, natural resources, development. **2 L**

3. Sustainable development:

3.1 Definition and need.
3.2 Exploitation of natural resources.
3.3 Concept of carrying capacity.
3.4 Three pillars of Sustainability.
3.5 UN 17 Sustainable Development Goals (SDGs).

4. **Overview of Environmental Protection acts:** **5 L**
4.1 The Air (Prevention and Control of Pollution) Act 1981.
4.2 The Water (Prevention and Control of Pollution) Act 1974.
4.3 The Environment Protection Act 1986.
4.4 The National Green Tribunal Act 2010.
4.5 Biological Diversity Act 2002.

5. **Environmental Impact Assessment (EIA):** **5 L**
5.1 Definition, need and importance of EIA.
5.2 EIA notification 2006 - key elements, History and Evolution of EIA.
5.3 Categories of Industries / establishments requiring EIA, Types of EIA - strategic EIA, regional EIA, sectoral EIA, project level EIA and life cycle assessment.
5.4 Rapid and comprehensive EIA.

6. **EIA Process:** **5 L**
6.1 Screening, Scoping and consideration of alternatives.
6.2 Baseline data collection, Impact analysis, Mitigation, Reporting, Public hearing.
6.3 Review of EIA.
6.4 Decision-making, monitoring clearance conditions.

7. **Stakeholders in EIA process:** **3 L**
7.1 Project proponent, Environmental consultant.
7.2 CPCB / MPCB.
7.3 Public, EIA agency (IAA).

8. **Overview of Scheme for Accreditation of EIA Consultant Organizations (NABET / QCI):** **5 L**
8.1 Eligibility and benefits.
8.2 EIA coordinator (EC), Functional area experts (FAEs).
8.3 Functional area associate (FAA) and team members: Role, educational qualification, experience and functions.

References:

1. Glasson, J., Therivel, R. (2019) Introduction to Environmental Impact Assessment. Routledge. London.
2. Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science.
3. Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGraw-Hill, New York, USA.

Course Title: Project
Course Code: ZO 3611
Credits: 02

ZO 3611 - Project

Students have to complete the research project in the stipulated time and present the dissertation at the time of the examination in a proper format. Students should be encouraged to take up laboratory work, hands-on practical investigation and design experimental setup. Field work to be carried out under proper supervision and permissions from the concerned authorities.

Possible key aspects of the project work -

1. Planning the project
2. Selecting a suitable title
3. Significance of the work
4. Hypothesis, Objectives
5. Reviewing the available literature
6. Methodology to be used
7. Outcomes of the Project work
8. Conclusion and Discussion
9. Future plans

Students should be made aware of plagiarism and research ethics.

Course Title: Zoology Practical Paper - I
Course Code: ZO 367
Credits: 02

ZO 367 - Zoology Practical Paper - I

Section I: Practicals in Medical & Forensic Zoology 2 (E)

1. To carry out routine analysis of given urine sample for -
   i. Physical Properties: Volume, Colour, pH, Turbidity, Specific gravity.
   ii. Chemical Properties: Sugars, Protein, Bile salts & bile pigments, Ketone bodies, Blood. (C) E
2. Determination of serum urea. E
3. Determination of serum uric acid. E
4. Determination of serum Calcium. (C) E
5. To examine human hair for cortex and medulla. (C) E
6. To examine hair morphology and determine the species to which the hair belongs. E
7. To prepare slides of scale pattern of human hair. (C) E
8. To Visit a Forensic Laboratory and submission of the report. E
9. To Identify and differentiate various types of Finger prints. (C) E

10. To prepare a case report on forensic entomology with respect to insect's succession and its relationship to determine time since death. E

Section II: Practicals in Animal Physiology

1. Haemoglobin estimation using Sahli's haemoglobinometer. (C) E
2. Preparation of haemin and haemochromogen crystals. (C) E
3. To estimate the blood glucose level from given sample. (C) E
4. Estimation of bleeding and clotting time. (C) E
5. Study of disorders caused by endocrine glands with the help of photographs. D
6. Detection of blood groups in human being. E
7. Differential count of blood. E
8. Estimation of haemoglobin percentage with the help of haemometer. E
9. Qualitative detection of nitrogenous waste products (Ammonia, urea, uric acid) in given sample. (C) E
10. Demonstration of kymograph unit, Respirometer through available resources. D
11. Measurement of lung capacity. E

Course Title: Zoology Practical Paper - II
Course Code: ZO 368
Credits: 02

ZO 368 - Zoology Practical Paper - II

Section I: Practicals in Molecular Biology

1. Lab safety techniques & sterilisation. D
2. Preparation of DNA paper model and study its characteristics. E
3. Staining of DNA and RNA by methyl green – pyronin. (C) E
4. Estimation of DNA by Diphenylamine method. (C) E
5. Estimation of RNA by Bial's Orcinol method. E
6. Isolation of DNA from Bacteria / liver / Onion. (C) – 2 P E
7. Absorption spectra of DNA isolated from Bacteria / Liver / Onion. (C) E
8. Principle & application of Spectrophotometer & PCR. D

Section II - Practicals in Entomology

1. Study of external characters of any Insect (Grasshopper / Cockroach / Plant bug). E
2. Study of Insect Head, its articulations and types of mouthparts and their modifications. D
3. Study of Insect Legs, wing and their modifications. D
4. Study of Digestive system of any locally available insect pest. (C) E

5. Study of Reproductive system of any locally available insect pest. (C) E
6. Study of Social organization in Termites and Honey Bees. D
7. Study of Insect egg, larva, pupa and their types. D
8. Study of Insect vectors - Mosquito, House fly, Cockroaches, Bugs. E
9. Temporary mountings of Mouthparts, Antennae, Legs and Wings of any locally available insect pest. (C) E
10. Study of Preservation of Insect pest by using spreading techniques & submission of any five insect pests / vectors. (C) E
11. Compulsory field visit to a Wildlife Sanctuary / National Park / Tiger Reserve / to study the Insect diversity – 2P. E

Course Title: Zoology Practical Paper – III
Course Code: ZO 369
Credits: 02

ZO 369 - Zoology Practical Paper III

Section I: Practicals of Techniques in Biology

1. Compound and Stereo microscope: Components, usage and maintenance. D
2. To observe different kind of cells under compound microscope and its measurement using micrometer scale or by image analysis software (Ex. Image J). (C) E
3. Tissue collection, fixation & Block preparation. (C) E
4. Sectioning, staining & mounting. Submission of any three permanent slides from three different organs. (C) D
5. To study population density and percentage frequency of different animal / insect species of a given area. D
6. Calculating the different alpha and beta biodiversity indices of different animal /insect species of a given area. E
7. Survey for insects using pit fall trap and light traps in your college campus / agriculture field. D
8. Use of photography (Mobile camera / DSLR) in scientific documentation of at least 5 species of insects / birds/ mammals. E
9. Visit to a water body / forest to study faunal biodiversity using field equipment – (C) 2P E
10. Study of Principle & working of PCR & DNA Barcoding – 2 P E

Section II - Practicals in Evolutionary Biology

1. Study of morphological similarities and differences between man and ape	(C)	D
2. Study of types of fossils with the help of specimens/ charts/ photos	(C)	D
3. Study of animal adaptations in: Turtle, Draco, Exocoetus, Bat and Parrot	(C)	D
4. Study of evidences of evolution- embryological, paleontological, connecting links, morphology and comparative anatomy.	(C)	E
5. Study of successive stages of evolution of man : a) Australopithecus b) *Homo erectus* c) *Homo neanderthalis* d) Cro-Magnon man e) *Homo sapiens.*	(C)	D
6. To record Zoogeographical distribution of animals to respective zoogeographical Realms on the world map (Lung fishes, marsupials, flightless birds, Camel, Elephant, Ostrich etc.).	(C)	E

Savitribai Phule Pune University

(Formerly University of Pune)

Two Year Degree Program in Zoology

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. (Zoology) Part-I

(for Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2019-2020

Following is the syllabus of each course along with the course outcomes:

Course Code and Course Name:

ZOUT 111 Biochemistry and Biochemical Techniques. (4 Credits: 60 Lectures)

Semester I

After successfully completing this course, students will be able to:

CO1: Define basic terms in biochemistry and biochemical techniques.

CO2: Explain the applications of the various biochemical techniques.

CO3: Explain the structure and functions of various biomolecules.

CO4: Explain the importance of tools and techniques in biology.

CO5: Illustrate the importance of pH, buffer and water in living systems.

CO6: Illustrate the principle, working and applications of basic techniques used in biology.

CO7:Draw the structures of various carbohydrates and amino acids.

CO8: Classify enzymes with examples.

Biochemical techniques:

CO1: Explain the importance and applications of techniques in biochemistry.

CO2: Explain theprinciple and applications of various chromatographic techniques with examples.

CO3: Explain the principle, working, materials used and applications of electrophoresis.

CO4: Describe the concept of light, electromagnetic spectrum and its application in absorption spectroscopy.

CO5: Illustrate the importance of radioactive compounds and radioactivity in biology.

CO6: Demonstrate the principle and working of Warburg's apparatus.

CO7: Demonstrate the principle, working, applications of centrifugation.

CO8: Justify the applications of radioactivity compounds in biology.

CO9: Compare the various separation techniques.

Sr. No.	Name of the topic	Lectures allotted
	Biochemistry:	
1.	**Basics of chemistry**- Structure of atoms, molecules and chemical bonds, Normality, molarity, molality	(02L)
2.	**Chemistry of Water** : Structure of water and physicochemical properties of water, water as universal solvent, pH and Buffers, Biological Buffer System	(04L)
3.	**Carbohydrates:** Classification, basic Structures and functions, Biological Significance.	(03L)
4.	**Lipids:** Classification, structure and function and biological significance.	(03L)
5.	**Vitamins:** Classification- water-soluble and fat-soluble vitamins, Biological significance.	(02L)
6.	**Amino acids:** Classification, properties (Physical properties- Optical Isomerization, Absorption in UV light, Ionization; Chemical properties- Reactions with carboxyl group and amino group)	(05L)
7.	**Proteins:** **a.** Peptide bond formation, Ramachandran plot. b. Protein structure:-Primary structure, Secondary structure, Tertiary structure and Quaternary structures with examples, Biological significance of proteins.	(09L)
8.	**Enzymes:** a. Classification, nomenclature and properties b. Enzyme kinetics -one substrate reaction (Michaelis-Menten Equation) c. Factors affecting enzyme activity d. Enzyme inhibition e. Allosteric Enzymes. f. Isozymes (LDH) and coenzymes g. Clinical and industrial significance- Any 3	
	Biochemical Techniques:	
1.	**Chromatography:** Principle, working and applications of: Adsorption chromatography Partition chromatography, Ion-exchange chromatography, Molecular exclusion chromatography, Affinity chromatography,Gas chromatography, High Performance Liquid Chromatography.	(8L)

2. **Electrophoresis:** Moving boundary electrophoresis, zone electrophoresis, different supports used for electrophoresis, electrophoresis of proteins, electrophoresis of Nucleic acids, isoelectric focussing. **(5L)**

3. **Absorption spectroscopy:** Concepts of light & electromagnetic spectrum, Ultraviolet and Visible spectrophotometry, atomic absorption spectrometry and applications. **(5L)**

4. **Radioactivity:** Properties of radioisotopes, commonly used isotopes, structure & working of G.M, counter, isotopic dilution analysis, use of isotopes in biology, radiation hazards. **(3L)**

6. **Manometry:** Respiratory quotient determination, Principle of Warburg's apparatus, working and applications. **(2L)**

7. **Methods for protein sequencing.** **(4L)**

N-terminal sequencing

C-terminal sequencing.

Methods for DNA sequencing.

Maxam- Gilbert Sequencing

Chain termination method

Dye terminator sequencing

8. **Centrifugation:** Principle, Types of centrifugation- Preparative and Analytical.applications of centrifugation. **(3L)**

REFERENCE BOOKS:

1.Biochemistry, 3rd Ed. (2005), Voet Donald and Voet Judith G. John, Publisher: Wiley & sons, New York.

2.Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, StryerLubert, Publisher: W. H. Freeman, New York.

3.Lehninger's Principles of Biochemistry, 4th edition, (2005) Nelson D. L. and Cox M. M. W. H. Freeman & Co. NY.

4.Biochemical Calculations, 2nd Ed., (1997) Segel Irvin H., Publisher: John Wiley and Sons, New York.

5.Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.

6.Biochemistry, Geoffrey Zubay, William C Brown Pub; 4th edition (June 1999)

7.Principles and Techniques of Biochemistry and Molecular Biology, 6th edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.

8.Light Microscopy in Biology: A Practical Approach, 2nd edition (1999), Alan J. Lacey, Publisher–Oxford University Press.

9.Electron Microscopy: Principles and Techniques for Biologists, (1992), Lonnie D. Russell, Publisher-Jones & Bartlett

Course Code and Course Name:

ZOUT 112 Cell Biology and Developmental Biology(4 Credit: 60 Lecture)

Semester I

After successfully completing this course, students will be able to:

Cell Biology:

CO1: Label the various cell parts

CO2: Sketch and label various types of cells and cell organelles.

CO3: Explain carbon as backbone of biomolecules.

CO4: Explain the ultrastructure and functions of various cell organelles.

CO5: Explain the concepts of cell signalling.

CO6: Illustrate the chemistry and organization of cytoskeleton.

CO7: Illustrate the types, development and causes of tumor.

CO8: Diagrammatically represent the cell cycle phases and its regulation.

Developmental Biology:

CO1: Define the terms in developmental biology

CO2: Explain the significance of model organism for developmental studies.

CO3: Explain the types of eggs, concept of fertilization and cleavage pattern.

CO4: Explain the concept of mesoderm induction and pattern formation with examples.

CO5: Describe neural competence and induction.

CO6: Explain the concept of growth and differentiation.

CO7: Illustrate postembryonic development.

CO8: Compare and contrast spermatogenesis and oogenesis.

Sr. No.	Name of the topic	Lectures allotted
1.	Cell theory, general organisation of cell and characteristics of living systems.	(02L)
2.	Overview of chemical nature of the cell and importance of carbon in biologically important molecules.	(02L)
3.	Plasma membrane: Ultrastructure, membrane proteins; membrane transport – channels, carriers and pumps; membrane potential and synaptic transmission.	(04L)
4.	Endomembrane system: (Endoplasmic reticulum, Golgi complex, Lysosomes); protein trafficking – secretory and endocytic pathways.	(04L)
5.	Mitochondria: Structure, genetic system, functions; protein import	(03L)
6.	Nucleus: Ultrastructure – nuclear envelope, nuclear lamina, nuclear pore complex, nucleolus.	(03L)
7.	Cell Cycle: Phases, check points, mechanism of regulation; regulators of cell cycle progression – MPF, cyclins and cyclin dependent kinases (CDKs).	(03L)
8.	Cytoskeleton: Types, chemistry, organisation, associated proteins and their role.	(03L)
9.	Cancer: Types, development, causes; characteristics of cancer cell, tumour viruses, oncogene and tumour suppresser gene.	(03L)
10.	Cell signalling: Signalling molecules and their receptors, cell surface receptors,significance of cell signalling.	(03L)
	Developmental Biology:	
1.	**Introduction to developmental biology:** Early theories of Developmental biology Concepts of Developmental biology – Growth, cell division, cell differentiation, cell communication, signalling, patterning, induction and competence.	(3L)
2.	**Model Organisms:** Invertebrate: *Drosophila melanogaster,* Pisces: Zebra Fish- *Danio rerio*, Amphibians: *Xenopuslaevis,* Birds: Chicken, Mammals: Mouse.	(3L)
3.	**Gametogenesis:** Spermatogenesis: spermatogenesis, structure of sperm, regulation of sperm motility, Oogenesis: structure of ovum, previtellogenesis, vitellogenesis and post-vitellogenesis	(2L)
4.	**Fertilization:**: Concept of fertilization, types of fertilization, Species specific sperm attraction, recognition of egg & sperm, acrosome reaction, signal transduction, molecular strategy to avoid polyspermy in fertilization	(4L)

5. **Types of eggs:** Based on amount of distribution of yolk, Cleavage: types and significance. **(2L)**

6. **Morphogenesis:** Blastulation: Amphiouxus, Frog, Chick, Mid Blastula Transition, **(5L)**
Comparative study of Gastrulation in Amphioxus, Frog, Chick
Neurulation: Frog, Chick
Organogenesis: Development of the vertebrate eye –formation of eye field, cell differentiation

7. **Pattern formation: Setting up the body axis** **(4L)**
   1. Animal vegetal axis: Amphibians,
   2. Dorsal ventral axis: Amphibians
   3. Antero-posterior axis: *Drosophila*-role of bicoidnanos hunchback.

8. **Organizers:** **(2L)**
Spemann and Mangold: Primary embryonic induction, Functions of organizer, Molecular mechanisms of Amphibian axis formation **(3L)**

9. **Regeneration:**
Limb regeneration: Salamander, Regeneration in Hydra **(2L)**

10. Apoptosis, aging and senescence.

REFERENCE BOOKS:

1. Karp Gerald (2010) *Cell Biology*. 6th Edition, John Willey & Sons (Asia) Pte. Ltd.
2. Cooper Geoffrey M. (1997) *The Cell: A Molecular Approach*. ASM Press, Washington D.C., U.S.A.
3. Sadava David E. (1993) *Cell Biology – Organelle Structure and Function*. Jones &Barlett Publishers, Boston, London.
4. Hardin Jeff, Gregory Bertoni and Lewis J. Kleinsmith (2012) *World of the Cell*. 8th Edition, Pearson Education, Inc., San Francisco, U.S.A.
5. Alberts B., A. Johnson, J. Lewis, M. Raff, K. Roberts and P. Walter (2008) *Molecular Biology of the Cell*. 5th Edition, Garland Science, New York, U.S.A.
6. Lodish H., D. Baltimore, A. Berk, L. Zipursky, M. Matsudaira and J. Darnell (1995) *Molecular Cell Biology*. Eds. 3, Scientific American &

W. H. Freeman, New York.

7. De Robertis E. D. P. and De Robertis E. M. E. (1987) *Cell and Molecular Biology*. 8th Edition, Lea and Febiger, Philadelphia.
8. Loewy A. G., P. Siekevitz, J. R. Menninger and J. A. N. Gallant (1991) *Cell Structure & Function*. Saunders College Publishing, U.S.A.
9. Nelson D. L. and Cox M. M. (2008) *Lehninger Principles of Biochemistry*. 5th Edition, W. H. Freeman & Co. NY.
10. *Developmental Biology*, 9th edition (2010), S.F. Gilbert. Publisher – Sinauer,Associates Inc.
11. *Principles of Development*, 3rd edition (2007), Lewis Wolpert, Publisher- Oxford,University Press.
12. *An Introduction to Embryology*, 5th edition (2004), B. I. Balinsky. Publisher – ThomasAsia Pvt. Ltd.
13. *Developmental Biology*, (2001), R. M. Twyman, Publisher - Bios Scientific, Publishers LTD.
14. Analysis of Biological Development , 2000, Klaus Kalthoff, McGraw-Hill Science/Engineering/Math; 2nd Ed edition.

Course Code and Course Name: **(4 Credit: 60 Lecture)**

ZOUT 113 Genetics and English in Scientific Communication.

Semester I

After successfully completing this course, students will be able to:

Genetics:

CO1: Define the basic terminologies in genetics.

CO2: Identify genetic disorders based on Karyotypes and traits.

CO3: Explain the concept of Mendelian genetics, gene, gene regulation and multiple alleles.

CO4: Discuss Linkage and crossing with their types and significance.

CO5: Explain the principles of Population genetics.

CO6: Illustrate the modified Mendelian laws of inheritance.

CO7: Justify the inheritance of qualitative and quantitative traits.

CO8: Solve the problems based on gene frequency.

English in Scientific Communication:

CO1: Write the outline of a scientific paper.

CO2: Write the title, abstract, discussion and citations of a given scientific article.

CO3: Prepare a scientific presentation using PowerPoint.

CO4: Explain language as a tool for effective scientific communication.

CO5: Use the formal elements of specific types of scientific writing.

CO6: Critically analyze data from research; incorporate it into assigned writing clearly, concisely, and logically; and attribute the source with proper citation.

CO7: Practice the unique qualities of professional rhetoric and writing style, such as sentence conciseness, clarity, accuracy, honesty, avoiding wordiness or ambiguity, using direct order organization, readability, coherence and transitional devices.

CO8: Justify the importance of plagiarism check and Proof-read given article.

Sr. No.	Name of the topic	Lectures allotted
1.	Recapitulation of Mendelian principles; Practical applications of genetics in brief	(02L)
2.	Classical concept of a gene:Allele, pseudoalleles, multiple alleles (blood groups)	(02L)
3.	Gene interactions and epistasis and their types.	(02L)
4.	Linkage and crossing over: Linkage, linkage groups, types of crossing over, sex linkage, sex limited and sex influenced characters, Recombination,recombination maps in diploids for 2 point and 3 point test cross, (determination of gene order with suitable examples)	(06L)
5.	Quantitative genetics : Polygenic inheritance, heritability and its measurementsand Quantitative Traits Locus mapping	(03L)
6.	Principles of Population Genetics: Hardy-Weinberg law and its application for autosomal genes. Calculations of gene frequencies with suitable examples.	(05L)
7.	Somatic cell genetics and its applications.	(02L)
8.	Microbial genetics : Methods of genetic transfers – transformation, conjugation, transduction	(03L)

9. Extra chromosomal inheritance:Inheritance of Mitochondria. **(01L)**

10. Human genetics: dominant and recessive disorders, physical traits. **(04L)**

English in Scientific Communication:

1. Language as a communication tool; relationship among reading, writing, listening and speaking **(2L)**

2. Pragmatic competence:co-operative principles and politeness principles **(1L)**

3. Organisation of English language: sentence structure, basic grammar, sequence and tenses, syntax, paragraphs, paraphrases and précis writing, synonyms and antonyms **(3L)**

4. Common errors in written and spoken English: tautology, double negative, double positive, superfluous words **(2L)**

5. Oral presentation: How to prepare a presentation, power point slides, use of communication and IT, voice, speed of delivery, obstacles in effective communication **(2L)**

6. Drafting of a researchproject for financial assistance from funding agency, writing of scientific paper using word processor. **(2L)**

7. Outline of a scientific research paper: **(14L)**

7.1Hypothesis, theory and concept

7.2Title designing, framing Abstract and Keywords

7.3 Introduction: statement of the problem and justification; aim, objectives, need, significance and rationale of the study, review of literature.

7.4Materials and Methods: contents, importance of measurements, reproducibility etc.

7.5Observations and Results: text and data presentation, tables, graphs, histograms, diagrams, photographic plates, legends and captions

7.6Discussion: logical sequence and critical analysis of ideas and evidences, data conclusion

7.7 References: finding references from journals, books and databases; Citation - styles of citations

7.8Summary, Acknowledgements

8. Editing and correcting: proof-reading symbols, jargons and abbreviations **(3L)**

9. Plagiarism: meaning, types, avoiding plagiarism. **(1L)**

REFERENCE BOOKS:

1. Genetics, 3Rd Edn by Strickberger, Pearson India, 2015, Paperback, 9789332555105
2. Principles of Genetics,Gardner, E.J., Peter & Simmons, M.J. and Snustad, D.P. 8thEdn.John Wiley and Sons, New York, 2006.
3. Concepts of Genetics. William S Klug and Michael R Cummings. 10thEdn. Pearson Education India, 2016.
4. Lewin, Benjamin. Genes IX. John Wiley and Sons, New York,2008.
5. Genetics By Verma,PS. And Agrawal, VK., S.Chand and Co.,New Delhi
6. Genetics By Gupta, PK., Rastogi Publication, Meerut
7. Genetics By Sarin,C., Tata McGraw Hill,New Delhi
8. Genetics: Daniel J Fairbanks, W. Ralph Andersen; Brooks / Cole Publ. co. (1999).
9. iGenetics: A Molecular Approach, 3rdEdn by Peter J Russell, Pearson India, 2016, Paperback, 9789332571624
10. O'Conner M. and F. P. Woodford (1975) Writing Scientific Papers in English. Elsevier-ExcerptaMedica-North Holland Publ., Amsterdam.
11. Trelease S. F. (1958) How to Write Scientific and Technical Papers. Williams and Wilkins Co. Baltimore, U.S.A.
12. Day Robert (1996) How to Write and Publish a Scientific Paper. Cambridge University Press.
13. McMillan V. (1997) Writing Papers in the Biological Sciences. Edn. 2, W. H. Freeman, New York.
14. Winkler Anthony C. and Jo Ray McCuen-Metherell (2008) Writing the Research Paper, A Handbook. 7th Edition, Wadsworth Cengage Learning, Boston, M.A., U.S.A.
15. Vijayalakshmi G. and C. Sivapragasam (2008) Research Methods – Tip & Techniques. M.J.P. Publishers, Chennai.
16. *Kothari C. R. (2009) Research Methodology: Methods & Techniques.* 2nd Revised Edition, New Age International Publishers, New Delhi.
17. Levinson Stephen C. (2003) Pragmatics. Cambridge University Press, Cambridge.
18. Yule George (2012)Pragmatics (Oxford Introduction to Language Study

Sr. No.	Name of the topic	Lectures allotted
1.	**Introduction:** 1.1 Applications and Uses of Statistics 1.2 Population & sample, Different types of Sample 1.3 Exercise & Problems.	(02L) (3L)
2.	**Data Classification:** 2.1 Some important terms (Class frequency, class- limits, Class-width, class mark) 2.2Frequency distribution, Cumulative frequency, Graphical representation of data (Histogram, Pie-Diagram, Ogive-Curve.) 2.3 Exercise & Problems	(3L)
3.	**Measures of central tendency:** 3.1 Concept of central tendency, Types of central tendency (Arithmetic mean, Median and mode) combined mean. 3.2 Partition values (Quartiles, Deciles, and Percentiles), Box plot. 3.3 Exercise & Problems.	(4L)
4.	**Measures of dispersion:** 4.1 Concept of dispersion, absolute and relative measure of dispersion. 4.2 Different measures of dispersion (Range, Quartile- Deviation, Variance and standard-deviation, Coefficient of Variation) combined variance 4.3 Exercise & Problems.	(5L)
5.	**Correlation and Regression:** 5.1 Bivariate data, concept of correlation, Types of Correlation, Scatter diagram, Karl Pearson's coefficient of correlation and its properties. 5.2 Concept of regression, Linear regression, regression Coefficients and its properties. 5.3 Exercise & Problems.	(5L)
6.	**Probability and probability distribution:** 6.1 Some important terms (types of experiment, sample Space and types of sample space, events and types of events.) 6.2 Definition of probability (mathematical and classical) Conditional	

probability. Concept of random variable Univariate Probability Distribution and its mathematical expectation.

6.3 Some standard probability distributions (binomial, Poisson and normal) their probability distribution, mean, variance, and properties of these distribution.

6.4 Exercise & Problems. **(8L)**

7. **Test of hypothesis:**

7.1 Some important terms (hypothesis, types of hypothesis, Test, Critical region, acceptance region, type I error, type II error, level of significance, p-value)

7.2 Test for mean and equality of two population means, Test for proportion and equality of two population proportions.

7.3 chi-square test for goodness of fit, Unpaired and paired t test. F test for equality of two population variances.

7.4 Software used for Statistical analysis

7.5 Exercise & Problems.

Course Code and Course Name: **(2 Credits- 60 Hours)**

ZODP 114 Practical Biostatistics.

Semester I

After successfully completing this course, students will be able to:

CO1: Construct frequency distribution chart.

CO2: Graphically represent the given data.

CO3: Solve the statistical problems based on Central Tendency, Dispersion, Correlation andregression.

CO4: Apply computer software for statistical analysis.

CO5: Solve numerical problems on test of hypothesis using biological data.

CO5: Illustrate the physicochemical properties of water.

CO6: Demonstrate the effect of pollutants on freshwater bodies

CO7: Justify the presence of zooplanktons and aquatics forms in freshwater bodies.

Sr. No.	Name of the topic	Lectures allotted
1.	Introduction to freshwater habitats. Lotic habitat: Major rivers in India Lentic habitat: Lakes, ponds, wetlands and ephemeral water bodies. Thermal stratification in lakes.	(02L)
2.	Physico-chemical conditions of freshwater and its implications on freshwater biota. Physical conditions: Water current, water colour, turbidity and temperature. Chemical conditions : pH, carbon dioxide, dissolved oxygen, hardness, acidity and alkalinity, nitrate, phosphate and sulphates.	(7L)
3.	General characters of plankton with special emphasis on the characters used in taxonomy and reproduction: Rotifera, Copepoda, Cladocera and Ostracoda.	(4L)
4.	Introduction to minor phyla: Gastrotricha, Bryozoa and Tardigrada (water bears).	(2L)
5.	Diversity and economic importance of freshwater Crustacea and Mollusca.	(2L)
6.	Locomotory and respiratory adaptation in freshwater insect orders: Ephemeroptera,Odonata, Plecoptera, Coleoptera, Diptera and Hemiptera. .	(2L)
7.	Diversity and distribution of vertebrates in the freshwater bodies of India. (Excluding fishes)	(6L)
8.	Adaptive physiology of freshwater fauna: Osmotic and ionic, thermal, respiratory, reproductive and life cycle, mechanical, locomotory and sensory adaptations.	(3L)
9.	Anthropogenic impact on freshwater: Waste and pollution, sewage and silage, mining waste, agricultural chemicals, industrial outflows and invasions. Eutrophication : Causes and problems.	

Course Code and Course Name:

ZODP 114 Practical Freshwater Zoology. **(2 Credits = 60 lectures.)**

Semester I

After successfully completing this course, students will be able to:

CO1: Identify commercially important freshwater fish.

CO2: Identify the aquatic adaptations in common freshwater forms.

CO3: Prepare the culture of *Paramecium* and *Daphnia.*

CO4: Estimate the hardness and chloride content in water samples.

CO5: Analyze the Zooplanktons from local freshwater bodies.

CO6: Evaluate the bio-indicators of pollution in freshwater.

Sr. No.	ZODP 114 Practical Freshwater Zoology	No. of Practicals
1.	Estimation of total carbon dioxide and chloride form given water sample.	(1P)
2.	Estimation of phosphates forms given water sample.	(1P)
3.	Estimation of total nitrate from given water sample.	(1P)
4.	Estimation of calcium and total hardness of given water sample.	(1P)
5.	Estimation of total alkalinity of given water sample.	(1P)
6.	Collection, preservation and identification of zooplankton from freshwater habitat. (Prepare permanent slides and Identify up to genus level using taxonomic key).	(2P)
7.	A qualitative and quantitative analysis of zooplankton from a given freshwater sample using Lackey's drop count method/ Sedgwick rafter counting cell.	(1P)
8.	Identification of economically important freshwater crustaceans and fishes.	(1P)
9.	Study of locomotory and respiratory adaptations in aquatic insects and larvae (*Ranatra, Notonecta, Gerris, Bellostoma and Dytiscus*).	(1P)
10.	Study of aquatic and semiaquatic adaptations in amphibians and reptiles.	(1P)
11.	Estimation of primary productivity with dark and light bottle method	(2P)
12.	To prepare and maintain a culture of paramecium, Daphnia and Hydra	(1P)
13.	A Compulsory visit to local freshwater body and preparation of report on physicochemical conditions and faunal organisms.	(1P)

REFERENCE BOOKS:

1. Limnology: lake and river ecosystem, Robert G. Wetzel. Academic Press,

3rd edition.

2. Treatise of Limnology. Hutchinson G. E. John Willy Publication, New York (3 volumes).
3. Field Guide to freshwater invertebrates of North America. Thorp and Rogers. Academic press.
4. Environmental Physiology of Animals. Pat Wilmer, Graham Stone and Ian Johnston. Wiley-Blackwell; 2nd edition.
5. Current status of freshwater resources of India. Kailash Chandra, Gopi K.C., Rao D.V., Valarmathi K. and Alfred J.R.B. Zoological survey of India, 2017.
6. Freshwater Ecology: Concepts and Environmental Applications of Limnology. Academic press, 2nd edition.
7. Freshwater invertebrates of the United States. Robert Pennak. A Wiley-Interscience Publication.
8. Freshwater Biology. Whipple and Ward. John Wiley & Sons Inc; 2nd edition (December 1959).
9. Freshwater Invertebrates: Ecology and General Biology. Thorp and Covich. Academic Press, 4th edition.
10. Limnological Methods. Paul and Welch. Mcgraw –Hill publication.
11. Limnological analysis. Wetzel Robert G., Springer Publication.

Course Code and Course Name:

ZOUP 115 Basic Zoology Lab-1. **(4 Credits- 120 hours)**

Semester I

Note: A total of 30 practicals are to be conducted. 10 practicals from each module are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

CO1: Identify the developmental stages of chick embryo, cell structures and phases of cell division

CO2: Identify the grammatical mistakes from the given paragraph and common errors in written and spoken presentations.

CO3: Write a scientific project and research article along with its proof reading.

CO4: Demonstrate the working of different microscopes, colorimetric and spectrophotometric methods,cell fractionation and ligature in *Drosophila* larvae,

CO5: Determine the gene distance and order, genotype and phenotype ratios and allelic frequencies from the given data.

CO6: Estimate sugar and protein by suitable biochemical method, and isolate protein from biological source.

CO7: Prepare acid and base solutions of desired strength, buffers, bacterial Culture, chick embryo culture and *Drosophila* culture.

CO8: Prepare temporary slide of various cells to demonstrate the cell morphology and cell division, giant chromosome and pedigree analysis chart.

CO9: Calculate % retention and % elution of amino acids on given ion exchanger.

Sr. No.	Name of the Practical	No. of Practicals
	Module-I Biochemistry and Biochemical Techniques	
1.	Preparation of Acid & Alkali solutions and acid-base titration **(Compulsory)**	1P
2.	Principle and working of Colorimetry and spectrophotometry	1P
3.	To prepare Buffers of known pH and molarity and measurement of pH of various samples, Buffering capacity	1P
4.	Units and specific activity of enzymes.	1P
5.	Effect of substrate concentration on enzyme activity **(Compulsory)**	

6	Determine the concentration of Vitamin C by titration method from various sources.	1P
7.	Estimation of Sugar (Glucose) by Folin Wu method. **(Compulsory)**	1P
8.	Isolate proteins by salting out / by adjusting isoelectric point. **(Compulsory)**	1P
9.	Estimation of protein by Biuret method method.**(Compulsory)**	1P
10	Principle and uses of different microscopes	1P
11	Principles of electrophoresis, separation of proteins using Gel electrophoresis.**(Compulsory)**	1P
12.	To find out the capacity and nature of a given ion-exchanger. Investigate the % retention and %elution of amino acids on a given ion exchanger	1P
13	To study the effect of different solvents for a given dye using thin layer chromatography **(Compulsory)**	2P
14.	Enzyme isolation and purification by fractionation methods.	1P
	Module-II Cell Biology and Developmental Biology	
1	Study of ultrastructure of cell organelles. **(Compulsory)**	1P
2	Study of different types of cells. **(Compulsory)**	1P
3	Temporary preparation of human cheek epithelial cells. **(Compulsory)**	1P
4	Study of different stages of mitosis in suitable material. **(Compulsory)**	1P
5	Study of meiosis in Grasshopper testes / Onion flower buds / *Aloe vera* with emphasis on all stages of prophase. **(Compulsory)**	2P
6	Limits of cleanliness (To check for microbial flora)	2P
7	Cell fractionation – Nuclei, mitochondria observation, nuclear count.	1P
8	Mounting of chick embryos and preparation of permanent mounts **(Compulsory)**	1P
9	Filter paper ring method for *in vitro* culturing of chick Embryo & observations.	1P
10	Gross anatomy and histology of chick embryo upto 72 hrs. Brain, heart, lens, ear development.**(Compulsory)**	1P
11	Study of embryonic and post-embryonic development using frog egg as a model system.	1P
12	Study of life cycle of *Drosophila melanogaster*.**(Compulsory)**	1P
13	Study of effect of ligature in Drosophila / House fly larva	1P
14	Study of regeneration in *Hydra/ Planaria.*	

15	Study the early developmental stages in any freshwater snail.	1P
	Module-III Genetics and English in Scientific communication	1P
1	Study of sex linked inheritance in *Drosophila sp.*	1P
2	Study of monohybrid and Dihybrid ratio in *Drosophila sp.*(**Compulsory**)	1P
3	Determination of gene distances and gene order for a given three-point test cross.(**Compulsory**)	1P
4	Polytene chromosomes of *Drosophila or Chironomous*-examination of puff and bands.(**Compulsory**)	1P
5	Estimation of allelic frequencies, heterozygote frequencies in human populations.(**Compulsory**)	1P
6	Pedigree Analysis: Sex-Linked, Autosomal dominant and recessive.	1P
7	Culturing *E.Coli* on solid and liquid media	1P
8	English vocabulary, word formation, basic grammar-verb, adverb, adjective, noun, pronoun (**Compulsory**)	1P
9	Syntax, paraphrasing and précis writing, synonyms, antonyms, abbreviations.	1P
10	Spoken English: pronunciation, diphthong, accent, clarity, speed, punctuation, simplicity and syntax	1P
11	Common errors in written and spoken presentation- Tautology, double negatives and double positives, sequence and tenses, ambiguity, spellings, jargons.	1P
12	Outline of a scientific paper; preparation of a research project.	1P
13	Writing abstracts, conclusion/ summary and acknowledgements, key words and suggest a suitable title to the given abstract/paper(**Compulsory**)	1P
14	Assigning legends to given graphs, figures and captions to given tables, Deciphering the given pictorals.	1P
15	Study of proof correction symbols; proof- reading the given text & correcting the proofs.	1P
16	How to write materials and methods ,observation section of a research paper.	1P
17	Write discussion section for the given discussion-less research paperand writingCitations/ Bibliography (**Compulsory**)	1P
18	Oral presentation: Rhythm, style, control, mock presentation of 10 minutes.	1P

M.Sc. Zoology (Semester - 2)

Course Code and Course Name:

ZOUT 121: Molecular Biology and Bioinformatics. **(4 Credits = 60 lectures)**

Semester II

After successfully completing this course, students will be able to:

CO1: Explain the DNA structure & types, topology, Physical properties; chromatin structure and organization.

CO2: Discuss genome organization, DNA and Protein sequencing with their application in evolutionary studies.

CO3: Explain the mobile DNA elements.

CO4: Explain mechanism of DNA damage and repair.

CO5: Illustrate the process of DNA replication, transcription, translation and their regulations.

CO6: Illustrate the database tools with their significance.

CO7: Schematically represent the processes of central dogma.

CO8: Justify the post translational and post transcriptional modifications.

Sr. No.	Name of the topic	Lectures allotted
1.	**DNA structure and topology** :-Structure of chromatin, nucleosome, chromatin organization and remodeling, higher order organization - chromosome, centromere, telomere, Histones and its effect on structure and function of chromatin, type of DNA **(A,B,Z)**	**(5L)**
2.	**Physical propertiesof DNA:** Tm, hypo and hyper chromicity, solubility, mutarotation and buoyancy.	**(2L)**
3.	**Genome organization:** *C* value paradox and genome size, Cot curves, repetitive and non-repetitive DNA sequence and their importance Cot ½ and, kinetic and sequence complixicity, satellite DNA.	**(2L)**
4.	**DNA Replication:** DNA replication in *E. coli*, Origin of replication, , types of replication, connection ofreplication to cell cycle. Different models of replication for linear and circular DNA replication features of single stranded *E. coli* DNA polymerases, details of replication process, regulation of	**(10L)**

phages. Eukaryotic DNA replication, multiplereplicons, eukaryotic DNA polymerases, ARS in yeast, Origin Recognition Complex(ORC), regulation of replication. (5L)

5. **DNA damage and repair:** Different types in DNA damages, Different DNA repair systems: Nucleotide excision repair, Base excision repair, mismatch repair, recombination repair, Double strand break repair, transcriptional coupled repair, Nick Translation and SOS Repair (8L)

6. **Transcription:**Transcriptional Unit in prokaryotes and eukaryotes, role and significance of promoter, enhancer, intron, exon, silencer, Transcriptional factors, mechanism of prokaryotic gene transcription, type and structure of RNA polymerase, post transcriptionalprocessing: Capping, polyadenylation and splicing in eukaryotes and significance, Ribonucleoproteins(SnRNPs&ScRNPs) (3L)

7. **Gene regulation and expression** in prokaryotes- Lac, arabinose and Trp operon. (6L)

8. **Protein synthesis:** Genetic Code ribosome structure, activation of amino acids, peptide bond formation and translocation of peptides, post-translational modifications, inhibitors of protein synthesis (4L)

9. **Mobile DNA elements:** Transposable elements in bacteria, IS elements, composite transposons, replicative, non-replicative transposons, Mu transposition Controlling elements in Tn A and Tn 10 transposition, SINES and LINES. Retroviruses and retrotransposon. (2L)

Bioinformatics

1. **Introduction**

Introduction to Bioinformatics and Bioinformatics web resource (NCBI, EBI, ExPASy, PubMed, OMIA), Applications of Bioinformatics (4L)

2. **Databases – Tools and their uses**

Biological databases, Primary sequence databases, Nucleic acid sequence databases (GenBank, EMBL-EBI, DDBJ),Protein sequence data bases (UniProtKB, PIR, PDB) Secondary sequence databases, Derived databases - PROSITE, BLOCKS, Pfam/ Prodom, Structure databases and bibliographic databases

3. Sequence alignment methods (4L)

BLAST, FASTA

Significance of sequence alignment

Pairwise sequence alignment (Needleman &Wunsch, Smith & Waterman methods) Multiple sequence alignment (PRAS, CLUSTALW)

4. Predictive applications using DNA and protein sequences (5L)

Evolutionary studies: Concept of phylogenetic trees, Parsimony and Bayesian approaches, synonymous and non-synonymous substitutions, convergent and parallel evolution, Pharmacogenomics: Discovering a drug: Target identification Protein Chips and Functional Proteomics: Different types of protein chip, detecting and quantifying; applications of Proteomics

Metabolomics: Concept and applications

REFERENCE BOOKS:

1. *Genes IX*, 9th edition (2008), Benjamin Lewin, Publisher - Jones and BarlettPublishers,Inc.
2. *Molecular Biology of the Gene*, 5th Edition (2004), James D. Watson, Tania Baker,
3. Stephen P. Bell, Alexander Gann, Michael Levine, Richard Lodwick. Publisher -Pearson Education, Inc. and Dorling Kindersley Publishing, Inc
4. Bioinformatics - Concepts, Skills, and Applications; S.C. Rastogi& others; CBS Publishing; 2003.
5. Bioinformatics - A practical guide to analysis of Genes & Proteins; Andreas D Baxevanis& B F Francis; John Wiley; 2000.
6. Introduction to Bioinformatics; 1st Edition; T K Attwood, D J parry-Smith; Pearson Education, 11th Reprint; 2005.
7. Bioinformatics; 1st Edition; C S V Murthy; Himalaya Publishing House; 2003
8. Bioinformatics sequence and genome analysis; David W. Mount; Cold spring harbor laboratory press; 2004
9. Basic Bioinformatics; S. Ignacimuthu, S.J.; Narosa Publishing House; 1995

10. An Introduction to Bioinformatics Algorithms; Neil C. Jones and Pavel A. Pevzner; MIT Press, First Indian Reprint; 2005
11. Bioinformatics - Managing Scientific Data; Zoe Lacroix, Terence Critchlow; Morgan Kaufmann Publishers (Elsevier Science); 2003 (for the V unit)
12. Phylogenetics: Theory and Practice of Phylogenetic Systematics; Second edition; Bruce S. Lieberman; Wiley-Blackwell; 2011
13. Molecular Evolution: A Phylogenetic Approach; Roderick D.M. Page, Dr Edward C. Holmes; Well Publishing; 1998
14. Essential Bioinformatics; JinXiong; Cambridge University Press; 2006
15. Proteomics - From Protein Sequence to Function; 12 S. R. Pennington, M. J. Dunn; First edition; Springer publications; 2001
16. Proteomics; Timothy Palzkill; Springer; 2002
17. Metabolomics - A Powerful Tool in Systems Biology; Jens Hřiriis Nielsen, Michael C. Jewett; Springer; 2007
18. Systems Metabolic Engineering; Dr. Christoph Wittmann, Sang Yup. Lee; Springer; 2012
19. Bioinformatics (Bios Instant Notes); Second Edition (Special Indian Edition); T. Charlie Hodgman, Andrew French and David R. Westhead; Garland Science (Taylor and Francis Group); 2010
20. Understanding Bioinformatics; Marketa Zvelebil and Jeremy O. Baum; Garland Science (Taylor and Francis Group); 2008
21. Bioinformatics Computing – The complete practical guide to bioinformatics for life scientists; Bryan Bergeron; Eastern Economy Edition; Prentice-Hall of India Pvt. Ltd., New Delhi; 2003
22. Bioinformatics; Prakash S. Lohar; MJP Publishers, Chennai; 2009
23. A text book of Molecular Biology- J.Pal and S. Ghaskadabi, Oxford Publication- India.
24. Freifelders Essentials of Molecular Biology, Malacinski G.M (2006) (Fourth Edition). Narosa Publishing House, New Delhi.
25. Karp's Cell and Molecular Biology: Concepts and Experiments, 8th Edition by Gerald Karp, Janet Iwasa, et al. 2016, Wiley Publication

Course Code and Course Name:

ZOUT 122 Endocrinology and Parasitology. **(4 Credits= 60 lecturers)**

Semester II

After successfully completing this course, students will be able to:

Endocrinology:

CO1: Discuss the roles of Pituitary gland and pineal body.

CO2: Explain hormonal regulation of biomolecules and mineral metabolism.

CO3: Describe the role of osmoregulatory and gastrointestinal hormones.

CO4: Explain the role of hormones in moulting, change in body colour of crustaceans; yolk synthesis in amphibians; insect development.

CO5: Explain the hormonal regulation of metabolism.

CO6: Illustrate the mechanism of hormone action and role of hormone receptors.

CO7: Justify hormones as coordination molecules.

CO8: Justify the significance of biological clocks and rhythms.

Parasitology:

CO1: Define the terminologies of parasitology.

CO2: Explain the concepts of animal association with examples.

CO3: Describe the role of parasites in public health and hygiene.

CO4: Explain the morphology and life cycle of common parasites.

CO5: Explain the pathogenicity and control measures of common parasites.

CO6: Illustrate the process of parasitic infections to human.

CO7: Justify the importance of control strategies against parasitic infections.

CO8: Justify the significance of vectors and disease transmission.

Sr. No.	Name of the topic	Lectures allotted
	Endocrinology:	
1.	Hormones as chemical messenger, types of hormones-protein and non-protein	(2L)
2.	Hormone receptors; on the plasma membrane, cytoplasm & nucleus	(2L)
3.	Mechanism of hormone action- signal transduction cascade.	(2L)
4.	Hypothalamic hypophysiotropins	(2L)

encoding Circumsporozoite protein &merozoites S- antigens, surface antigendiversity. Resistance of Malaria to drugs, its mechanism & assessment.

3.3 Platyhelminthes: Inseminative behaviour, parthenogenesis and polyspermy, sexdetermination, sex linked inheritance in Schistosomes. **(6L)**

4 **Serology & immunodiagnostic methods:**

4.1 Serology & antibody synthesis, preparation & demonstration of specific antigensof *Entamoeba, Plasmodium, Trypanosoma&Leishmania*

4.2Immunodiagnostic assays, Immunodiffusion, haemogglutination test, Radioimmuno assay, ELISA, complement fixationtest. **(2L)**

5. **Prophylaxis & control:** Biologic, Genetic, Chemical, Physical & Other methods.

REFERENCE BOOKS:

1. Bentley, P.J. (1998). Comparative vertebrate endocrinology, edn.3, CambridgeUniversity Press, London.
2. Bollander, F. (1994). Molecular endocrinology, edn.2,Acad. Press, SanDiego.
3. Hadely, M.E. (1996). Endocrinology. Edn.4, Prentice Hall, Upper Saddle Park.
4. Thomdyke, M.C. and Goldsworthy, G.J. (1988). Neurohormones in Invertebrates. Cambridge University Press.
5. Hoar, W.S. and Hickman, C.P., Jr. (1983). A laboratory companion for general and comparative physiology. Edn.3, Prenticed- Hall, Englewood Cliffs, N.J., USA.
6. Kobayashi, H. Malsumolo, A. and Ishii, S. (Eds.) (1992).Atlas of endocrine organs: vertebrates and invertebrates. Springer Verlag, Berlin.
7. Zarrow, M.X., Yachim, J.M. and McCarthy, J.L. (1964). Experimental endocrinology: a sourcebook of basic techniques. Academic Press, New York
8. Comparative protozoology, Ecology, Physiology, Life history, Anderson, O.R. , Springer verlag, Berlin.
9. General Parasitology, Cheng T. C., Academic Press.
10. Modem Parasitology, Cox F.E.G.,Eds.Parasitology in focus, facts &

trends, Melhorn h.,Eds., SprigerVerlag, Beriin.

11. Medical Parasitology, Piakarsky G. L., Springer Verlag, Berlin.
12. Modern Parasitology, Cellular immunological & immunological aspects, Wyler D. J., Eds.,
13. Molecular Parasitology: Protozoan parasites and their MoleculesWalochnik, J, Duchene M, 2016

Course Code and Course Name:

ZOUT 123 Comparative Animal Physiology & Environmental Biology.

Semester II

(4 Credits= 60 lecturers)

After successfully completing this course, students will be able to:

Comparative Animal Physiology:

CO1: Explain the physiology of processes like digestion, respiration, muscle contraction and excretion.

CO2: Describe the mechanism of thermoregulation in both poikilotherms and homeotherms.

CO3: Explain the mechanism of chemical communication in vertebrates.

CO4: Comment on the structure and functions of various sense organs.

CO5: Illustrate the concept of osmotic regulation in various animals with suitable examples.

CO6: Compare the physiology of regulatory mechanisms in various groups of animals.

CO7: Justify the survival strategies of organism in varied climatic conditions.

CO8: Justify the evolution of various life processes in living forms.

Environmental Biology:

CO1:List the endangered, endemic and extinct animal species of India.

CO2:Identify various types of natural resources, human impact on these resources, and common resourcemanagement practices.

CO3:Explain the structure and impact of biogeochemical cycles, ecosystems and energy transformation across trophic levels.

CO4: Describe concepts in population ecology and their significance.

CO5: Discuss environmental hazards and risks and the socio-economic implications.

CO6: Illustrate the impact of climate and anthropogenic factors on biodiversity with reference to India.

CO7: Illustrate the wildlife management practices and their significance.

CO8: Analyze the impact of lifestyle on the environment and animal life.

Topic No.	Name of the topic	Lecturesallotted
1.	**Digestion:** Physiology of digestion.	(03L)
2.	**Respiration:** Respiratory Surfaces: comparison of ventilation associated with gills and pulmonary respiration. Blood pigment, role in Oxygen transport.O2 dissociation curves physiological and ecological significance, CO2	(04L)
3.	**Muscle contraction:** Structure (light & electron microscopic) of the skeletal muscle, proteins of the myofilaments, nature of actin-myosin interaction, sarcoplasmic recticulum and role of Ca++ in contraction	(04L)
4.	**Osmotic regulation:** Concepts of osmole, osmolarity and tonicity, ionic regulation, Hyper-and hypo-osmotic regulators, ureosmotic animals.	(04L)
5.	**Excretion:** Basic processes in urine formation, renal function in animals specially the mammalian kidney, Renal pressure system, Comparative biochemistry of nitrogen excretion.	(04L)
6.	**Thermoregulation:**Biokinetic Zones, tolerance and resistance. Thermobiological terminologies. Compensatory patterns in piokilotherms. Critical temp, and zone of thermal neutrality. Mechanism of thermoregulation in homeotherms.	(03L)
7.	**Chemical Communication**: Nuerosecretion, neuroheamal& endocrine organs.	(04L)
8.	**Sense organ:** classification & functions (details of photoreception as a model).Reflexes, Principles of neural integration.	
	Environmental Biology	
1.	Introduction: Fundamentals of Ecology, Ecosystems: Definition and, concept of ecosystems, energy flow in ecosystems, Nutritional Flux. Development and evolution of the ecosystems. Biogeochemical cycles, Food-chains, ecotone, edge effects, ecological niche, and ecosystem stability.	(5L)
2.	Environmental Microbiology: Microbes - classification and their	(2L)

applications in the environmental sciences. Cultivation and growth of microorganisms. Microorganisms and their association with man, animals and plants. Microbes as anti-microbial agents.

3. Biomes and Habitat Diversity: Classification of biomes, major biotic elements of each biome and their characteristics. Human impact on the natural environment. **(2L)**

4. Biological diversity of India: Definition and nature, India's biogeographically history, physiography, climate and its impact on biodiversity. Indian forest and vegetation types and diversity of flora and fauna. **(4L)**

5. Population and Community Ecology

6. Wetlands Forests and Semi-Arid Habitats of India: Definition and types of wetlands, important wetlands and their conservation issues. Forests and semi-arid habitats and their distribution in India, ecological status of forests and arid lands, and their conservation. **(2L)** **(3L)**

7. Endangered, Endemic and Extinct Species of India: Threatened species categories of IUCN, threatened species of animals and the reasons, Red data book, Biodiversity hotspots of India. **(4L)**

8. Wildlife management and conservation. Protected Areas Network in India: Goals of management, Strategies for planning. Factors influencing wildlife management such as habitats, population, behaviour, food-habits, health, etc., tools for data collection and analysis. Human land-use and wildlife management units, important projects for the conservation of wildlife in India, Role of local communities in wildlife management. **(6L)**

9. Introduction to human animal conflict. **(2L)**

REFERENCE BOOKS:

1. Comparative animal physiology, Clifford Ladd Prosser, John Wiley & Sons
2. Animal physiology, Richard W. Hill, Gordon A. Wyse. Harper and Row

3. Comparative animal physiology, Philip Carew Withers, Saunders College Pub., 1992
4. Fundamentals of Ecology: E. P. Odum
5. Modern concepts in Ecology: H: D. Kumar
6. Microbes, Man and Animals: The Natural History of Microbial Interactions: Linton, A. H. andBurns, R.G. John Wiley and Sons.
7. Elements of Microbiology: Pelczar, M.J. and Chan ECS, McGraw Hill.
8. General Microbiology: Stainer, R.Y, Adelberg, EA and Ingraham, J.L. . Macmillan Press.
9. Microbial Methods for Environmental Biotechnology: Grainer, J.M. and Lynch, J.M. . Academic Press.
10. Microbiological Methods for Environmental Scientists and Enginners
11. Gaudy, A.F. and Guady, E.T. McGraw Hill.

Course Code and Course Name:

ZODT 124: Metabolic Pathways.(2 Credits= 30 lecturers)

Semester II

CO1: Define basic terminologies of metabolic pathways.

CO2: Explain the laws of thermodynamics, concept of free energy and ATP as currency molecule.

CO3: Describe the Concepts and regulation of metabolism.

CO4: Discuss the oxidation of fatty acids and its significance.

CO5: Illustrate the electron transport chain and oxidative phosphorylation.

CO6: Illustrate the reactions, energetics and regulation of glycolysis, glycogen biosynthesis, TCA cycle, Purine and Pyrimidine metabolism

CO7: Write the general reactions of various metabolic pathways.

CO8: Justify the role of enzymes in metabolism

Sr. No.	Name of the topic	Lectures allotted
1.	Basic law of thermodynamics, internal energy, enthalpy, entropy, concept of free energy, redox potentials, high energy compounds, structure and function of ATP.	(4L)
2.	Concepts of metabolism, Metabolic pathways-Catabolic and anabolic, regulation of metabolic pathways	(2L)
3.	Carbohydrate Metabolism 1. Steps of Glycolysis (EMP Pathway). 2. PFK 3. Regulation of Glycolysis. 4. Glycogenesis, Glycogenolysis and Glyconeogenesis 5. Inborn errors of metabolism- Von- Gerkes disease, Tarui'sdisease, Galactosemia, Maple syrup urine	(7L)
4.	Electron transport chain and oxidative phosphorylation.	(3L)
5.	Citric acid cycle: Detailed study, energetics, regulation and significance, Role of PDH.	(4L)
6.	Oxidative degradation of amino acids: transamination, oxidative deamination.	(2L)
7.	Biosynthesis of purine and pyrimidine nucleotides	(3L)
8.	A Lipid metabolism: Introduction, oxidation of even chain saturated fatty acids, oxidation of unsaturated fatty acids, oxidation of odd chain fatty acids, omega (ω)-oxidation of fatty acids, Ketogenesis. Transport of Fatty Acids.	(5L)

Course Code and Course Name:

ZODP 124: Practical in Metabolic Pathways.

Semester II **(2 Credits- 60 Hours)**

After successfully completing this course, students will be able to:

CO1: Identify the common diseases/conditions caused due to errors in metabolism.

CO2: Explain the principle of Colorimetry and Spectrophotometry.

CO3: Use the basic equipment in biochemistry lab.

CO4: Illustrate the enzyme activity from suitable material.

CO5: Demonstrate the effect of various physical and chemical factors on enzyme activity.

CO6: Demonstrate the absorption studies of biomolecules.

CO7: Estimate the concentration of cholesterol, uric acid, amino acids and starch.

CO8: Separate biomolecules by chromatographic methods.

Sr. No.	ZODP 124: Practical in Metabolic Pathways.	No. of Practicals
1.	Estimation of Starch.**(Compulsory)**	(1P)
2.	Separation amino acids by paper chromatography	(2P)
3.	Estimation of uric acid in wall Lizard excreta/ Human blood any other suitable material.**(Compulsory)**	(1P)
4.	To find absorption spectrum of haemoglobin, BSA, Tyrosine.	(1P)
5.	Estimation of Protein by Lowry et al Method.**(Compulsory)**	(1P)
6.	Estimation of Sugar by DNSA method.	(1P)
7.	Separation of amino acids by TLC **(Compulsory)**	(1P)
8.	Estimation of free amino acids by Ninhydrin method.**(Compulsory)**	(1P)
9.	Estimation of cholesterol.	(2P)
10.	Study α-Amylase Activity in Germinating Seeds.	(1P)
11.	Determination of saponification value of a fat.	(1P)
12.	Study the effect of pH and temperature on enzyme activity.	(1P)
13.	Study of human diseases caused due to errors in metabolic pathways with the help of pictures/charts/models/laboratory reports.	

REFERENCE BOOKS:

1. Biochemistry, 3rd Ed. (2005), Voet Donald and Voet Judith G. John, Publisher: Wiley & sons, New York.
2. Biochemistry 6th Ed, (2007) Berg Jeremy, Tymoczko John, StryerLubert, Publisher: W. H. Freeman, New York.
3. Lehninger's Principles of Biochemistry, 4th edition, (2005) Nelson D. L. and Cox M. M. W. H. Freeman & Co. NY.
4. Biochemical Calculations, 2nd Ed., (2010) Segel Irvin H., Publisher: John Wiley and Sons, New York.
5. Enzymes: Biochemistry, Biotechnology & Clinical chemistry, (2001) Palmer Trevor, Publisher: Horwood Pub. Co., England.
6. Biochemistry, Geoffrey Zubay, William C Brown Pub; 4th edition (June 1999)
7. Principles and Techniques of Biochemistry and Molecular Biology, 6th

edition (2008), Keith Wilson and John Walker, Publisher–Cambridge University Press.

8. Biochemical Methods, 2018, S.Sadashivam, New Age International Pvt Ltd Publishers; Third edition.
9. An Introduction to Practical Biochemistry,2017, David Plummer, McGraw Hill Education; 3th edition.
10. Medical Biochemistry,2018- John W Baynes and Marek H. Dominiczak, Publisher- Elsevier; 5th edition.
11. Harper's Illustrated Biochemistry, 2018, Victor W.Rodwell, David A., Bender, Kathleen M.,Botham, Peter J.,Kennelly, P. AnthonyWeil, McGraw-Hill; Illustrated edition,
12. Principles of Medical Biochemistry-2016, Gerhard Meisenberg, William H. Simmons,Elsevier; 4th edition.

Course Code and Course Name:

ZODT 124: Ichthyology(2 Credits= 30 lecturers)

Semester II

After successfully completing this course, students will be able to:

CO1: Identify the common fishes in India.

CO2: Explain the general characters and evolution of fishes.

CO3: Explain the fish morphology and anatomical modifications.

CO4: Illustrate the physiology of reproductive and endocrine organs in fish.

CO5: Discuss the signs, symptoms and control measures of common diseases in fish.

CO6: Justify the role of respiratory and excretory organs in survival of fishes.

CO7: Classify fishes upto order level.

CO8: Setup aquarium and manage it.

Topic No.	Name of the topic	Lecture allotted
1.	Introduction, general characteristics, evolutionary succession and fossil history of fishes. The early evolution of fishes: Chondrichthian fishes - Sharks, Skates and Rays.	(3L)
2.	Eschmeyer's classification of fishes and diagnostic characters up to orders (one major order from each class).	(4L)
3.	External morphology, body form, appendages, pigmentation, skin and scales.	(1L)
4.	Food and feeding habits, Digestive system and its anatomical modifications.	(2L)
5.	Respiratory mechanism: Respiratory gills and lungs. Accessory respiratory organs: Origin of air breathing organs; skin, buccopharynxopercular cavity and air bladder.	(2L)
6.	Circulatory system: Heart and accessory pumps.	(3L)
7.	Excretion and Osmoregulation: Glomerular and aglomerular kidneys; Nitrogen (ammonia, urea, TMAO) excretions. Water and salt balance in steno- and euryhayline fishes. Role of skin and gills.	(2L)
8.	Reproduction: Structure of gonads, gametogenic cycles; spawning.	(3L)
9	Nervous system and Sense organs: Organization of the central and peripheral nervous systems. Olfactory, taste buds, touch receptors, photoreceptors, lateral line and internal ear	(2L)
10	Endocrine system: Pituitary gland, urohypophysis, adrenal gland, gonads, and thyroid gland.	(2L)
11	Fish pathology: Signs of sickness and effects on fish; Pathological procedure for diagnosis of fish diseases,Symptoms and control measures of viral, bacterial, fungal, protozoan, worm and crustacean diseases.	(4L)
12	Ornamental Fish production and management: World trade of ornamental fishes. Different varieties of exotic and indigenous ornamental fishes. Principles of a balanced aquarium. Fabrication, setting up and maintenance of freshwater aquarium. Water quality management. Water filtration system – biological, mechanical and chemical. Types of filters. Aquarium plants and their propagation methods. Lighting and aeration. Aquarium accessories and decoratives. Aquarium fish feeds. Dry, wet and live	

feeds. Breeding and rearing of ornamental fishes. Common diseases and their control. Conditioning, packing, transport and quarantine methods. Trade regulations and wild life act in relation to ornamental fishes.

Course Code and Course Name:

ZODP 124: Practical in Ichthyology (2 Credits – 60 hours)

Semester II

Sr. No.	Name of the Practical	No.ofPractical
1.	Study of fish evolution with the help of charts/models/Pictures.	(1P)
2.	General external characters, fins and scales (permanent slides & temporary preparations and submission during examination).	(1P)
3.	Classification of fishes (one example from each order); use of diagnostic keys.	(2P)
4.	Length-weight relationship, condition factor, gonado-somatic index of any one fish species.	(1P)
5.	Adaptations of fishes (adhesive organs, accessory respiratory organs, stomachless fishes, spiral valve, electric organs and sense organs.)	(1P)
6.	Study of Weberian ossicles in Heteropneustes/ Labeo.	(1P)
7.	Anatomical observations, demonstration and detailed explanation of fish in general, Digestive, urino-genital system, Endocrine glands of carp/ catfish/ Tilapia.	(1P)
8.	Identification of fish developmental stages: egg, spawn, fry fingerling and adult.	(1P)
9.	Cranial nerves (V, VII, IX & X) and eye ball musculature and innervations in Scoliodon/ carp/ catfish.	(1P)
10.	Histology of digestive, respiratory, excretory, reproductive and endocrine organs.	(1P)
11.	Study of common diseases in fish their diagnosis and control strategies.	(1P)
12.	Setting up of an aquarium and its management and study of breeding behaviour of gourami, Siamese fighting and swordtail.	(2P)
13.	Visit to fish farm/ fish breeding centre/fish market and preparation of detail visit report.	(1P)

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Zoology

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Course Code and Course Name:

ZODP 124: Practical in Ichthyology (2 Credits – 60 hours)

Semester II

Sr. No.	Name of the Practical	No.ofPractical
1.	Study of fish evolution with the help of charts/models/Pictures.	(1P)
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11.	Study of common diseases in fish their diagnosis and control strategies.	(2P)
12.	Setting up of an aquarium and its management and study of breeding behaviour of gourami, Siamese fighting and swordtail.	(1P)
13.	Visit to fish farm/ fish breeding centre/fish market and preparation of detail visit report.	

REFERENCE BOOKS:

1. Bal D. V. & K. V. Rao (1984). Marine Fisheries. Tata McGraw-Hill, New Delhi.
2. Bone Q., N. B. Marshall & J. H. S. Blaxter (1995). Biology of Fishes, Edn.2, Blackie, Academic % Professional (Chapman & Hall), London.
3. C. Vandujn. Diseases of fishes – Narendra Publishing House, New Delhi.
4. Hoar W. S. & D. J. Randall (1969). Fish Physiology. Vols. I onwards, Academic Press, New York.
5. Jayaram K. C. (1981). The freshwater fishes of India. Pakistan, Bangladesh, Burma and Sri Lanka- A Handbook. Zool. Survey of India, Academic Press, New York.
6. Khanna, S. S. (1984). An Introduction to Fishes. Central Book Depot., Allahabad.
7. Lagler K. E., J. E. Bardach, R. R. Miller D.R.M. Passino (1977). Ichthyology, Edn.2, Wiley, New York.
8. Rahul P. Parihar. Textbook Of Fish Biology & Indian Fisheries
9. Talwar P.K. & A.G. Jhingran (1991). Fish and Fisheries of India and Adjacent Countries, Vols. I & II. Oxford & I.B.H., New York.
10. Wake, M.H. (Ed.) (1979). Hyman's Comparative Vertebrate Anatomy. Edn.3, University of Chicago Press, Chicago
11. Wedemeye G. A. Environmental stress and fish diseases –Narendra. Publishing House.
12. William N. Eschmeyer (2019). Eschmeyer'sCatalog of Fishes (Vol. 1, 2 & 3). Published by the California Academy of Sciences, San Francisco © 1998.

Course Code and Course Name:

ZOUP 125 Basic Zoology Lab-2(4 Credits, 120 hours)

Semester II.

Note: A total of 30 practicals are to be conducted. 10 practicals from each module are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

CO1: Identify the various parasites and parasitic stages of common parasites, nitrogenous wasteproducts of animals, feshwater planktons and slides of endocrine glands.

CO2: Explain the principle and significance of gonadectomy, thyrodectomyand pancreactomy.

CO3: Demonstrate the role of eye stalk and insulin in sugar level in crab.

CO4: Demonstrate the retro cerebral complex in cockroach.

CO5: Demonstrate the RBCs of common vertebrates and effect of various osmolarities.

CO6: Demonstrate the effect of body size, oxygen consumption and Insulin on aquatic animal.

CO7: Determine the bleeding and clotting time, heartbeat of crab, species richness in selected area, physico- chemical properties of soil and water.

CO8:Perform Sterilization of lab equipment, prepare microbial culture, Isolate Bacterial, liver DNA and RNA from given sample, quantify and resolve them using electrophoretic procedures, analyse protein sample by PAGE and SDS PAGE and construct phylogenetic tree using tools inbioinformatics.

Sr. No.	Name of the Practical	No. of Practicals
	Module-I Molecular Biology and Bioinformatics	
1.	Lab Safety Techniques and sterilization.	1P
2.	Isolation of bacterial DNA and estimation by UV spectrophotometry	2P
3.	Isolation of Liver DNA and quantification, Agarose gel electrophoresis of isolated DNA.**(Compulsory)**	2P
4.	Isolation of RNA and agarose gel electrophoresis.	1P
5.	Concept of biological database, gene and protein search by BLASTA and **(Compulsory)**	1P

	FASTA **(Compulsory)**	
6	To analyse protein on native PAGE and SDS-polyacrylamide gel electrophoresis.(**Compulsory)**	**2P**
7.	Construction of phylogenetics tree for DNA and protein **(Compulsory)**	**1P**
8.	Demonstration of DNA amplification by PCR	**1P**
	Module- II Endocrinology and Parasitology	**1P**
1	Histology of invertebrate and vertebrate neurosecretory and endocrine structures.(Compulsory)	**1P**
2	Blood sugar regulation in the crab- role of eye stalk. **(Compulsory)**	**1P**
3	Study of retrocerebral complex of the cockroach.	**1P**
4	Introduction of alloxan diabetes in the mouse/ rat / human. **(Compulsory)**	**2P**
5	Gonadectomy in the mouse/ rat.	**1P**
6	Pancreatectomy in the mouse/ rat.	**1P**
7	Effect of insulin on blood sugar, hepatic and muscle glycogen of the rat/human. **(Compulsory)**	**1P**
8	Thyroidectomy in the rat.	**2P**
9	Study of life cycle, role as vector & control measures of: Ticks(*Argas, Boophilus*) Mosquito – any two from- *Anopheles/ Aedes/ Culex* Any two flies: *Tabanus/ Phlebotomus/ Sarcophaga*.Cyclops. **(Compulsory)** (Specimen, Slides or charts may be used.)	
10	Ectoparasites&Endoparasites of wild rat, cattle, dog, chick & human including stages in excreta.	**2P**
11	Study of life cycle of parasitic protozoa: *Trypanosoma, Leishmania.***(Compulsory)**	**1P**
12	Study of life cycle of helminth parasites: *Schistosoma. Echinococcus, Ancylostoma, Dracunculus***(Compulsory)**	**2P**
13	Study of Parasites from digestive tract of Cockroach/gut / parasites of hen. (Compulsory)	**1P**

Module-III Comparative Animal physiology and Environmental Biology

1	Study of nitrogenous waste products of animals from different habitats. **(Compulsory)**	1P
2	Study of RBCs in different vertebrates and in different physiological conditions.	1P
3	Study of relation of Body size and oxygen consumption in aquatic animals (crab/fish). **(Compulsory)**	1P
4	Estimation of sugar in rat/crab/human blood. **(Compulsory)**	1P
5	Determination of bleeding time & clotting time of human blood. **(Compulsory)**	1P 1P
6	Determination of the heart beat in the crab-effect of temperature & ions.	1P
7	Effect of eye stalk ablation on glucose in the haemolymph of the crab.	1P
8	A visit to aquatic ecosystem and methods for water and plankton collection. **(Compulsory)**	2P
9	Plankton identification and quantification from river / lake water samples. **(Compulsory)**	2P
10	Vegetation studies by line, quadrates and belt transect methods and their analysis.	2P
11	Preparation of media for microbial culture, Isolation and culturing of microbes from soil/water samples. **(Compulsory)**	2P
12	Water analysis for physico-chemical characteristics.**(Compulsory)**	1P
13	Physico-chemical analysis of soil. **(Compulsory)**	1P

Note: Latest edition of the recommended books may also be used

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Savitribai Phule Pune University

(Formerly University of Pune)

Two Year Degree Program in Zoology

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. (Zoology) Part-II

(for Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System Syllabus

To be implemented from Academic Year 2020-2021

Title of the Course: M.Sc. (Zoology)

Preamble

Zoology is a major subject of Basic Sciences which deals with all aspects of animal biology. It includes an interesting range of highly diverse topics. The advancements in biological Sciences demands, a zoology student to be a master of many areas in the subject. This Postgraduate degree program has been designed by the Board of Studies in Zoology of Savitribai Phule Pune University with a tangible understanding of what is needed from zoologists and what zoologists need to pursue as a skilled career. It emulates closely the Benchmark Statement for Biosciences and the guidelines laid down by the University Grants Commission, New Delhi. This Newly designed Curriculum is an appropriate blend of the classical aspects in Zoology which has been the "backbone" knowledge required for all zoologists and the recent and specialized areas. The flexibility in the Curriculum allows the students to choose their areas of interest leading to enhanced employability. Students will be provided sufficient number of hours for their skill development through the Lab Courses and the Project component. The lab courses have differing flavours and priorities to make a good zoologist. This degree offers specialization in areas like Genetics, Animal Physiology and Entomology along with a range of core courses like Biochemistry, Molecular Biology, Comparative Animal Physiology, Developmental Biology, Environmental Biology etc. Various cross cutting issues relating to Environmental biology have been aptly included to develop the students' sense towards human wellbeing. The field trip/surveys and study tours are included to gives the student an enticing taste of what life is specially outside the walls of the classroom. On successful completion of the programme, the students are expected to understand the key life processes of human and other animal groups, the functioning of molecules, cells, tissues, organs and systems. Also the students will gain increased confidence to use initiative and judgement to make decisions in complex and changeable situations and reflect critically and analytically on personal experience and make informed decisions about further study, training and employment opportunities. The Master of Science (M.Sc.) in Zoology is a Postgraduate program under the Faculty of Science and Technology of Savitribai Phule Pune University Pune. The curriculum designed encompasses subjects like Physiology, Entomology, Genetics, Cell Biology, Developmental Biology, Endocrinology, Biochemistry, Molecular Biology, Freshwater Zoology, Environmental Biology etc. Both classical and applied subjects of Zoology have been rightly blended to offer holistic understanding of the subject.

The Choice Based Credit System (CBCS) will be implemented through this curriculum. This curriculum would certainly felicitate students to develop a strong base of the fundamentals and specialize in the desired area of their fondness and abilities. The students pursuing this program

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would get a privilege to select optional subjects of their choice. A total of 210 hours for theory lectures and 180 hours for laboratory work have been prescribed in each semester including a research project (advisable to be start at the first year in consultation with the department staff) to inculcate the research culture amongst students. This newly designed curriculum will allow students to acquire the skill in handling scientific instruments planning and performing in the laboratory and exercising critical judgement, independent thinking and problem solving skills.

M.Sc. Zoology - Course structure & Distribution of Credits

M.Sc. Zoology, Part –I,

Semester-I

Sr. No.	Core Compulsory Theory Paper (CCTP)	Choice Based Optional Paper (CBOP)	Theory/ practical	Credit	Core Compulsory Practical Paper (CCPP)	Credit
1	**ZOUT 111** Biochemistry and Biochemical Techniques	-			-	4
2	**ZOUT 112** Cell Biology and Developmental Biology	-			-	4
3	**ZOUT 113** Genetics and English in Scientific Communication.	-			-	4
4	-	**ZODT 114** Theory.	~~Biostatistics~~/ Freshwater Zoology	2	-	4
		ZODP 114 Practical	Zoology Practical Paper-1	2		
5	-	-			**ZOUP 115** Basic Zoology Lab-I	4
	Total Credit of Semester 1					20

M.Sc. Zoology, Part-I, Semester-II

Sr. No.	Core Compulsory Theory Paper (CCTP)	Choice Based Optional Paper (CBOP)	Theory/ practical	Credit	Core Compulsory Practical Paper (CCPP)	Credit
1	**ZOUT 121** Molecular Biology and Bioinformatics	-			-	4
2	**ZOUT 122** Endocrinology and Parasitology	-			-	4
3	**ZOUT 123** Comparative Animal Physiology and Environmental Biology.	-			-	4
4	-	**ZODT 124** Theory. ---------- **ZODP 124** Practical	Metabolic pathways / ~~Ichthyology~~	2	-	4
			Zoology Practical Paper-2	2		
5	-	-			**ZOUP 125** Basic Zoology Lab- II	4
		Total Credit of Semester 2				20

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M.Sc. Zoology, Part-II, Semester - III

Sr. No.	Core Compulsory Theory Paper (CCTP)	Choice Based Optional Paper (CBOP)	Theory/ practical	Credit	Core Compulsory Practical Paper (CCPP)	Credit
1	ZOUT 231 Special Paper (any one) Animal Physiology-I/ ~~Entomology~~-I/ ~~Genetics~~ I	-			-	4
2	ZOUT 232 Fundamentals of Systematics and Economic Zoology	-			-	4
3	ZOUT 233 Research Methodology and Insect Physiology and Biochemistry	-			-	4
4	-	ZODT 234 Theory ---------- ZODP 234 Practical	~~Immunology~~/ ~~Genetic~~ ~~Toxicology~~/	2	-	4
			Zoology Practical Paper- 3	2		
					ZOUP 235 Special Lab I	4
5	-	-				

M.Sc. Zoology, Part II, Semester – IV

Sr. No.	Core Compulsory Theory Paper (CCTP)	Choice Based Optional Paper (CBOP)	Theory/ practical	Credit	Core Compulsory Practical Paper (CCPP)	Credit
1	ZOUT 241 Special Paper-Any One- ~~Animal~~ Physiology-II/ ~~Entomology-II~~/ ~~Genetics-II~~	-			-	4
2	ZOUT 242 Mammalian Reproductive Physiology and Aquaculture				-	4
3	-	ZODT 243 Theory	~~Histology and Histochemistry~~/ Pest Control	2	-	4
		ZODP 243 Practical	Zoology Practical Paper-4 (Practicals corresponding to ZOUT 241and ZODT 243)	2		
4	-	ZODT 244 Theory	Pollution Biology/ ~~Apiculture~~	2	-	4
		ZODP 244 Practical	Zoology Practical Paper-5 (Practicals corresponding to ZOUT 242 and ZODT 244)	2		
5	-	-			ZOUP 245 (Project)	4
	Total Credit of Semester 4					**20**

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Equivalence of Previous Syllabus:

Semester-I

Old Course (2013 Pattern)	New Course (2019 Pattern)
ZY101T: Biochemistry-I	ZOUT 111 Biochemistry and Biochemical Techniques
ZY102T: Cell Biology	ZOUT 112 Cell Biology and Developmental Biology
ZY103T: Genetics	ZOUT 113- Genetics and English in Scientific Communication.
ZY104T: Biostatistics	ZODT 114 Biostatistics
ZY105T: Skills in scientific communication and Writing	ZOUT 113 Genetics and English in Scientific Communication.
ZY106T: Freshwater Zoology	ZODT 114 Freshwater Zoology
ZY101P:Practicals in Biochemistry	ZOUP 115 Basic Zoology Lab-I
ZY102P: Practicals in Cell Biology	
ZY103P: Practicals in Genetics	
ZY105P: Practicals in Skills in scientific communication and writing	ZODP 114 Zoology Practical-1
ZY106P: Practicals in Fresh water zoology	
ZY104P: Practicals in Biostatistics	

Old Course (2013 Pattern)
ZY101T: Biochemistry-I
ZY102T: Cell Biology
ZY103T: Genetics
ZY104T: Biostatistics
ZY105T: Skills in scientific communication and Writing
ZY106T: Freshwater Zoology
ZY101P:Practicals in Biochemistry
ZY102P: Practicals in Cell Biology
ZY103P: Practicals in Genetics
ZY105P: Practicals in Skills in scientific communication and writing
ZY106P: Practicals in Fresh water zoology
ZY104P: Practicals in Biostatistics

M.Sc. Zoology, Part II, Semester – IV

Sr. No.	Core Compulsory Theory Paper (CCTP)	Choice Based Optional Paper (CBOP)	Theory/ practical	Credit	Core Compulsory Practical Paper (CCPP)	Credit
1	ZOUT 241 Special Paper-Any One- ~~Animal Physiology-II~~/ ~~Entomology-II~~/ ~~Genetics-II~~	-			-	4
2	ZOUT 242 Mammalian Reproductive Physiology and Aquaculture				-	4
3	-	ZODT 243 Theory	~~Histology and Histochemistry~~/ Pest Control	2	-	4
		ZODP 243 Practical	Zoology Practical Paper-4 (Practicals corresponding to ZOUT 241and ZODT 243)	2		
4	-	ZODT 244 Theory	Pollution Biology/ ~~Apiculture~~	2	-	4
		ZODP 244 Practical	Zoology Practical Paper-5 (Practicals corresponding to ZOUT 242 and ZODT 244)	2		
5	-	-			ZOUP 245 (Project)	4
	Total Credit of Semester 4					**20**

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Equivalence of Previous Syllabus:

Semester-I

Old Course (2013 Pattern)	New Course (2019 Pattern)
ZY101T: Biochemistry-I	ZOUT 111 Biochemistry and Biochemical Techniques
ZY102T: Cell Biology	ZOUT 112 Cell Biology and Developmental Biology
ZY103T: Genetics	ZOUT 113- Genetics and English in Scientific Communication.
ZY104T: Biostatistics	ZODT 114 Biostatistics
ZY105T: Skills in scientific communication and Writing	ZOUT 113 Genetics and English in Scientific Communication.
ZY106T: Freshwater Zoology	ZODT 114 Freshwater Zoology
ZY101P:Practicals in Biochemistry	ZOUP 115 Basic Zoology Lab-I
ZY102P: Practicals in Cell Biology	
ZY103P: Practicals in Genetics	
ZY105P: Practicals in Skills in scientific communication and writing	ZODP 114 Zoology Practical-1
ZY106P: Practicals in Fresh water zoology	
ZY104P: Practicals in Biostatistics	

Old Course (2013 Pattern)
ZY101T: Biochemistry-I
ZY102T: Cell Biology
ZY103T: Genetics
ZY104T: Biostatistics
ZY105T: Skills in scientific communication and Writing
ZY106T: Freshwater Zoology
ZY101P:Practicals in Biochemistry
ZY102P: Practicals in Cell Biology
ZY103P: Practicals in Genetics
ZY105P: Practicals in Skills in scientific communication and writing
ZY106P: Practicals in Fresh water zoology
ZY104P: Practicals in Biostatistics

Semester-II

Old Course (2013 Pattern)	New Course (2019 Pattern)
ZY201T: Biochemistry-II	ZODT 124Metabolic pathways
ZY202T: Molecular Biology	ZOUT 121 Molecular Biology and Bioinformatics
ZY203T: Developmental Biology	ZOUT 112 Cell Biology and Developmental Biology
ZY204T: Endocrinology	ZOUT 122 Endocrinology and Parasitology
ZY205T: Comparative Animal Physiology	ZOUT 123 Comparative Animal Physiology & Environmental Biology
ZY206T: Biochemical Techniques/Ichthyology	ZOUT 111 Biochemistry & Biochemical Techniques ZODT 124 Ichthyology
ZY201P:Practicals in Biochemistry-II ZY202P: Practicals in Molecular Biology ZY203P: Practicals in Developmental Biology ZY204P: Practicals in Endocrinology ZY205P: Practicals in Comparative Animal Physiology	ZOUP 125 Basic Zoology Lab-II

Semester-III

Old Course (2013 Pattern)	New Course (2019 Pattern)
ZY 301T Animal Physiology I (special)	ZOUT 231 Special Paper Animal Physiology-I
ZY 301T Entomology I (special)	ZOUT 231 Special Paper Entomology-I
ZY 301T Genetics I (special)	ZOUT 231 Special Paper Genetics-I
ZY 302T Immunology	ZODT 234 Immunology
ZY 302T Environmental Biology	---
ZY 303T Genetic toxicology	ZODT 234 Genetic toxicology

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ZY 303T Aquaculture	ZOUT 242- Aquaculture
ZY 304T Insect Physiology and Biochemistry	ZOUT 233- Insect Physiology and Biochemistry
ZY 305T Research methodology	ZOUT 233- Research methodology
ZY 306T Parasitology	--
ZY 307T Fundamentals of Systematics	ZOUT 232- Fundamentals of Systematics
ZY 308T Insect Ecology	--
ZY 309T Toxicology I	--
ZY 301P Practicals in Animal Physiology I (special)	ZOUP 235 Special Lab I
ZY 301 P Practicals in Entomology I (special)	
ZY 301 P Practicals in Genetics I (special)	ZODP 234 Practical
ZY 302 P Practicals in Immunology	
ZY 302 P Practicals in Environmental Biology	
ZY 303 P Practicals in Genetic toxicology	
ZY 303P Practicals in Aquaculture	
ZY 304P Practicals in Insect Physiology and Biochemistry	
ZY 305P Practicals in Research methodology	
ZY 306P Practicals in Parasitology	
ZY 307P Practicals in Fundamentals of Systematics	
ZY 308P Research Project	
ZY 309P Practicals in Toxicology I	

Semester-IV

Old Course (2013 Pattern)	New Course (2019 Pattern)
ZY 401T Animal Physiology II (special)	ZOUT 241- Animal Physiology II (special)
ZY 401T Entomology II (special)	ZOUT 241- Entomology II (special)
ZY 401T Genetics II (special)	ZOUT 241- Genetics II (special)
ZY 402T Economic Zoology	ZOUT 232- Economic Zoology
ZY 402T Bacteria and phage Genetics	--

ZY 403T Mammalian Reproductive Physiology	ZOUT 242- Mammalian Reproductive Physiology
ZY 403T Biodiversity assessment	--
ZY 404T Histology and Histochemistry	ZODT 243 Histology and Histochemistry
ZY 405T Pollution Biology	ZODT 244 Pollution Biology
ZY 406T Apiculture	ZODT 244 Apiculture
ZY 407T Pest control	ZODT 243 Pest control
ZY 408T Toxicology II	--
ZY 401 P Practical Animal Physiology II	ZODP 243 Practical
ZY 401 P Practical Entomology II	
ZY 401 P Practical Genetics II	ZODP 244 Practical
ZY 402 P Practical Economic Zoology	
ZY 402 P Practical Bacteria and phage Genetics	ZOUP 245 (Project)
ZY 403 P Practical Mammalian reproductive physiology	
ZY 403 P Practical Biodiversity assessment	
ZY404 P Practical Histology and histochemistry	
ZY405 P Practical Pollution biology	
ZY406 P Practical Apiculture	
ZY308 P Research Project	
ZY 408 P Practicals in Toxicology II	

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Detailed Syllabus with Recommended Books:

Program outcomes (POs): After successfully completing the M.Sc. Zoology program students will be able to:

PO1. **Zoology knowledge**: Apply the knowledge of Zoology, Life Sciences and allied subjects to the understanding of complex life processes and phenomena.

PO2. **Problem analysis**: Identify, review research literature, and analyse complex situations of living forms.

PO3. **Design/development of solutions**: Design processes/strategies that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions in real situations.

PO5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and ICT tools for understanding of the subject.

PO6. **The Postgraduate and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability**: Understand the impact of the natural and anthropogenic activities in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. Identify a range of invertebrates and vertebrates and justify their conservation.

PO8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the work/research practice.

PO9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication**: Communicate effectively on complex life activities with the scientific community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance**: Demonstrate knowledge and understanding of Zoology and management principles and apply these to one's own work, as a member and leader in a team.

PO12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Following is the syllabus of each course along with the course outcomes:

M.Sc. Zoology, Part II, Semester – III

Course Code and Course Name:

ZOUT231: Animal Physiology- I (Special Paper) (4 Credits: 60 Lectures)

Semester III

After successfully completing this course, students will be able to: CO1:

CO1: Explain the membrane physiology and its dynamics.

CO2: Explain the concept of nutrition and digestion.

CO3: Explain the structure, contraction and types of contraction of muscle.

CO4: Illustrate bioluminescence and animal electricity with examples and its significance

CO5: Correlate the organisms Internal and external environments with homeostasis and biological Clocks.

CO6: Diagrammatically represent the mechanism of respiration, gas exchange and transport of O_2 and CO_2

Sr. No.	Name of the topic	Lectures allotted
1.	**External and Internal environment** 1.1 External environment: the atmosphere, aquatic & terrestrial environment 1.2 Internal environment: Extracellular and intra cellular environment 1.3 Homeostasis and regulation: tolerance and resistance, acclimatisation and acclimation, regulatory mechanism. 1.4 Biological clock and their regulation: Circadian rhythms lunar and tidal rhythm, circa annual rhythm, photoperiodism.	(08L)
2.	**Membrane Physiology** 2.1 Membrane structure, membrane permeation, diffusion mediated transport, dynamics of semi permeable membrane. 2.2 Resting membrane potential, diffusion, equilibrium potential, Goldman-Hodkin- Katz potential, conductance, current, capacitance 2.3 Excitable cell membrane: action potential, role of various ion channels, role of Na+ K+ pump, properties of action potentials	(10L)
3.	**Physiology of Digestion** 3.1 Nutritive requirements (concept of balanced diet), Regulation of hunger, satiety 3.2 Digestion and absorption in the G.I tract: carbohydrate, lipids & protein 3.3 Control and regulation of digestion 3.4 Calorimetry and BMR	(09L)
4.	**Respiration** 4.1 Internal and external respiration; Anatomy of respiratory system 4.2 Pulmonary respiration: Partial pressure, inspiration and expiration, Lung volume and capacities	(10L)

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	4.3 Gas exchange across the pulmonary and systemic capillaries 4.4 Gas transport; O2 transport, CO2 transport and abnormalities in the blood gas content 4.5 Neuronal control of respiration, role of central and peripheral receptors 4.6 Other functions of respiratory system, waste elimination	
5.	**Muscle Physiology** 5.1 Structure of skeletal muscle and molecular basis of skeletal muscle contraction, types of contraction, twitch summation and tetanus, relation between muscle length and tension, velocity of contraction 5.2 Chemical basis of muscle contraction 5.3 Innervation of muscles, excitation and contraction coupling 5.4 Skeletal muscle fiber types, contractile machinery of smooth muscle	(09L)
6.	**Bioluminescence and Animal electricity** 6.1 Bioluminescence: phyletic distribution, structure of luminescent organs, biochemical and molecular mechanism. 6.2 Animal electricity: electro receptors electro organs and their structure and functions	(08L) (06L)
7.	**Buoyancy** 7.1 Definition, density reduction 7.2 Gas floats with examples 7.3 Swim bladder with example	

REFERENCE BOOKS:

1. Animal Physiology: Adaptation and Environment (1997) Knut Schmidt-Nielsen Publisher: Cambridge University Press.
2. Principles of Animal Physiology (2006), C. D. Moyes and P. M. Schulte. Publisher - Pearson Education Inc. and Dorling Kindersley Publishing Inc.
3. Text book of Medical Physiology 10th edition (2001), A. C. Guyton and J. E. Hall. Publisher - W. B. Saunders Company, Philadelphia. –
4. Principles of Anatomy and Physiology, 11th edition (2006), G. J. Tortora and B. Derrickson. Publisher-John Wiley and Sons Inc.
5. Endocrinology, 5th edition (2008), Mac. E. Hadley. Publisher-Pearson Education Inc. and Dorling Kindersley Publishing Inc.
6. Comparative Vertebrate Endocrinology 3rd edition (1998), P. J. Bentley. Publisher Cambridge University Press.
7. Vertebrate Endocrinology 3rd edition (1997), D. O. Norris. Publisher- Academic Press: An imprint of Elsevier.
8. The World of the Cell, 7th edition, (2005), Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin., Publisher - Benjamin Cummings.
9. Principles of Animal Physiology (2nd Edition) (2007) Christopher D. Moyes , Patricia M.

Schulte

10. Animal Physiology, Third Edition (2012) Richard W. Hill, Gordon A. Wyse, Margaret Anderson
11. Functional Anatomy and Physiology of Domestic Animals 4th Edition (2009) William O. Reece Animal Physiology 2nd Edition Richard W. Hill Publisher: Sinauer Associates, Incorporated
12. Eckert's Animal Physiology (2004) Roger Eckert, D.J. Randall, Warren Burggren, Kathleen French Publisher: W.H.Freeman & Co Ltd
13. Principles of Animal Physiology (2013) Christopher D. Moyes, Patricia M. Schulte • Publisher: Pearson Education Limited
14. Environmental Physiology of Animals (2004) Pat Willmer, Graham Stone, Ian Johnston • Publisher: Blackwell Publishing Ltd
15. Introduction to Animal Physiology (1998) Ian Kay Publisher: Bios Scientific Publishers Ltd

Note: Use the latest editions of the recommended books

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Course Code and Course Name:

ZOUT 231 : Entomology- I (Special Paper)

4 Credits: 60 Lectures

Semester III

After successfully completing this course, students will be able to:

CO1: Define entomology and Insects and understand origin and evolution of insects and their relation to other arthropods.

CO2: Give outline of Classification of insects up to family with distinguishing characters and examples of each order and family.

CO3: Explain the structure, chemical composition and functions of Integument and Derivatives of Integument.

CO4: Explain the structure, modifications of insect body regions and their appendages.

CO5: Explain the Comparative anatomical and histological structure of various body systems.

CO6: Explain the location structure and functions of various Endocrine and Exocrine glands.

CO7: Explain the location and structure of Light and Sound producing organs in various insects

Sr. No.	Name of the topic	Lectures allotted
1.	Introduction to Entomology: Definition, Origin, Evolution and Inter-relationship of insects with other arthropods.	(04L)
2.	General outline of Classification and Phylogeny of insects up to family : Aptrygote insects (4 orders), Exopterygote insects (16 orders) and Endopterygote insects (9 orders).	(19L)
3.	Integument : Structure, chemical composition and functions. Derivatives of Integument: Cuticular appendages & Processes.	(02L)
4.	Comparative study of : Head and its appendages; Thorax and its appendages ; Abdomen and its appendages.	(09L)
5.	Comparative anatomical and histological study of the following : Digestive system, Respiratory system, Circulatory system, Excretory system, Reproductive system, Nervous system and Sense organs.	(20L)
6.	Endocrine and Exocrine glands and Hormonal action.	(04L)
7.	Light and Sound producing organs.	(02L)

REFERENCE BOOKS:

1. A Text book of Entomology-By H. H. Ross (John Wiley and Sons, Ins. New York,).
2. An Introduction to Entomology- By J. H. Comstock (Ithaca, New York).
3. General & Applied Entomology- By K. K. Nayar, T.N. Anathakrishnan & B.V. David, (Tata McGraw-Hill, New Delhi).

4. General Entomology, 2nd edition- By M.S. Mani Oxford & IBH Publishing Company, New Delhi.
5. Imm's text book of entomology by O. W. Richards and R. G. Davies (Methuen and com, London) vol. I and II
6. Introduction to comparative Entomology- By R. M .Fox and J. W. Fox (Reinhold, New York)
7. Modern Entomology, 2nd edition- By D. B. Tembhare (Himalaya Publication House, Bombay).
8. Principles of insect morphology- By R. E. Snodgrass (Tata Mc-Graw Hill Bombay).
9. The Insect: Structure & Function- By R. F. Chapman (E.L.B.S., & E.U.P. London).

Note: Use the latest editions of the recommended books

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Course Code and Course Name:

ZOUT 231 : Genetics- I (Special Paper) **(4 Credits: 60 Lectures)**

Semester III

After successfully completing this course, students will be able to:

CO1: Define the basic terminologies in Genetics

CO2: Elaborate the advantages of model organisms used in genetic studies

CO3: Apply molecular methodologies in genetic analysis

CO4: Estimate gene frequencies

Sr. No.	Name of the topic	Lectures allotted
1.	Model Genetic System: Life cycles, genetic nomenclature and advantages of the following organisms commonly used in genetic studies: 1.1 T phages 1.2 *E.coli* *1.3 Saccharomyces cerevisiae* and *Schizosaccharomyces pombe* *1.4 C. elegans* *1.5 Drosophila* 1.6 Zebra fish 1.7 Mouse	6L
2.	Advanced Population Genetics: 2.1 Recapitulation of basic concepts and Hardy-Weinberg law. 2.2 Estimation of gene frequencies in population through mutation, migration and selection, selection-mutation equilibrium, derivation and genetic equations for above. 2.3 Assortative mating, inbreeding and genetic drift.	12L
3.	Quantitative genetics: 3.1 Concept of continuous variation, phenotypic variance and its partitioning into subcomponents. 3.2 Co-variance, correlation and regression, degree of genetic determination, measurement of heritability, quantitative inheritance in humans.	12L
4.	Evolutionary Genetics: 4.1 Genetic polymorphism. 4.2 Selection strategies and effects. 4.3 Genetics of speciation: classical and modern concepts. 4.5 Use of molecular information in understanding phylogenetic relationship.	12L
5.	Applications of Molecular methodologies in genetic analysis: 5.1 Introduction to gene localization on chromosomes. 5.2 Chromosomal Probes and Paints. 5.3 Gene Therapy: *Ex vivo* and *In vivo* gene therapy and two examples of gene delivery system. 5.4 Reverse Genetics.	12L

	5.5 History of Human genome project: Strategies, methodologies, and current status.	
6.	Genetics in Toxicology: 6.1 History of genetic toxicology and role of FDA, EPAand its guidelines and regulation. 6.2 Role of model organisms in genetic toxicology studies. 6.3 Screening tests: use of test systems- Bacterial, Yeast, *Drosophila* and Mammalian system.	06L

REFERENCE BOOKS:

1. An Introduction to Genetic Analysis – A.J.F. Griffiths, J. Doebley, C. Peichel, D.A. Wassarman (12th ed.) W.H. Freeman Publ. 2020.
2. Concepts of Genetics – W.S. Klug and M.R. Cummings (12th ed.) Pearson Publ. 2019.
3. Genetics : A conceptual approach – B.A. Pierce (6th ed.) W.H. Freeman Publ. 2016.
4. Lewin's GENES XII – J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick. Jones and Bartlett Publ. 2018.
5. Human Molecular Genetics – T. Strachan and A. Read (5th ed.) Garland Science Publ. 2018.
6. Genetics – M.W. Strickberger (3rd ed.) Pearson India Publ. 2015
7. Principles of Genetic Toxicology – D. Brusick. Springer (reprint of Basic Book Publ) 2013.
8. Principles of Genetics – E.J. Gardner, M.J. Simmons, D.P. Snustad (8th ed.) John Wiley & Sons 2006.
9. Genetics: Analysis of Genes and Genomes – D.L. Hartl and E.W. Jones (6th ed.) Jones & Bartlett Publ. 2004.
10. Strickberger's Evolution – B. Hall (4th ed.) Jones and Bartlett Publ. 2008.

Note: Use the latest editions of the recommended books

Course Code and Course Name:

ZOUT 232 : Fundamentals of Systematics and Economic Zoology **(4 Credits: 60 Lectures)**

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Semester III

After successfully completing this course, students will be able to: CO1:

Fundamentals of Systematics

CO1: Explain principles, methods of biological classification and diversity in kingdom Animalia.

CO2: Explain the importance of taxonomic keys and taxonomic characters.

CO3: Explain the principles of zoological classification and nomenclature

CO4: Discuss the various taxonomic procedures and molecular phylogenetics & phylogeography.

CO5: Illustrate the methodologies used in systematics.

Economic Zoology

CO1: Illustrate the lac culture, apiculture, prawn culture, vermiculture, Poultry, dairy industry and Piggery.

CO2: Explain the role of insects of economic importance.

CO3: Explain parasitic roundworms of animal and plants.

CO4: Signify the role of parasitic and soil protozoan in human welfare.

CO5: Justify the use of animals in pharmaceutical research.

CO6: Explain coral reef and its significance.

Sr. No.	Name of the topic	Lectures allotted
	Fundamentals of Systematics	
1.	Fundamental of Systematics: Biological classification, Hierarchy of Categories and taxa.	2L
2.	Taxonomic keys: Types of taxonomic keys, their merits and demerits. International code of Zoological nomenclature: Its operative principles, interpretation and application of important rules, zoological nomenclature, formation of names	7L
3.	Taxonomic procedures: taxonomic collection preservation, curetting process and identification.	3L
4.	Species concepts: Definition and types (Allopatric, sympatric, parapatric, sibling etc.)	2L
5.	Kingdoms of Life: General outline of kingdoms including Monera & Protista. Broad outline & Diversity in kingdom Animalia (Major and Minor phyla).	5L
6.	Methodologies in systematics: Morphology based taxonomy, Numerical taxonomy, Cyto-taxonomy and chemotaxonomy, Molecular systematic, DNA fingerprinting & Molecular markers for detection/evaluation of polymorphism, RFLP, RAPD etc.	8LL

7.	Molecular phylogenetics and phylogeography.	3L
	Economic Zoology	
1.	Animal husbandry: Poultry, Piggery, Dairy industry and wool industry.	08L
2.	Economic importance of insects: Apiculture, Lac culture, Sericulture, House hold insect and stored grain pest and Agricultural pest.	10 L
3.	Economic importance of amphibian, reptiles and birds.	02 L
4.	Vermiculture industry in India.	01 L
5.	Prawn culture	01 L
6.	Nematodes- parasitic roundworms of animals and plants.	01 L
7.	Helminthes as human and animal parasites.	02 L
8.	Concept of Coral reef and its significance.	01 L
9.	Sponge culture and its importance in industry.	01 L
10.	Parasitic protozoan's and their role in human welfare, soil protozoan's and their role in agriculture.	02 L
11.	Model animals in pharmaceutical industry.	01 L

REFERENCE BOOKS:

Fundamentals of Systematics :

1. Kato., The biology of biodiversity, Springer.
2. Avise J.C., Molecular markers, Natural history and evolution, Chapman and Hill, NY.
3. Wilson A.O., biodiversity, Academic Press, Washington.
4. Principals of systematic Zoology by Ernst Mayr.

Economic Zoology :

1. Economic Zoology: An Introductory Text-Book in Zoology, with Special Reference to Its Applications in Agriculture, Commerce, and Medicine, Herbert Osborn, Ulan Press (August 31, 2012)
2. Economic Zoology-Shukla and Upadhaya, Rastogi Publication, 2017
3. A Textbook of Economic Zoology, Dr Sanjeev Jain, Indian Books and Periodicals 2018.
4. Economic Zoology-Manju Yadav , Discovery Publication 2013
5. Economic Zoology-K.R.Ravindranathan , Om Publications 2013
6. Textbook of Economic Zoology- P.R.Venkitaraman Sudharsana Puubl. Kochi 1983
7. A Handbook on Economic Zoology , Dr Jawaid Ahsan And Dr Subhas Prasad Sinha S. Chand Group.
8. Encyclopedia of Economic Zoology, A.A. Khan. Anmol Publications
9. Economic Zoology by. Manju Yadav, Discovery Publishing House Pvt. Limited. Economic Zoology by Malhotra ,Prakash, Adhyayan Puhlishers & Distributers
10. Introduction to Economic Zoology, Sarkar, Kundu and Chaki, New Central Book Agency; New edition edition (14 May 2014)

Course Code and Course Name:

ZOUT 233 : Research Methodology and Insect Physiology and Biochemistry

(4 Credits: 60 Lectures)

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Semester III

After successfully completing this course, students will be able to:

Research Methodology

CO1: demonstrate knowledge of research processes (reading, evaluating, and developing)

CO2: perform literature reviews using print and online databases.

CO3: select and define appropriate research problem and parameters to prepare a project proposal.

CO4: identify, explain, compare, and prepare the key elements of a research proposal/report.

CO5: compare and contrast quantitative and qualitative research paradigms

CO6: Use sampling methods, measurement scales and instruments, and appropriate uses of each.

CO7: Justify the rationale for research ethics,

Insect Physiology and Biochemistry

CO1: Explain the structure, Chemistry of integument and sclerotization.

CO2: Describe the process of digestion and metabolism

CO3: Explain the characteristics of haemolymph and types of haemocytes.

CO4: illustrate the structure, physiology and biochemistry of flight muscle.

CO5: Demonstrate the process of excretion, detoxification and water balance

CO6: Justify the role of insect hormones in physiological processes.

Sr. No.	Name of the topic	Lectures allotted
	Research Methodology	
1.	Research: Meaning, Objectives, Types of research, Planning research project – Identifying Research problems, selection of problem – formulation of a problems. Literature review- Collection of literature- Books - Journals. Digital library and search of articles - Key words and search - Internet – Google Scholar – Pub med – Inflibnet – Medline	04L
2.	Data Collection: Meaning, Methods and Tools of Data Collection Hypothesis Sampling, Data Processing, Analysis and Interpretation of Data.	03L
3.	Research Design: Meaning and Objectives, Characteristics of good research design, components of the research design & steps in scientific research process.	02L
4.	Quantitative methods: Biostatistics used for analysis of Biological data	02L

5.	Computer application: bioinformatics, databases and their applications	03L
6.	Tools and techniques: • Techniques used Purification and characterization of biomolecules: Recapitulation of centrifugation, chromatography and electrophoresis. • NMR, MALDI-TOF, X-ray crystallography, Circular Dichroism CD • Microscopic techniques including Fluorescence microscopy, Confocal microscopy, Atomic force microscopy and live cell imaging FACS analysis.Real time PCR, DNA microarray, New generation DNA sequencing, Protein Microarray.	10L
7.	Dissertation structure –Components - Writing Introduction – review of literature – Materials & Methods – Presentation of results – Discussion of Results based on literature – Arriving conclusions – Briefing of Summary – Arrangement and how to quote reference in thesis -Appendix.	02L
8.	Publishing of Articles in National and International Journals - Selection of Journals – ISSN Number – Peer reviewed Journals – Science citation index – impact factor and its importance.	01L
9.	Intellectual property rights and patent law – Trade Related aspects of Intellectual Property Rights – Reproduction of published material – Plagiarism - Citation and acknowledgement Patent Criteria and procedure of patenting, patenting biological material.	03L
	Insect Physiology and Biochemistry	
10.	Integument: Structure, Chemistry, sclerotization, functions.	03 L
11.	Digestion and absorption of proteins, Carbohydrates and lipids.	03 L
12.	Fat body: Structure, physiology, biochemistry, functions. Integration of carbohydrate, fat and acid metabolism	04 L
13.	Ventilatory mechanisms and their control	03 L
14.	Haemolymph: Physico-chemical characteristics of plasma: types and structure of haemocytes, functions.	03 L
15.	Muscle: structure, physiology and biochemistry of flight muscles	03 L
16.	Excretion and water balance: Structure and function of Malpighian tubules. Water balance and nitrogen excretion.	04 L
17.	Endocrines, neurosecretory hormones, chemistry, function and mechanism of hormone action, moulting and juvenile hormones; chemistry and physiology, other peptide and steroid hormones	04 L
18.	Microsomal and extra-microsomal enzymes insecticide degradation and detoxification.	03 L

REFERENCE BOOKS:

Research Methodology

1. Kothari, C.R. (1985): Research Methodology: Methods and Techniques, Wiley Eastern.
2. Dominowski, R.L. (1980): Research Methods, Prentice Hall Inc., New Jersey.
3. Mishra, R.P. (1980): Research Methodology, Handbook Concept Publishing Company, New Delhi.
4. IIPS (1996): Research Methodology, IIPS, Mumbai.
5. Research and Writtings – By-P. Ramdas , A.Wilson srunai M.J.Publisher (2009).
6. Scientific thesis writings and Paper presentations-N.Gurumani. M.J.Publisher (2010).
7. Anderson, Durston&Polle 1970: Thesis and assignment, writing Wiley Eastern Limited

Sonavane College, KOPARGAON SCIENCE LIBRARY

8. G. Vijayalakshmi and C. Sivapragasam. (2008) Research Methods –Tip & Techniques MJP
9. Publishers, Chennai. WWW.mjppublishers.com
10. Malter K. 1972: Statistical analysis in Biology, Chapmen Hall, London.
11. Cohen, L. Lawrence, M., & Morrison, K. (2005). Research Methods in Education (5th edition). Oxford: Oxford University Press.
12. Leedy, P. D. (1980). Practical Research: Planning and design. Washington: Mc Millan Publishing Co., Inc.
13. Singh, Y. K. (2006). Fundamental of Research Methodology and Statistics. New Delhi. New International (P) Limited, Publishers

Insect Physiology and Biochemistry

1. Fundamentals of insect physiology, Blum N.S., John Wiley and sons, NY
2. An introduction to insect physiology, Bursell, e. academic press, NY
3. Insect biochemistry and function Candy D.J. and Kilby D.A. Chapman and hall, London
4. Comprehensive insect physiology, biochemistry and pharmacology, Kerkut G.A and Gilbert L.I., Vol 1 to 13 Pergamon press, Oxford, NY
5. The Insects: Structure and Function. Forth ed., Chapman R. F. (1998), Cambridge University Press, UK.
6. Insect Physiology. Prakash, M. (2008), Discovery Publishing House Pvt. Ltd., New Delhi.
7. Physiological Systems in Insects. Second ed., Klowden, Marc (2007), Elsevier, USA
8. The Principles of Insect Physiology, Seventh ed. Wigglesworth, V.B. (1972), Chapman and Hall, London.

Course Code and Course Name: **(2 Credits: 30 Lectures)**

ZODT 234 : Immunology

Semester III

After successfully completing this course, students will be able to:

CO1: List the primary and secondary immune organs.

CO2: Explain the concepts of immunity, self-nonself immune response, autoimmune disease.

CO3: Explain the theories of antibody synthesis and generation of antibody diversity.

CO4: Explain the principle and application of the common techniques used in Immunology

CO5: Illustrate the events and dynamics of inflammation

CO6: Compare the MHC molecules and diseases associated with HLA.

CO7: Differentiate between active and passive immunization

CO8: Compare the three pathways of complement fixation pathway.

Sr. No.	Name of the topic	Lectures allotted
1.	Introduction to Immune system. 1.1. Overview of Immunology 1.2. Innate and Adaptive immunity; Humoral immunity and cell mediated immunity 1.3. Primary and secondary lymphoid organ. Tissue, cells and molecules of the human immune system. 1.4. Immediate response to infection: inflammation, cell migration, acute phase response interferons and NK cell. 1.5. Concept of immunity (self- non self, antigen) and active and passive immunization (natural and artificial)	07L
2.	Antibody structure, antibody classes, subclasses, structure-function relationship, iso, idio and allo types., T cell receptors.	04L
3.	Theories of antibody synthesis, generation of antibody diversity (molecular basis), antibody class switching.	03L
4.	MHC, HLA and disease association, immune deficiencies and disorders. Antigen processing & Immunogenetics.	05L
5.	Immunological Tolerance, Autoimmunity	02L
6.	Hypersensitivity.	01L
7.	Immunological memory, types of vaccines and vaccination	02L
8.	Immunotechniques: Antigen-antibody reaction and complement system and complement fixation test.	02L
9.	Hybridoma principle and application, ELISA, immunofluorescence, immunoelectrophoresis, RIA and monoclonal-polyclonal antibody and its application.	04L

REFERENCE BOOKS:

1. Immunology: Kindt T. J., Goldsby R.A. , Osborme B. A., Kuby J. : freeman WH publications.
2. Essential immunology, IvonRoitt, Blackwell Scientific publication, London.
3. Immunology, Roitt I. V., Butterworth Publishers, USA.

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Course Code and Course Name:

(2 Credits: 30 Lectures)

ZODT 234 : Genetic Toxicology

Semester III

After successfully completing this course, students will be able to:

CO1: Define genotoxicity test systems.

CO2: Describe basic toxicological principles and describe how different chemicals are taken up by, processed in and eliminated from the body

CO3: Inspect physical and chemical genotoxic agents being exposed in his/her environment

CO4: Illustrate physical and chemical genotoxic agents.

CO5: Explain efficiency mechanisms of physical chemical genotoxic agents

CO6: Relate genotoxicity and DNA repair mechanisms and relate types of mutation and DNA repair

CO7: Judge about proper genotoxicity test for mutation types

Sr. No.	Name of the topic	Lectures allotted
1.	Toxicology: Definition and its subdivisions, scope and significance of genetic toxicology	03L
2.	Mutations at molecular, functional and chromosomal levels. Mechanisms of Mutagenesis End point mutations and its function, carcinogenicity and transformation. Biological significance of mutagenesis	07L
3.	Mutagenic agents in human environment. Applications of genetic toxicology to human and environmental monitoring	05L
4.	Methodologies used in detection of mutation, functional, cytogenetic effects. Use of Ames test, mammalian systematics, Drosophila etc.	05L
5.	Screening chemicals for genotoxic properties: Screening tests, hazard assessment, Risk analysis tests. Common assays used for testing mutagenic activity using bacteria, yeasts, insects, plants, animals.	07L
6.	Genetic toxicology and its role in the study of congenital malformations	03L

REFERENCE BOOKS:

1. Chemical mutagens- principles and methods for their detection, Ed. Hollander, A. Vol. 1-5, Plenum press
2. Chemical mutagenesis in mammals and men. Eds. Vogel, F. and Rohtborn, G. Springer Verlag

3. Mutagenic effects of Environmental contaminants, Eds. Suttoa, H.E. and Harris, M.I., Academic press
4. Mutation research (section on genetic toxicology testing)
5. Genetic Toxicology: Principles and methods, Parry J.M., Parry E.M. (eds) Springer Publ. (2012)
6. Principles of Genetic Toxicology, Second Edition, David Brusick, Springer Science+Business Media New York

Course Code and Course Name:

ZODP 234 : Zoology Practical Paper-3 (Immunology) **(2 Credits: 60 Hours)**

Semester III

Note: A total of 15 practicals are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

CO1: Identify the pattern of identity of antigen- antibody reaction.

CO2: Identify the microscopic structure of the lymphoid organs.

CO3: Demonstrate immunoelectrophoresis technique.

CO4: Demonstrate the double diffusion techniques.

CO5: Detect the human blood groups by antigen -antibody reactions

CO6: Prepare the human blood smear to identify various blood cells.

Sr. No.	Name of the topic	Lectures allotted
1.	Double diffusion or Ouchterlony technique (using kit). **(Compulsory)**	(2P)
2.	Demonstration of Immunoelectrophoresis (using kit). **(Compulsory)**	(2P)
3.	Separation of e gamma globulins from the serum using native PAGE.	(2P)
4.	Histology of lymphoid organs: skin, spleen, thymus, ileum lymph node and bone marrow. **(Compulsory)**	(1P)
5.	To study the differential count of WBCs. **(Compulsory)**	(1P)
6.	Cell counting and viability testing using splenocytes (from goat spleen)	(2P)
7.	To estimate the antigen concentration by rocket electrophoresis (kit using). **(Compulsory)**	(2P)
8.	To study the immunology of blood transfusion (universal donor, universal recipient, Bombay blood group and erythroblastosis foetalis). **(Compulsory)**	(1P)
9.	Blood group analysis with reference to cross matching.	(1P)
10.	Demonstration of Various routes of egg inoculations for vaccine production using dye. (amniotic, yolk sac, allantoic and chorio-amniotic)	(1P)
11.	Enzyme detection: acid phosphatase, alkaline phosphatase, esterase	(1P)

Course Code and Course Name:

ZODP 234 : Zoology Practical Paper-3 **(2 Credits: 60 Hours)**

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Semester III

Note: A total of 15 practicals are to be conducted. 1 practical is of 4 clock hour duration.

Sr. No.	Name of the topic	Lectures allotted
1.	Dominant lethal test in *Drosophila* **(Compulsory)**	2 P
2.	Sex linked recessive lethal test in *Drosophila* **(Compulsory)**	2 P
3.	Micronucleus test in mouse	2P
4.	Bone marrow chromosome analysis in mouse	2P
5.	Auxotroph mutation induction in Bacteria	2P
6.	Ame's test **(Compulsory)**	2P
7.	Study of Drosophila mutants and maintaining *Drosophila* culture. **(Compulsory)**	2P
8.	DNA analysis using electrophoretic technique	1p
9	Temporary stained preparation of blood smear	

Course Code and Course Name:+ **(4 Credits: 120**

ZOUP 235 : Special Lab I

Hours)

Semester III

Note: A total of 30 practicals are to be conducted. 10 practicals from each module are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

Module-I: Animal Physiology-I

CO1: Demonstrate the effect of body size and salinity on oxygen consumption in given animal.

CO2: Demonstrate the effect of starvation on liver and muscle glycogen in given animal

CO3: Demonstrate the effect of exercise on breathing, pulse rate and blood lactate level.

CO4: Demonstrate the effect of pH, temperature and inhibitors on salivary amylase.

CO5: Map the taste buds on human tongue

Module-II: Fundamentals of Systematics and Economic Zoology

CO1: Identify museum specimen/pictures of minor phyla, Invertebrates, Protochordates and Vertebrates.
CO2: Identify animals with the help of taxonomic keys.
CO3: Collect and preserve animal samples using common methods.

CO4: Write scientific report of field/ institutional visit.

CO5: Compare the methods of collection and curation of insects.

CO6: Identify the poultry breeds.

CO7: Identify edible freshwater fish from nearby area.

CO8: Demonstrate the apiculture equipment.

CO9: Demonstrate the methods of prawn culture.

CO10: Compare various fishing tools, crafts and gears.

Module-III: Research Methodology and Insect Physiology and Biochemistry

CO1: Use MS excel in presentation and analysis of data using common statistical tests.
CO2: Suggest a suitable title for a research article.
CO3: Write the abstract, key words, result, discussion, conclusion and citations of references.

CO4: Write a research project to seek funding.

CO5: Conduct a scientific survey.

CO6: Perform protein purification experiment.

CO7: Demonstrate the heart and haemocytes of cockroach.

CO8: Demonstrate the effect of starvation on glycogen in insects.

CO9: Demonstrate the effect of temperature on water loss in cockroach.

CO10: Detect the amino acids in insect haemolymph by chromatographic method.

CO11: Determine the oxygen consumption in dragon fly nymph

CO12: Perform the assay of amylase activity in midgut of insect

Sr. No.	Name of the Practical	No. of Practicals
	Module-I: Practical Animal Physiology-I	
1.	Body size and oxygen consumption in aquatic animals **(Compulsory)**	1P
2.	Estimation of Respiratory Quotient by Warburg's Respirometer	1P
3.	Effect of salinity on oxygen consumption in aquatic animals **(Compulsory)**	1P
4.	Effect of exercise on breathing rate, pulse rate and blood lactate of man **(Compulsory)**	1P
5.	Effect of pH, temperature and incubation on human salivary amylase activity. **(Compulsory)**	1P
6.	Absorption spectra of blood pigment **(Compulsory)**	1P
7.	Mapping of taste areas on human tongue. **(Compulsory)**	1P
8.	Carbohydrates in mammalian gut **(Compulsory)**	1P
9.	Effect of starvation on liver and muscle glycogen in mouse **(Compulsory)**	1P

10.	Preparation of glycerinated muscle fibers and study of its properties. **(Compulsory)**	1P
11.	Phosphagen kinase in mouse and crab muscle phosphagen	1P
12.	Effect of load on muscles contraction in frog	1P
13.	LDH isoenzymes isolation and detection using agarose gel electrophoresis in heart / skeletal muscle of rat	1P
14.	Determination of Body Mass Index (BMI)	1P
	Module-I: Practical Entomology- I	(02P)
1.	Method of collection, preservation & presentation of insects.	(06P)
2.	Study of Taxonomy and diagnostic features up to family of Apterygote, Exopterygote and Endopterygote insects (at least one insect from each order). **(Compulsory- 3)**	(03P)
3.	Study of generalized insect: Grasshopper/ Cockroach i. Systematic position, Habit, Habitat and Important morphological features. ii. Dissection so as to study: Digestive, Nervous and Reproductive system and Retro-cerebral complex. **(Compulsory)**	(01P)
4.	Temporary mounting of mouth parts, antenna, legs, wings, spiracles and tympanum of a generalized insect. **(Compulsory)**	(03P)
5.	Dissection of an insect pest (Plant bug or any insect pest as per local availability and legal permissibility) so as to study taxonomy, diagnostic features and anatomy pertaining to digestive, nervous and reproductive systems.	(02P)
6.	Study of head capsule: Structure of head capsule, head orientations and modifications. Study of types of mouthparts and antennae. **(Compulsory- 1)**	(02P)
7.	Study of general structure of legs and their modifications. Study of general structure of a wing and its modifications. **(Compulsory)**	(01P)
8.	Study of abdominal appendages.	[1P]
	Module-I: Practical Genetics- I	[1P]
1.	Analysis of metric trait and estimation of phenotypic variance.	[1P]
2.	Partitioning of phenotypic variance in genetic and non-genetic components in a simulated population. Estimation of DGD.	[1p]
3.	Detection of polymorphism in a population – Biochemical (Enzyme, protein etc.)	[2P]
4.	To study population cage experiments using *Drosophila*: a) Genetic Drift b) Artificial selection- Experimental simulation and modeling.	[1P]
5.	Extraction of Genomic DNA (*Drosophila*).	[1p]
6.	*In-silico* design of PCR primers for a gene of interest.	[2P]
7.	Chromatography of *Drosophila* eye colour pigments (wild type and/ or eye colour mutants).	[2P]
8.	Microbial genetics: Basic methodology, colony count and growth curve.	[1P]
9.	Microbial genetics: Isolation of Auxotroph (Estimation of frequency) Replica plate technique.	[2P]
10.	Microbial genetics: Bacterial transformation and blue white selection. Calculation of transformation efficiency.	[1P]
11.	Study of conventions of nomenclature of genes, genotypes and gene products in different model systems.	[1P]
12.	Sex-linked recessive lethal test in *Drosophila*.	

	Module-II: Practical Fundamentals of Systematics and Economic Zoology	
	Practical Fundamentals of Systematics	
1.	To Study specimens of Minor phyla. **(Compulsory)**	1
2.	Study of museum specimens and slides of invertebrates, (2 examples from each phyla). **(Compulsory)**	2
3.	Study of museum specimens (protochordates and chordates,1or 2 examples of each phyla) **(Compulsory)**	2
4.	Identification of animals with the help of keys-House fly, Honey bee etc. **(Compulsory)**	1
5.	Identification of animals with the help of keys- Cockroach, Earthworm.	1
6.	Method of collection, Preservation, and Curetting of any insect Specimen **(Compulsory)**	2
7.	Visits to Scientific Institute like Zoological Survey of India/ Animal Museum and Report writing.	2
	Practical Economic Zoology	
1.	Study of Prawn culture on commercial basis.	1P
2.	Study of Apiculture equipments. **(Compulsory)**	1P
3.	Study of Poultry breeds, feeding utensils in poultry. **(Compulsory)**	2P
4.	Study of Fishing tools: crafts and gear **(Compulsory)**	2P
5.	Study of economic importance of freshwater fishes- *Catla*, Rohu, *Labeo*, *Mrigala*, *Notopterus*, *Mystus* sp., Clarius, *Channa*, *Heteropneustes*, *Reba*, *Wallago*. **(Compulsory)**	2P
6.	Collection and identification of locally available/cultured fishes.	1P
7.	A visit to piggery/ poultry/ pearl culture centre/ apiculture centre/ sericulture centre and report writing **(Compulsory)**	1P
	Module-III: Practical Research Methodology and Insect Physiology and Biochemistry	
	Practical Research Methodology	
1.	Selecting a title for the paper, writing the abstract and key words. **(Compulsory)**	1P
2.	Writing the Discussion Conclusions and Results: Citation of references **(Compulsory)**	1P
3.	Importance of scientific surveys, primary data and secondary data in research.	1P
4.	Writing a project proposal to a funding agency **(Compulsory)**	1P
5.	Use of MS Excel in data presentation.	1P
6.	Examples of some common statistical tests. **(Compulsory)**	2P
7.	Purification of a biomolecule.	1P
8.	Making a ICT enabled scientific presentation. **(Compulsory)**	1P
9.	Microscopic techniques.	1P
10.	Presentation of any ONE research paper. **(Compulsory)**	1P
	Practical Insect Physiology and Biochemistry	
1.	Kymographic study of ventilatory movement in beetle	1P
2.	Oxygen consumption in dragon fly nymph **(Compulsory)**	1P
3.	Study of heart and haemocytes of cockroach **(Compulsory)**	1P
4.	To determine the trehalase activity in haemolymph of any insect	1P
5.	Amino acid in haemolymph of any insect by chromatographic technique	2P

6.	Study of fat body glycogen of cockroach and effect of starvation **(Compulsory)**	1P
7.	Effect of temperature on water loss in cockroach **(Compulsory)**	1P
8.	Von Wisselinghs test for presence of chitin in insect cuticle **(Compulsory)**	1P

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M.Sc. Zoology, Part II, Semester – IV

Course Code and Course Name: **(4 Credits: 60 Lectures)**

ZOUT 241: Animal Physiology- II (Special Paper)

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain the composition of blood, types of blood cells, vascular dynamics and clotting.
CO2: Illustrate the anatomy and physiology of heart and cardiac cycle
CO3: Describe the excretory system, nitrogenous wastes and renal regulation
CO4: Illustrate the osmoregulatory mechanism in Invertebrates and Vertebrates
CO5: Discuss the neuronal physiology and various potentials.
CO6: Justify the location and structure of eye, ear and taste buds to their functions.
CO7: Justify energy utilization in physiological and metabolic activities.

Sr. No.	Name of the topic	Lectures allotted
1.	**Blood and blood vessels:** a) Blood composition and function, Haematopoiesis b) Blood clotting and it's molecular mechanism c) Blood vessels and blood pressure: Blood vessel types, Arteries, role as pressure reservoir and arterial pressure: Aeteriole:role in distribution in cardiac output and maintainance of arterial blood pressure, Capillaries and it's functions, veins:its role as blood reservoir and venous return d) Blood pressure-Hypertension and Hypotension	(08L) (09L)
2.	**Cardiac Physiology:** a) Anatomy of heart	

	b) Electrical activity of the heart pace makers, spread of cardial coupling, action potential of cardiac cells c) Elecrocardiography d) Mechanism events of cardiac cycle, Heart sound e) Neuronal and Hormonal control of heart f) Cardiovascular response of exercise	
3.	**Excretion & Osmoregulation:** a) Nitrogenous waste- ammonia and its excretion, urea, urea cycle, uric acid and its excretion, products of nucleoprotein metabolism, miscellaneous end product of nitrogen metabolism. b) Organ of excretion and urine formation c) Renal regulation and acid –base balance. d) Maintaining water and electrolyte balance and its regulation in aquatic invertebrates & vertebrate, moist skinned animals, arthropods, terrestrial, vertebrate and marine air breathing vertebrates.	(09L)
4.	**Neuronal Physiology:** a) Nerve cells : Structure & Function b) Excitation and conduction of nerve fiber: Resting membrane potential, Action potential, all or none law, electronic potential, saltatory conduction c) Ionic basis of excitation and conduction d) Neurotransmitter types and receptors: Metabolism of neurotransmitters, Neuropeptides e) Synapse and Neuronal integration f) Impact of drugs and disease on synaptic transmission	(8L)
5.	**Sensory Physiology**: a) Receptor types, receptor potential and receptor adaptation b) Eye-structure and physiology of vision c) Ear-Hearing and equilibrium, sound waves and it's characters, structure of ear and physiology of hearing and equilibrium d) Chemical senses : Taste and smell e) Tactile sensation / response	(09L)
6.	**Energy metabolism:** a) Metabolic rate b) Energy storage: Fat and glycogen c) Effect of O2 concentration: acclimation to low O2 level, anaerobic metabolism, lactic acid and glycolysis d) Problem of diving and deep sea hydro thermal vent e) Metabolic rate and body size: mammals, birds, marsupials & monotremes f) Energy cost of locomotion: running, swimming, flying g) Effect of high altitude	(12L)
7.	**Stress & Adaptation:** a) The Autonomic nervous system & HPA axis coordinate the stress response to an acute threat. b) The HPA axis modulates the immune system. c) Chronic stress causes deleterious effects. d) Plasma glucocorticoid concentration shows seasonal variations.	(05L)

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REFERENCE BOOKS:

1. Principles of animal physiology. (2006), C. D. Moyes and P. M. Schulte. Publisher - Pearson Education Inc. and Dorling Kindersley Publishing Inc.
2. Text book of Medical Physiology. 10th edition (2001),. A. C. Guyton and J. E. Hall. Publisher - W. B. Saunders Company, Philadelphia.
3. Principles of Anatomy and Physiology, 11th edition (2006), G. J. Tortora and B. Derrickson. Publisher-John Wiley and Sons Inc.
4. Endocrinology, 5th edition (2008), Mac. E. Hadley. Publisher-Pearson Education Inc. and Dorling Kindersley Publishing Inc.
5. Comparative Vertebrate Endocrinology. 3rd edition (1998), P. J. Bentley. Publisher- Cambridge University Press.
6. Vertebrate Endocrinology. 3rd edition (1997), D. O. Norris. Publisher- Academic Press: An imprint of Elsevier.
7. The World of the Cell, 7th edition, (2005), Wayne M. Becker, Lewis J. Kleinsmith, Jeff Hardin., Publisher - Benjamin Cummings.
8. Molecular Cell Biology, 6th edition (2007). Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, Paul Matsudaira, Publisher-W. H. Freeman.
9. Molecular Biology of the Cell, 5th edition (2007). Bruce Alberts, Alexander Johnson, Julian Lewis, Martin Raff, Keith Roberts, Peter Walter. Publisher - Garland Science.
10. An Outline of Energy Metabolism in Man, Gordon L. Atkins, William Heinemann Medical Books Limited, London 1981
11. Stress Physiology in Animals, Paul H.M. Balm, Blackwell; 1 edition (20 August 1999).
12. Sensory Systems: Anatomy, Physiology and Pathophysiology, Aage R. Moller, Academic Press 2003.

Course Code and Course Name: **(4 Credits: 60 Lectures)**

ZOUT 241: Entomology- II (Special Paper)

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain Gametogenesis, Fertilization and oviposition.

CO2: Explain embryonic developmental stages such as Cleavage, Blastoderm and Germ band formation; Gastrulation, Blastokinesis, differentiation of germ layers, Segmentation and Appendages formation and organogenesis.

CO3: Explain post-embryonic developmental stages such as Nymph, Naiad, larva, Pupa and Metamorphosis.

CO4: Explain specialized reproductive mechanisms.

CO5: Explain Hadorn's experiments with imaginal disc, Regeneration and Aging.

CO6: Explain Occurrence, Initiation, Preparations for diapauses and its Controls.

Sr. No.	Name of the topic	Lectures allotted
1.	**Gametogenesis** : Spermatogenesis, Seminal transfer and spermatophore formation; Oogenesis, Structure and Types of insect eggs. Fertilization and oviposition.	(08L)
2.	**Insect embryonic development:** Cleavage and Blastoderm formation, Germ band formation, Gastrulation, Embryonic membranes, Blastokinesis, Dorsal closure and dorsal organ, Fate/ differentiation of germ layers, Segmentation, Appendages formation and organogenesis in brief.	(18L)
3.	**The post embryonic development:** Eclosion from the egg. The developmental stages: Nymph, Naiad, larva, Pupa, Emergence from the pupa/ cocoon. Metamorphosis and Growth.	(20L)
4.	**Specialized reproductive mechanism:** Oviparity, viviparity, polyembryony, paedogenesis and parthenogenesis.	(04L)
5.	Hadorn's experiments with imaginal disc, Regeneration and Aging.	(06L)
6.	**Diapause:** Occurrence, Initiation and Preparations for diapauses. Diapause development and Controls.	(04L)

REFERENCE BOOKS:

1. 'The Insect- structure and Function'- by R.F. Chapman , ELBS, London
2. 'A Text book of Entomology'- by H. H. Ross (John Wiley and Sons, Ins. New York,
3. 'Imms' Text Book of Entomology- by O. W. Richards and R. G. Davies, (Methuen &Cc., London,), Vols. I & II.
4. 'Embryology of Insects and Myriapods'- by O. A. Johanson and F.H. Butt, (McGraw Hill, New York,).
5. 'The ecology of insect populations in theory and practice'- by L.R. Clarks P. W. Geier, R.D. Hughes, R.F. Morris (Methuen, London).
6. 'Developmental system: Insects' Vol. I and II- by S. J. Counce and C.H. Waddington (Academic Press, London,).

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Course Code and Course Name: **(4 Credits: 60 Lectures)**

ZOUT 241: Genetics- II (Special Paper)

Semester IV

Sr. No.	Name of the topic	Lectures allotted
1.	Solving problems (Numerical: Probability estimation) of Mendelian and non-mendelian genetics.	02L
2.	Basic Human Genetics: 2.1 History of Human Genetics 2.2 Pedigree- Gathering Family history, pedigree symbols, construction of pedigrees, Autosomal inheritance- Dominant &Recessive, Monogenic traits(Sex Linked inheritance, Sex Limited & Sex-influenced traits, mitochondrial traits), MIM number. 2.3 presentation of molecular genetic data in pedigrees 2.4 Complications to the basic pedigree patterns- non penetrance, variable expressivity, pleiotropy, late onset, dominance problems, genetic heterogeneity, genomic imprinting & uniparental disomy, spontaneous mutations, mosaicism & chimerism, male lethality, X- inactivation. 2.5 Parametric and non-parametric analysis, identifying recombinants & non recombinants in pedigree, two- point mapping- LOD score analysis, genetic & physical map distances, genetic markers.	12L
3.	Clinical Genetics : 3.1 Monogenic diseases- 3.1.1 Cystic Fibrosis 3.1.2 Tay-Sachs syndrome 3.1.3 Marphan syndrome 3.2 Triplet repeat based disorders 3.3 Inborn metabolic errors-	15L

	3.3.1 Disorders of carbohydrate metabolism 3.3.2 Disorders of nucleic acid metabolism 3.3.3 Disorders of lipid metabolism 3.3.4 Lysosomal storage disorders 3.3.5 Peroxisomal disorders 3.4 Disorders of Hematopoietic systems- 3.4.1 Overview of blood cell types & haemoglobin 3.4.2 Sickle cell anemia 3.4.3 Thalassemia 3.4.4 Hemophilia's 3.5 Prenatal and pre-implantation diagnosis 3.5.1 Indications for prenatal diagnosis 3.5.2 Indications for chromosomal testing 3.5.3 Non- invasive methods 3.5.4 Invasive methods	
4.	Epigenetics: concept and applications	2L
5.	Physical mapping methods: 5.1 Low resolution mapping- cell hybrids, radiation hybrid mapping, synteny homology. 5.2 Restriction maps, clone contig maps, STS map, EST map, DNA sequence map.	3L
6.	Immunogenetics: 6.1 Genetic basis of antibody diversity. 6.2 Regeneration of TCR diversity. 6.3 HLA polymorphism and disease association.	3L
7.	Oncogenetics : 7.1 Concepts of oncogenes and tumor suppressor genes. 7.2 Role of oncogenes. 7.3 Cytogenetic studies.	3L
8.	Behavioural Genetics: 8.1 Rothenbuhler's experiment on genetics of Bee behavior (hygienic and non-hygienic Trait). 8.2 Nature-nurture and behavior- 8.2.1 Genetic experiments to investigate animal behavior- 8.2.1.1 Selection studies. 8.2.1.2 Inbred strain studies. 8.3 Identifying genes for controlling behavior- 8.3.1 Induced mutations 8.3.2 Quantitative trait loci. 8.3.3 Synteny orthology. 8.4 Twin and adoption study designs. 8.5 Environmental influence- shared and non-shared environment. 8.6 Genetics of human behavioural defects- Schizophrenia.	5L
9.	Neurogenetics: 9.1 Genetics of Circadian rhythm (sleep-wake cycle), learning and memory mutants in *Drosophila*. 9.2 Psychopathology- Alzheimer's disease	3L

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10.	*Drosophila* genetics: 10.1 History of *Drosophila* genetics. 10.2 Genetic basis of Sex determination and dosage compensation in *Drosophila*. 10.3 Maternal genes and formation of body axis. 10.4 Segmentation genes. 10.5 Homeotic gene functions. 10.6 Regulation of Hox- gene expression	6L
11.	Bacterial and phage genetics: 11.1 Bacteriophage lambda: morphology and structure of nucleic acids, lytic cycle and lysogeny. 11.2 T even and odd phages: bacteriophage T2, T4 and T7 morphology, nucleic acid structure and life cycle. Special features compared to lambda 11.3 RNA phages: Q beta and MS2, replication and concept of overlapping genes	6L

REFERENCE BOOKS:

1. An Introduction to Genetic Analysis – A.J.F. Griffiths, J. Doebley, C. Peichel, D.A. Wassarman (12th ed.) W.H. Freeman Publ. 2020.
2. *i*-Genetics : A molecular Approach – P.J. Russell. Pearson Publ. 2016.
3. Concepts of Genetics – W.S. Klug and M.R. Cummings (12th ed.) Pearson Publ. 2019.
4. Lewin's GENES XII – J.E. Krebs, E.S. Goldstein, S.T. Kilpatrick. Jones and Bartlett Publ. 2018.
5. Genetics – M.W. Strickberger (3rd ed.) Pearson India Publ. 2015
6. Genetics : The continuity of Life – D.J. Fairbanks and W.R. Andersen. Thomson Brooks / Cole Publ. 1999.
7. Principles of Genetics – E.J. Gardner, M.J. Simmons, D.P. Snustad (8th ed.) John Wiley & Sons 2006.
8. Genetics: Analysis of Genes and Genomes – D.L. Hartl and E.W. Jones (6th ed.) Jones & Bartlett Publ. 2004.
9. Developmental Biology – S.F. Gilbert (10th ed.) Sinauer Associates Inc. 2013.
10. Medical Genetics – L.B. Jorde, J.C. Carey, M.J. Bamshad (5th ed.) Elsevier 2015.
11. Genetics in Medicine (Thomson & Thomson) – R.L. Nussbaum, R.R. McInnes, H.F. Willard (8th ed.) Elsevier 2016.
12. Behavioral Genetics – V.S. Knopik, J.M. Neiderhiser, J.C. DeFries, R. Plomin (7th ed.) Worth Publ. 2016. An Introduction to Genetic Analysis – A.J.F. Griffiths, J. Doebley, C. Peichel, D.A. Wassarman (12th ed.) W.H. Freeman Publ. 2020.

Course Code and Course Name:

ZOUT 242: Mammalian Reproductive Physiology and Aquaculture

(4 Credits: 60 Lectures)

Semester IV

After successfully completing this course, students will be able to:

Mammalian Reproductive Physiology

CO1: Explain the male and female reproductive systems and sexual dimorphic characteristics

CO2: Explain the sexual cycles with examples

CO3: Illustrate the reproductive dysfunctions.

CO4: Diagrammatically represent the hormonal regulation of reproductive processes like pregnancy, lactation and parturition.

CO5: Prepare the flow chart to demonstrate the hormonal coordination of reproductive Processes

CO6: Justify the artificial control of reproduction.

Aquaculture

CO1: Identify the fish diseases and the causative organisms

CO2: Mention the various composite fish culture with significance of each type.

CO3: Describe the methods of freshwater prawn culture and its management.

CO4: Explain the methods of pearl culture and pearl harvesting.

CO5: Illustrate the preparation and management of fish culture ponds.

CO6: Demonstrate the methods of packaging and transport of fish and brood fish.

CO7: Illustrate techniques of fish harvesting, preservation & processing.

CO8: Compare the techniques used in fishery development.

Sr. No.	Name of the topic	Lectures allotted
	Mammalian Reproductive Physiology	
1.	Reproductive Systems: Anatomy of Male Reproductive System, Accessory organs and their function Spermatogenesis, Function of Sertoli cells, Blood Testisbarriers, inhibin, Leydig cell. Capacitation. Functions of Androgens.	05L

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	Anatomy of Female Reproductive System.	
2.	Reproductive patterns: Environmental factors and breeding, continuous and seasonal breeders.	02L
3.	Sexual cycles: puberty, oestrous and menstrual cycles and its hormonal regulation. Ovarian cycle and its hormonal regulation. Cycling of non-pregnant uterus and vagina.	04L
4.	Hormonal regulation: GnRH, pituitary gonadotropins, behavioural effects, testicular hormones, testosterone derivatives, inhibin, ovarian hormones: Pituitary gonadal axis, Oestrogen, progesterone's feedback relationships Prostaglandins and their role in reproduction.	04L
5.	Fertilization, Gamete Transportation Pregnancy: conception and blastocyst formation, implantation and delayed implantation, hormonal regulation in pregnancy.	04L
6.	Placenta: formation, types and functions,	02L
7.	Parturition; birth process, Ferguson reflex, neuroendocrine control, purperium	02L
8.	Lactation: Anatomy and growth of mammary glands, Lactogenesis and galactopoiesis. Hormonal regulation and suckling reflex	02L
9.	Reproductive dysfunctions: Aging and reproduction. Climacteric, anatomical, endocrine and genetic disorders.	01L
10.	Artificial control of reproduction: increasing reproductive potential, artificial insemination, in vitro fertilization and embryo transfer, induced breeding, physical, physiological, surgical, chemical methods of contraception in male, female. Infertility: its causes and treatment, Recent advances in female contraception. Prenatal diagnostic test for genetic disorders-foetal ultra-sonography, Amniocentesis, Chorionic villi sampling,	04L
	Aquaculture	(1L)
1.	**Aquaculture concept and its scope** Nutritional value of fish	(3L)
2.	**Physicochemical parameter of water for fish culture** pH, Calcium, Total Alkalinity, Nitrate, Ammonia, Total hardness of fresh water	(3L)
3.	**Construction and management of fish culture pond:** Construction of ponds, management of ponds, Predatory and weed fishes and their control, Aquatic weeds and their control, Aquatic insects and their control, fish feeding: natural and artificial.	(2L)
4.	**Fish breeding: natural and induced.** Natural breeding in pond water, Induced breeding- Pituitary extract, selection of breeders, injection of pituitary extract, spawning, Advantages of induced breeding.	(3L)
5.	**Transport of fish seed and Brood fish**: causes of mortality in transport, methods for packaging and transport, open systems, closed systems, use of chemicals in live fish transport, anesthetic drugs, antiseptics & antibiotics.	(7L)
6.	**Fish culture:**Selection of cultivable fish, monoculture, composite culture, culture of Indian major carps, Culture of common carps, culture of cat fishes, paddy cum fish culture, mari culture, cage culture, integrated fish farming	(2L)
7.	**Fish preservation, processing and byproducts.** Fish preservation techniques, fish biproducts.	

8.	**Fish pathology:** bacterial, fungal, protozoan and worm diseases of fish.	(2L)
9.	**Fresh water prawn culture (*Macrobracium rosenbegii*):** Seed procurement from natural resources, breeding and larval rearing of fresh water prawn, management of cultural ponds, harvesting and marketing.	(2L)
10.	**Pearl Culture:** Composition & quality of pearl, collection of oysters, rearing of oysters, insertion of nucleus, pearl formation, harvesting of pearls.	(2L)
11.	**Technologies in Fisheries development:** Geographic Information System (GIS) technology, Use of Information Communication Technology (ICT) in fishes: production aspects, marketing aspects.	(2L)

References:

Mammalian Reproductive Physiology

1. Austin C.R.and Short R.V.,Reproduction in mammals Books 1-5,Univ. of Cambridge
2. Hogarth P.H.biology of Reproduction,Blackie and Son, Glasgow, London.
3. Nalbandov,AV,Reproductive Physiology,Lea and Febiger ,Philadelphia
4. Turner and bagnara .General Endocrinology Sixth Edition, W.B. Saunders Company,

Aquaculture

1. Agustí, S. 1991. Light environment within dense algal populations: cell size influences on self-shading. Journal of Plankton Research, 13(4): 863–871.
2. Ahamad Ali, S. 1982. Relative efficiencies of pelletized feeds compounded with different animal proteins and the effect of protein level on the growth of the prawn Penaeus indicus. Proceedings of the Symposium on Coastal Aquaculture, Marine Biological Association of India, 1: 321–328.
3. Biswas, K. P. (2002), **A Text Book of Fish, Fisheries & Techonology**, Narendra Publishing House, Delhi.
4. Jain, K.K. 2003, Indused **breeding of carps by hypophysation**. In: Carp and Cat fish breeding & culture CIFE. PUBlication, Versova. Mumbai.
5. Jyoti, M. K. & Sharma, A. 2006. **Fishes, Aid to collection, preservation and identification** daya Publishing House, New Delhi.
6. Langur, R.K., 2002. **Management of carp rearing ponds**. 62-65. In: Carp and catfish breeding & culture. C.I.F.E.,Versova, Mumbai.
7. Mark, D.L. (1983) **Fish Diseases**. T.F.H. Publication Inc. New Jersey.
8. Sharma, B.D. and Sanjappa, M. 1993., **Flora of India**. Botanical Survey of India, Calcutta.1-639.
9. Sinha, V.R.P. 1999. **Rural Aquaculture in India**. RAP Publications, 21, Bankok, Thhailand.
10. Srivastava, C.B.L. 2005, **A textbook of Fisheries and Indian Fish**.
11. Tamot/P, Mishra,R, Somdutta (2008). Proceeding of taal, 2007 : In 12th Lake Conference : 318-324.

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Course Code and Course Name: **(2 Credits: 30 Lectures)**

ZODT 243: Histology and Histochemistry

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain the fundamental tissues in details.

CO2: Describe the process of histological preparations.

CO3: Illustrate the tools used in histological preparations.

CO4: Justify the use of various stains and dyes used in histochemical detection of biomolecules.

CO5: Justify the importance of Immunohistochemistry.

CO6: Draw the structures of various tissues and label them.

Sr. No.	Name of the topic	Lectures allotted
1.	Scope and importance of Histology and Histochemistry Fundamentals of histology: Epithelial, connective, muscular, nervous and other specialized tissues.	05L
2.	Tools in histology: Principles, design and functioning of microtomes, automated microtomes, ultra-microtome, cryostat, problems and troubleshooting.	04L
3.	Techniques in histology: General principles for the preparation of Tissue for Histological studies. Fixation – Principle, Aims and Objectives of fixatives. Chemical action of fixatives on cells and tissue components Processing of fixed samples, dehydration (procedure and significance), embedding, block making, Temporary and permanent preparations, whole mount preparation	05L
4.	Staining (staining methods histochemical and immunohistologial methods) dyes and dye binding reactive groups, mordants and mordanting	02L
5.	Fundamentals of histochemical techniques: Histochemical classification of Carbohydrates and Principle for the Identification of Carbohydrates- glycogen (Periodic acid/Shift method (PAS)	02L
6.	Histochemical localization of Mucopolysaccharides by KMNO4/AB and PAS method.	02L
7.	Histochemical classification of Proteins- Principles and mechanism for the identification of total Proteins and Glycoproteins (Bromophenol Blue & Congo red method). Importance of Enzyme histochemistry. -Localization of enzymes in tissues, Alkaline and Acid phosphates.	04L
8.	Histochemical localization of Nucleic Acids, DNA and RNA (Feulgen reaction &Pyroninmethod).	02L

9.	Application of Histochemical methods for the detection of various types of Carcinoma and Immunofloroscent techniques	02L
10.	Histochemical classification of Lipids. Principle for the demonstration of Lipids in various animal tissues (Copperpthyalocyanin method and Sudan Blank- B method)	02L

Reference books: -

1. Text book of Histology Roland lesson DL. WB Saunders Company, Tokyo.
2. Histology: Roland lesson and Thomas Leesan WB Saunders company Co., Canada
3. Histochemistry Vol. I II III A G E pearse Churchill Livingstone NY
4. Histochemistry in Focus,A source book of Technics and Research needs (2007), K.Shyamasundari and K.Hanmantha Rao,MJP Puplishers,Chennai.
5. An introduction to Functional Histology, Bourne, G.H. (1988), Churchil, London.
6. Histochemical Techniqes, Cassilmann,W.G.B (1988), Methuen, London

Course Code and Course Name:

ZODT 243: Pest Control **(2 Credits: 30 Lectures)**

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain the Pest, nature of damage caused by pests and pest control.

CO2: Explain medical, veterinary, Household and stored grain pests.

CO3: Explain the Principles and methods of pest control including Biological control measures.

CO4: Explain the Integrated pest management (IPM)

CO5: Explain the Non- insect pest and their control: Rat, Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels.

CO5: Explain the principle and working of pesticide appliances.

Sr. No.	Name of the topic	Lectures allotted
1.	Introduction of the pest control : Pest, pest control, types of pests and their importance and damage caused by pests.	02L
2.	Brief outline of medical and veterinary entomology with reference to important measures to control the vectors. Household and stored grain pest and their control measures.	06L
3.	Principles and methods of pest control: Cultural control measures, Physical control measures, Mechanical Control measures, Chemical control measures. Types and mode of action. Insecticidal formulations and dilutions. Drawbacks of chemical control.	12L

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	Biological control measures: History, principles and scope of biological control. Biological agents: important groups of Parasitoids, predators and pathogens. Advantages and Drawbacks of Biological control, Biological Control Management.	
4.	Autocidal control : Chemosterilants and radiations for sterilization, Male sterile Theory, Hormones and Pheromones, Attractants and Repellants. Integrated pest management (IPM) : Principles and application	06L
5.	Non- insect pest and their control: Rat, Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels.	02L
6.	Pesticide- Appliances: Sprayers and Dusters, Hazards of Pesticides and Antidotes.	02L

Reference Books

1. "Pest control- A Survey" By A. Woods. (McGraw-Hill, London, 1974).
2. Pest control" – By W. W. Kilgore and R. L. Doutt (Academic Press, New York, 1967).
3. Integrated Pest Management- By J. L. Apple and R. E. Smith, Plenum Publication Co., New Delhi.
4. An Introduction of Biological Control- By R.V.D. Boarscho, P. S. Y. Messenger and A. P. Gaiter, Plenum Publication Co.
5. Insect Pests and their Control- By Evans J.W., Asiatic Publ., New Delhi.
6. Applied Entomology, Vol- 1, 2nd Edition- By K.P. Srivastava, Kalyani Publishers, New Delhi.

Course Code and Course Name:

ZODP 243: Zoology Practical Paper- 4 **(2 Credits: 60 Hours)**

Semester IV

Note: A total of 15 practicals are to be conducted. 10 practicals from module I (Practicals corresponds to ZOUT 241) and 5 practicals from module II (Practicals corresponds to ZODT 243) are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

Animal Physiology- II

CO1: Determine the bleeding and clotting time of human blood.

CO2: Demonstrate the invertebrate heart.

CO3: Calculate the heartbeats of Daphnia/*Drosophila* larva.

CO4: Determine serum urea and protein and glucose in human blood and urine.

CO5: Justify the effects of various physical and chemical factors on frog heart and muscle.

Entomology- II

CO1: Identify the histological structure of male and female reproductive system of insect.

CO2: Identify the eggs of different insects.

CO3: Identify the different embryonic stages of insects.

CO4: Identify the different post-embryonic stages of insects.

CO5: demonstrate various body organs, systems and appendages of housefly and butterfly.

Histology and Histochemistry

CO1: Identify the various tissues with the help of permanent slides.

CO2: Demonstrate the effect of fixatives on tissues.

CO3: Detect the biomolecules with histochemical staining methods.

CO4: Sketch and label the microscopic details of tissues.

CO5: Prepare the permanent histological slides.

Pest Control

CO1 : Identify beneficial and harmful insects.

CO2 : Identify and classify insect pest of agricultural, veterinary and public health importance.

CO3 : Know the effects of contact insecticides and fumigants on behavior of insect pests.

CO4 : Determine the LD_{50}

CO5 : Behavior of insects to repellants and attractants.

CO6 : Know the principle and working of pesticide appliances.

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CO7 : Identify and know the role of biological controlling agents.

CO8 : Know the non-insect pests.

Sr. No.	Name of the Practical	No. of Practicals
	Module- I : Practical Animal Physiology- II	
1.	Determination of bleeding time and clotting time in man **(Compulsory)**	1P
2.	Study of invertebrate (earthworm and crab) heart	1P
3.	Ionic effects on perfused heart of frog (with the help of ICT tool/ Charts/diagrams.)	1P
4.	Effect of adrenalin and acetylcholine on perfused heart of frog (with the help of ICT tool/ Charts/diagrams.) **(Compulsory)**	1P
5.	Osmotic stress and volume change in earthworm	1P
6.	Effect of temperature on water loss in cockroach **(Compulsory)**	1P
7.	Detection and measuring of heart beats (Manually) in Drosophila larva/Daphnia.	1P
8.	Detection of allantoin in mammalian urine **(Compulsory)**	1P
9.	Study of Glomerular filtration rate by creatinine clearance	1P
10.	Study of Types of heart (Myogenic and Neurogenic)	1P
11.	Estimation of SGOT/SGPT from blood sample (Source of blood: Local recognized pathology laboratory	1P
12.	Determination of protein, glucose in Urine. **(Compulsory)**	1P
13.	Determination of protein, glucose in Urine from diabetic patient. **(Compulsory)**	1P
14.	Qualitative Analysis: 1) Preparation and study of Urine crystals. 2)Estimation of serum urea. **(Compulsory)**	1P
15.	Normal & abnormal constituents of human urine **(Compulsory)**	1P
16.	Quantitative estimation of salt gain and salt loss by fresh water Crab.	1P
17.	Total RBC, WBC and Different WBC count- A comparative study of fish, goat and human. **(Compulsory)**	1P
18.	Estimation of blood Sodium, potassium, Calcium	1P
19.	Estimation of blood alkaline & acid phosphatases	1P
20.	Estimation serum uric acid **(Compulsory)**	
	Module- I : Practical Entomology- II	**(01P)**
1.	Histological studies of male reproductive system (Testes, Vas deference, Ejaculatory duct, Accessory gland and spermatogenesis). **(Compulsory)**	**(01P)**
2.	Histological studies of female reproductive system (Ovariole, lateral oviduct, common oviduct, Accessory glands, bursa copulatrix, spermatheca). **(Compulsory)**	**(01P)**
3.	Study of types of Eggs in insects. **(Compulsory)**	**(01P)**
4.	Early embryology of insect: cleavage, blastula, germ band, gastrula, embryo- 1 day old, 2 day old and 3 day old in suitable insect.	**(02P)**
5.	Study of post embryonic development of insects: Collection and study of types of Nymph, naiads, larvae and pupae. **(Compulsory)**	

6.	Dissection of House fly: The digestive system, Nervous system, Male and Female Reproductive System; Temporary mountings of antenna, halter, legs and ovipositor. **(Compulsory)**	(03P)
7.	Dissection of butterfly: The digestive system, Nervous system, Male and Female Reproductive System, Temporary mountings of antenna, scales and ovipositor. **(Compulsory- 2)**	(03P)
	Module- I : Practical Genetics- II	
1.	Methodology for constructing Human Pedigree.	[1P]
2.	Analysis and construction of typical pedigrees for autosomal dominant and recessive genes, sex linked dominant and recessive genes.	[1P]
3.	Preparation of metaphase chromosomal spreads from any vertebrate model system.	[1P]
4.	G banding and C banding on mouse metaphase spread	[2P]
5.	Study of courtship behavior in wild type and mutant *Drosophila*.	[1P]
6.	Study of maternal effect mutants : Bicoid and Nanos.	[1P]
7.	Preparation of metaphase chromosomal spread of 3rd instar larva of *Drosophila* (from brain Ganglion).	[2P]
8.	Measurement of olfaction activity in *Drosophila* larvae and Adult Fly [The olfaction trap assay for behavioural genetics and screening].	[1P]
9.	Measurement of Locomotory activity in *Drosophila* larvae and Adult Fly [flight escape assay for behavioural genetics and screening].	[1P]
10.	Larval mechanosensation assay in *Drosophila*.	[1P]
11.	Concept of genetic disorder databases and demonstration of use of OMIM.	[1P]
12.	Open field Activity test and Elevated plus maze test for anxiety levels in laboratory mice.	[1P]
	Module- II : Practical Histology and Histochemistry	
1.	Study of different types of tissue with help of permanent slides **(Compulsory)**	(2P)
2.	Preparation of different reagent/stains for histology **(Compulsory)**	(2P)
3.	Block preparation and sectioning **(Compulsory)**	(2P)
4.	Effect of fixatives, fixation of tissues	(1P)
5.	Comparative study of effect of fixative on a given tissue	(1P)
6.	Mucolpolysaccharide staining, AB pH 1.5, 2.5 **(Compulsory)**	(1P)
7.	Proteins and lipid staining by Sudan black **(Compulsory)**	(1P)
8.		(1P)
9.	Nucleic acid staining: methyl green, pyronine, feulgen stain **(Compulsory)**	(1P)
10.	Effect of fixatives on tissue sections- liver	(1P)
	Module- II : Practical Pest Control	
1.	Morphological and taxonomic study of insect pest of agricultural importance. (Any 10).	(01)
2.	Study of insect pests of veterinary and public health importance. **(Compulsory)**	(01)
3.	Study of Household and stored grain pests. **(Compulsory)**	(01)

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4.	Study of effects of contact poison on pests: Chlorinated hydrocarbons, Organophosphates and Carbamate.	(01)
5.	Calculation of LD_{50} and effects on behavior. **(Compulsory)**	(01)
6.	Study of respiratory poisons (fumigants)- Carbon tetrachloride, ethylene dichloride and Nicotine. **(Compulsory)**	(01)
7.	Study of Pesticide appliances: Sprayers and Dusters.	(01)
8.	Study of Parasitoids, predators and pathogens in biological control.	(01)
9.	Study of Non- insect pests : Rat, Bandicoots, Crabs, Snails, Slugs, Birds and Squirrels.	(01)
10.	Study of insect attractants and repellants (any two). **(Compulsory)**	(01)

Course Code and Course Name: **(2 Credits: 30 Lectures)**

ZODT 244: Pollution Biology

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain the organization of biosphere.

CO2: Explain in details the types of pollution.

CO3: Describe the pollution monitoring strategies.

CO4: Illustrate the bioassay methods.

CO5: Elucidate the methods to study the impact of pollutants.

CO6: Justify the importance of biomedical waste management.

Sr. No.	Name of the topic	Lectures allotted
1.	Biosphere: Introduction, hydrosphere, lithosphere, atmosphere. (2L)	2L
2.	Pollution: Types of pollution (Air, Water, Agricultural), pollutants and effect of pollution on health, on biosphere and on economy. Eutrophication: Definition, Limnology of lake, process of eutrophication (3L)	3L
3.	Noise pollution: Characteristics of sound, source, effects and control measures of noise pollution.	3L
4.	Pesticide pollution: Pesticides and their kinds, possible sources and pathways of pesticide Pollution. Impact of pesticides on living organisms	2L
5.	Radioactive pollution: Types, sources and effects, radioactivity assessments and control.	3L
6.	Bioassay: Purpose of bioassay, selection and test organisms, pollutant bioassay using fish	2L
7.	Pollution monitoring: strategies for water, soil, noise.	2L
8.	Histological, biochemical and physiological methods to study Impact of pollutants on animals.	3L

9.	Bioconcentration, Bioaccumulation and Biomagnifications of pollutants- Causes and Consequences.	3L
10.	Biological methods for assessment of environmental quality.	3L
11.	Biomedical waste – Handling and Management.	2L
12.	Environment protection act 1986	2L

References

1. Ecology, E.P. Odum, Amerind publ.
2. Environmental biology, P.D. Sharma, Rastogi Publ.
3. Environmental pollution, H.M. Dix, John Wiley Publ.
4. Pesticides in aquatic environment, M.A. Q. Khar, Plenum Press.
5. Environmental pollution and its control under international law, R.A. Malviya , Chay Publ.
6. Ecology, Ricklefs, freeman, W.H.
7. Limnology, Welch McGrew Hill Publ.
8. Practical Ecology – K.S. Rao, Ujjain (M.P) Anmol Publ. New Delhi (India)

Course Code and Course Name:

ZODT 244: Apiculture **(2 Credits: 30 Lectures)**

Semester IV

After successfully completing this course, students will be able to:

CO1: Explain the basic concepts of apiculture like systematics, colony organization, polymorphism, morphology and foraging.

CO2: Explain the tools and management of apiary.

CO3: Explain the importance of institutions pertinent to apiculture.

CO4: Discuss the setup of beekeeping business.

CO5: Illustrate the bee keeping as occupation.

CO6: Justify the presence of bees to increase the agriculture productivity.

Sr. No.	Name of the topic	Lectures allotted
1.	Biology of Bees : History, Classification and Biology of Honey Bees. Social Organization of Bee Colony.	05L
2.	Rearing of Bees : Introduction to apiculture practices and handling of Beehives. Artificial Bee rearing (Apiary), Beehives – Newton and Langstroth Bee Pasturage Selection of Bee Species for Apiculture Bee Keeping Equipment Methods of Extraction of Honey (Indigenous and Modern)	11L
3.	Diseases and Enemies Bee Diseases and Enemies Control and Preventive measures, Hormones in Apiculture.	06L
4.	Bee Economy : Products of Apiculture Industry and its Uses (Honey, Bees Wax, Propolis), Pollen etc.	03L

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5.	Entrepreneurship in Apiculture Bee Keeping Industry – Recent Efforts, Modern Methods in employing artificial Beehives for cross pollination in horticultural gardens	05L

References:

1) Bees and Beekeeping D. P. Abrol ,Kalyani Publisher, New Delhi. 51
2) A Comprehensive guide to Bees and Beekeeping. D. P. Abrol. Scientific Publisher, New Delhi.
3) Honey bees and their management S. B. Withhead. Axis books Publisher, Jodhpur.
4) Honey bees: Diseases, Parasites, Pests, Predator and their management. N. Nagaraja and D. Rajagopal , M.J.P Publisher, Chennai.
5) A Handbook of Beekeeping Dharamsing and D. P. Singh (Agrobios India (Publisher), Jodhpur.
6) Prost, P. J. (1962). Apiculture. Oxford and IBH, New Delhi.
7) Bisht D.S., Apiculture, ICAR Publication.
8) Singh S., Beekeeping in India, Indian council of Agricultural Research, NewDelhi.
9) Introduction to disease of bee –Bailey, L
10) World of honeybee –Butter C. G.
11) Beekeeping in India –Sardar Sing (ICAR).
12) The Principle of Insect Physiology-Wigglesworth, V.S.
13) Applied Zoology- B. B. Waykar, A. Y. Mahajan, B. C. More . (Prashant Publication Jalgaon)
14) D.K. Belsare Beekeeping for livelihood

Course Code and Course Name:

ZODP 244 : Zoology Practical Paper- 5 (*Practicals corresponding to ZOUT 242 and ZODT 244*)

(2 Credits: 60 Hours)

Semester IV

Note: A total of 15 practicals are to be conducted. 5 practicals from each module (**Module- I :** Practicals corresponding to ZOUT 242 MRP, **Module- II :** Practicals corresponding to ZOUT 242 Aquaculture and **Module- III :** Practicals corresponding to ZODT 244 Pollution Biology/ Apiculture) are to be conducted. 1 practical is of 4 clock hour duration.

After successfully completing this course, students will be able to:

Mammalian Reproductive Physiology

CO1: Identify the histological slides of reproductive organ/tissues.

CO2: Explain the various types of placenta in mammals.

CO3: Comment on merits and demerits of contraceptive devices/methods.

CO4: Illustrate the technique of gonadectomy.

CO5: Perform vaginal smear technique to identify the phases of oestrous cycle.

CO6: Distinguish the male and female anatomical features of reproductive system in mammals.

Aquaculture

CO1: Identify Indian oysters.

CO2: Identify the common freshwater fish used in culture farming.

CO3: Demonstrate the processing and storing methods for fish and prawn.

CO4: Test the freshness of fish/prawn by histological methods.

CO5: Test the freshness of fish/prawn by biochemical methods.

CO6: Prepare the culture of Daphnia and rotifers.

CO7: Estimate the productivity of water bodies.

Pollution Biology

CO1: Identify the bioindicators from given water sample.

CO2: Write a report on eutrophication of water body.

CO3: Determine the LC50 value for the given compound

CO4: Determine the biomass of given sample.

CO5: Analyze pH and salinity of given sample.

CO6: Estimate calcium and magnesium, sulphate from polluted water.

Apiculture

CO1: Identify the honey bees

CO2: explain the bee morphology and behaviour

CO3: Illustrate the bee enemies

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CO4: Justify the rearing techniques and bee management

Sr. No.	Name of the Practical	No. of Practicals
	Module- I : Practical Mammalian Reproductive Physiology	
1.	Anatomy of male and female reproductive system in rat/Mouse **(Compulsory)**	1P
2.	Study of histological slides of male reproductive System-Testis, Vas deferens, Epididymis, Prostate, Seminal vesicle, Cowper's gland **(Compulsory)**	1P
3.	Study of histological slides of female reproductive System-Ovary, Uterus fallopian tube **(Compulsory)**	1P
4.	Vaginal smear technique in Rat	1P
5.	Study of placental types **(Compulsory)**	1P
6.	Study of Uterine smooth muscles	1P
7.	Study of contraceptive devices **(Compulsory)**	1P
8.	E-Demonstration of Orchiectomy or Vasectomy or Epididymoctomyin rat/ Mice	1P
9.	E-Demonstration of Ovariectomy in rat/Mice	1P
10.	Visit to artificial insemination Centre and family planning Centre.	1P
	Module- II : Practical Aquaculture	
1.	To Study Physico-chemical parameters of fresh water –pH, Turbidity, Calcium, Nitrate, Ammonia. **(Compulsory)**	1P
2.	Determination of total alkalinity and total hardness of fresh water.	1P
3.	Determination of dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD) of fresh water. **(Compulsory)**	1P
4.	Study of conventional method for testing the soil of fresh water pond.	1P
5.	Study of control methods of aquatic weeds.	1P
6.	Study of induced breeding techniques by using pituitary extract.	1P
7.	Study of Indian major carps, prawns, and oysters. **(Compulsory)**	1P
8.	Study of fish disease (bacterial, fungal, protozoan), head and lateral line erosion and eye disease. **(Compulsory)**	1P
9.	Use of Geographic Information Technique (GIS) and Information and communication technology (ICT).	1P
10.	Visit to fish farm/ fish industry. **(Compulsory)**	1P
	Module- III : Practical Pollution Biology	
1.	Study of bio – indicators of pollution. **(Compulsory)**	1P
2.	Analysis of CO, CO_2,NO pollution level data in collaboration with district pollution dept. of Maharashtra state.	1P
3.	Study of Eutrophic ponds /lakes /river.	1P
4.	Visit to water filtration plant/Pollution. **(Compulsory)**	1P
5.	Analysis of pH and salinity from water /soil sample.	1P
6.	Determination of LC_{50} / LD_{50} for insecticide / pollution/molluscicide etc. **(Compulsory)**	1P
7.	Estimation of Biomass by:- i) Wet weight and ii) Dry weight.	1P
8.	Estimation of calcium and magnesium in polluted water. **(Compulsory)**	1P

9.	Soil analysis for calcium carbonate. **(Compulsory)**	1P
10.	Estimation of sulphate in polluted water.	1P
	Module- III : Practical Apiculture	
1.	Study of Honey bee species, Castes and Bee morphology. **(Compulsory)**	(3P)
2.	Study of Beekeeping equipment: Bee box and tools. **(Compulsory)**	(2P)
3.	Study of Bee products: Honey, Bees wax, Pollens, Royal Jelly, Propolis and Bee venom. **(Compulsory)**	(2P)
4.	Study of diseases and enemies of honeybee. **(Compulsory)**	(2P)
5.	Study of bee flora in the locality and observations on bee foraging Behaviour. **(Compulsory)**	(1P)
6.	A compulsory visit to an Apiary or Central Bee Research and Training Institute or a Beekeeper to gain a firsthand experience in handling bees.	(2P)

Kopargaon Taluka Education Society's

K. J. Somaiya College of Arts, Commerce and Science, Kopargaon.

Department of Zoology

Revised Syllabus for Certificate Course in Vermiculture and Vermicomposting

(To be implemented from 2021-22)

(Syllabus)

Theory:

1.	Definition and Scope of Vermiculture	02
2.	Taxonomic Status of Earthworms/ Classification	01
3.	Habit, Habitat and General Morphology	02
4.	Anatomy of Earthworm with respect to Digestive System and Excretory System. Significance of Gut in the Formation of Vermicompost.	04
5.	Useful Species of Earthworms and Economic Importance.	01
6.	Methods of Vermiculture	06
	a. Preparations of Vermiculture Bed.	
	b. Vermiculture technique: On Small scale.	
	c. Bioconversion of kitchen waste using vermiculture.	
	d. Vermiculture technique at Farm and production of vermicompost and Vermiwash: On large Scale. (Points to be covered: Containers, Shade, Vermi Bed, Feed Mixture, Maintenance, Harvesting, Packaging etc.)	01
7.	Precautionary Measures:	02
8.	Factors influencing Vermiculture: Food, Moisture, Temperature, Sunlight, pH, Predators *etc.*	01
9.	Concept of Commercial Farming	02
10.	By-Products of Vermiculture: Vermicompost, Vermiwash, Vermigold	

Practical: 08

Preparation and Maintenance of Vermiculture Bed in the Field.

Field Report

Total Lectures: 30

Duration 60 Days.

K. J. SOMAIYA COLLEGE Dept. of Zoology KOPARGAON

Head
Department of Zoology
K. J. Somaiya College, Kopargaon

Coordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
K.J.Somaiya College of Arts
Commerce & Science,Kopargaon

QIM 1.3.1 List of Courses addresses crosscutting issues as per Syllabus (2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment & Sustainability)
1	B. Sc. Botany	BO.111	Plant Life and Utilization-I	Environment & Sustainability
2	B. Sc. Botany	BO.112	Plant Morphology andAnatomy	Professional Ethics
3	B. Sc. Botany	BO.113	Practical Based on BO.111 & BO.112	Professional Ethics
4	B. Sc. Botany	BO.121	Plant Life and Utilization-II	Professional Ethics
5	B. Sc. Botany	BO.122	Principles of Plant Science	Professional Ethics
6	B. Sc. Botany	BO.123	Practical Based on BO. 121 &BO. 122	Professional Ethics
7	B. Sc. Botany	BO.231	Taxonomy of Angiospermsand Plant Ecology	Environment & Sustainability
8	B. Sc. Botany	BO.232	Plant Physiology	Professional Ethics
9	B. Sc. Botany	BO.233	Practical based on BO. 231 & BO. 232	Professional Ethics
10	B. Sc. Botany	BO.241	Plant Anatomy andEmbryology	Professional Ethics
11	B. Sc. Botany	BO.242	Plant Biotechnology	Professional Ethics
12	B. Sc. Botany	BO.243	Practical based on BO.241 &BO.242	Professional Ethics
13	B. Sc. Botany	BO.351	Algae and Fungi	Environment & Sustainability
14	B. Sc. Botany	BO.352	Archegoniate	Environment & Sustainability
15	B. Sc. Botany	BO.353	Spermatophyta and Paleobotany	Environment & Sustainability
16	B. Sc. Botany	BO.354	Plant Ecology	Environment & Sustainability
17	B. Sc. Botany	BO.355	Cell and Molecular Biology	Human Values
18	B. Sc. Botany	BO.356	Genetics	Human Values
19	B. Sc. Botany	BO.357	Practical Based on BO.351 &BO.352	Professional Ethics
20	B. Sc. Botany	BO.358	Practical Based on BO.353 &BO.354	Professional Ethics
21	B. Sc. Botany	BO.359	Practical Based on BO.355 &BO.356	Professional Ethics
22	B. Sc. Botany	BO.3510	Medicinal Botany	Human Values
23	B. Sc. Botany	BO.3511	Plant Diversity and HumanHealth	Environment & Sustainability
24	B. Sc. Botany	BO.361	Plant Physiology	Environment & Sustainability
25	B. Sc. Botany	BO.362	Biochemistry	Environment & Sustainability
26	B. Sc. Botany	BO.363	Plant Pathology	Professional Ethics
27	B. Sc. Botany	BO.364	Evolution and Populationgenetics	Professional Ethics
28	B. Sc. Botany	BO.365	Advanced Plant Biotechnology	Environment & Sustainability
29	B. Sc. Botany	BO.366	Plant Breeding and SeedTechnology	Professional Ethics
30	B. Sc. Botany	BO.367	Practical based on BO.361 &BO.362	Professional Ethics
31	B. Sc. Botany	BO.368	Practical based on BO.363 &BO.364	Professional Ethics

32	B. Sc. Botany	BO.369	Practical based on BO.365 &BO.366	Professional Ethics
33	B. Sc. Botany	BO.3610	Nursery and GardeningManagement	Professional Ethics
34	B. Sc. Botany	BO.3611	Biofertilizers	Professional Ethics
35	M. Sc. Botany	BOUT 111	Botany Theory Paper 1 Plant systematics I	Professional Ethics
36	M. Sc. Botany	BOUT 112	Botany Theory Paper 2 Cell Biology and Evolution	Professional Ethics
37	M. Sc. Botany	BOUT 113	Botany Theory Paper 3 Cytogenetics and Plant Breeding	Professional Ethics
39	M. Sc. Botany	BODT 114	Botany Theory Paper 4- a)Pomoculture and Fruit processing technology	Professional Ethics
40	M. Sc. Botany	BODP 114	Botany Practical Paper 4- Based on BO.114	Professional Ethics
41	M. Sc. Botany	BOUP 115	Botany Practical Paper based on BOUT 111, BOUT 112 and BOUT 113	Professional Ethics
42	B. Sc. Botany	BOUT 121	Botany Theory Paper 1-PlantSystematics II	Environment & Sustainability
43	M. Sc. Botany	BOUT 122	Botany Theory Paper 2-Molecular Biology	Professional Ethics
44	M. Sc. Botany	BOUT 123	Botany Theory Paper 3-Biochemistry	Professional Ethics
45	M. Sc. Botany	BODT 124	Botany Theory Paper 4- a.Floriculture and Nursery Management	Professional Ethics
46	M. Sc. Botany	BODP 124	Botany Practical paper 4-based on BODP 124	Professional Ethics
47	M. Sc. Botany	BOUP 125	Botany Practical paper based on BOUT 121, BOUT 122 and BOUT 123	Professional Ethics
48	M. Sc. Botany	BOUT 231	Botany Theory Paper 1-Computational Botany	Professional Ethics
49	M. Sc. Botany	BOUT 232	Developmental Botany	Environment & Sustainability
50	M. Sc. Botany	BOUT 233	Botany Theory Paper 3- PlantPhysiology	Professional Ethics
51	M. Sc. Botany	BODT 234	Botany Theory Paper seed science	Professional Ethics
52	M. Sc. Botany	BODP 234	Botany Practical Paper basedon BODT 234	Professional Ethics
53	M. Sc. Botany	BOUP 235	Botany Practical Paper basedon BOUT 231, BOUT 232, BOUT 233	Professional Ethics
54	M. Sc. Botany	BOUT 241	Botany Theory Paper 1-Botanical Techniques	Professional Ethics
55	M. Sc. Botany	BOUT 242	Advanced Plant Ecology	Environment & Sustainability
56	M. Sc. Botany	BODT 243	a) Seed technology	Professional Ethics
57	M. Sc. Botany	BODT 244	Research methodology	Professional Ethics
58	M. Sc. Botany	BODP 243	Botany Practical paper basedon BODT 243 BODT b) Herbal Technology	Professional Ethics
59	M. Sc. Botany	BODP 244	Botany Practical Paper basedon BODT 244 Or PG Dissertation based on BODT 244	Professional Ethics
60	M. Sc. Botany	BOUP 245	Botany Practical paper based on BOUT 241 and BOUT 242	Professional Ethics

Title of the Course: B. Sc Botany

1. Structure of Course:

Structure B.Sc. Botany syllabus					
Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Compulsory Course	BO 111	Plant life and utilization I	2
			BO 112	Plant morphology and Anatomy	2
			BO 113	Practical based on BO 111 & BO 112	1.5
	2	Compulsory Course	BO 121	Plant life and utilization II	2
			BO 122	Principles of plant science	2
			BO 123	Practical based on BO 121 & BO 122	1.5
2	3	Compulsory Course	BO 231	Botany Theory Paper 1	2
			BO 232	Botany Theory Paper 2	2
			BO 233	Botany Practical Paper	2
	4	Compulsory Course	BO 241	Botany Theory Paper 1	2
			BO 242	Botany Theory Paper 2	2
			BO 243	Botany Practical Paper	2
3	5	Discipline Specific Elective Course	BO 351	Botany Theory Paper 1	2
			BO 352	Botany Theory Paper 2	2
			BO 353	Botany Theory Paper 3	2
			BO 354	Botany Theory Paper 4	2
			BO 355	Botany Theory Paper 5	2
			BO 356	Botany Theory Paper 6	2
			BO 357	Botany Practical Paper 1	2
			BO 358	Botany Practical Paper 2	2
			BO 359	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3510	Botany Theory Paper 7	2
			BO 3511	Botany Theory Paper 8	2
3	6	Discipline Specific Elective Course	BO 361	Botany Theory Paper 1	2
			BO 361	Botany Theory Paper 2	2
			BO 362	Botany Theory Paper 3	2
			BO 363	Botany Theory Paper 4	2
			BO 364	Botany Theory Paper 5	2
			BO 365	Botany Theory Paper 6	2
			BO 366	Botany Practical Paper 1	2
			BO 367	Botany Practical Paper 2	2
			BO 368	Botany Practical Paper 3	2
		Skill Enhancement course	BO 3610	Botany Theory Paper 7	2
			BO 3611	Botany Theory Paper 8	2

SEMESTER-I: PAPER-I

BO-111: PLANT LIFE AND UTILIZATION I (30 Lectures)

CREDIT-I **15 Lectures (15 Hours)**

1. INTRODUCTION **3 L**

General outline of plant kingdom (**Lower Cryptogams**: Thallophytes- Algae, Fungi & Lichens; **Higher Cryptogams**: Bryophytes and Pteridophytes; **Phanerogams**: Gymnosperms and Angiosperms- Dicotyledons and Monocotyledons). Distinguishing characters of these groups and mention few common examples from each.

2. ALGAE **9 L**

2.1: Introduction
2.2: General Characters
2.3: Classification (Bold and Wynne 1978) up to classes with reasons
2.4: Life Cycle of *Spirogyra* w.r.t. Habit, Habitat, Structure of thallus, structure of typical cell, Reproduction- Vegetative, Asexual and Sexual, systematic position with reasons
2.5: Utilization of Algae in Biofuel Industry, Agriculture, Pharmaceuticals, Food and Fodder

3. LICHENS **3 L**

3.1: Introduction
3.2: General Characters
3.3: Nature of Association, forms- Crustose, Foliose and Fruticose.
3.4: Utilization of lichens.

CREDIT-II

4. FUNGI **15 Lectures (15 Hours)** **9 L**

4.1: Introduction
4.2: General Characters
4.3: Classification (Ainsworth, 1973)
4.4: Life Cycle of Mushroom- *Agaricus bisporus* w.r.t. Habit, Habitat, Structure of thallus, Structure of Sporocarp, Structure of Gill, Reproduction- Asexual and sexual, Systematic position.
4.5: Utilization of Fungi in Industry, Agriculture, Food and Pharmaceuticals.

5. BRYOPHYTES **6 L**

5.1: Introduction
5.2: General Characters
5.3: Classification (G.M. Smith 1955)
5.4: Life Cycle of *Riccia* w.r.t. Habit, habitat, external and internal structure of thallus, Reproduction- vegetative, asexual and sexual- Structure of sex organs, fertilization, structure of mature sporophyte, structure of spore, systematic position with reasons.
5.5: Utilization: Bryophytes as ecological indicators, agriculture, fuel, industry and medicine.

(Development of sex organs not expected for all the above mentioned life cycles).

SEMESTER-I: PAPER-II

BO-112: PLANT MORPHOLOGY AND ANATOMY (30 Lectures)

CREDIT-I **15 Lectures (15 hours)**

1. MORPHOLOGY: **2 L**

1.1: Introduction, definition, descriptive and interpretative morphology.
1.2: Importance in identification, nomenclature, classification, phylogeny and Plant breeding.

2. MORPHOLOGY OF REPRODUCTIVE PARTS:

2.1: INFLORESCENCE: **3 L**

2.1.1 Introduction and definition
2.1.2 Types:
a) Racemose -Raceme, Spike, Spadix, Corymb, Umbel, Catkin and Capitulum.
b) Cymose -Solitary, Monochasial- Helicoid and scorpiod; Dichasial and Polychasial.
c) Special types -Verticillaster, Cyathium and Hypanthodium.
2.1.3 Significance

2.2: FLOWER: **7 L**

2.2.1 Introduction and definition
2.2.2 Parts of a typical flower: Bract, Pedicel, Thalamus- forms, Perianth- Calyx and Corolla, Androecium and Gynoecium.
2.2.3 Symmetry: Actinomorphic and zygomorphic, Sexuality- Unisexual ands bisexual, Insertion of floral whorls on thalamus- Hypogyny, Epigyny and perigyny, Merous condition-Trimerous, tetrmerous and pentamerous.
2.2.4 Floral whorls:
a) **Calyx:** Nature- Polysepalous, Gamosepalous; Aestivation- types, Modifications of Calyx- Pappus, Petaloid and Spurred.
b) **Corolla:** Forms of Corolla-
i) Polypetalous- Cruciform and Papilionaceous.
ii) Gamopetalous- Infundibuliform, Bilabiate, Tubular and Campanulate.
iii) Aestivation- types and significance.
c) **Perianth:** Nature- Polytepalous, Gamotepalous.
d) **Androecium:** Structure of typical stamen, Variations- cohesion and adhesion.
e) **Gynoecium:** Structure of typical carpel, number, position, cohesion and adhesion; placentation- types and significance.

2.3: FRUITS: **3 L**

2.3.1 Introduction and definition
2.3.2 Types of fruits:
a) **Simple:** Indehiscent - Achene, Cypsela, Nut and Caryopsis.
Dehiscent - Legume, Follicle and Capsule,
b) **Fleshy:** Drupe, Berry, Hespiridium and Pepo.
c) **Aggregate:** Etaerio of Berries and Etaerio of Follicles.
d) **Multiple fruits:** Syconus and Sorosis.

CREDIT- II **15 Lectures (15 Hours)**

3. ANATOMY:

3.1 Introduction and definition **2 L**

3.2 Importance in Taxonomy, Physiology, Ecological interpretations, Pharmacongnosy and Wood identification.

4. TYPES OF TISSUES:

Outline with brief description, simple and complex tissues. **8 L**

4.1: **Meristmatic tissues:** Meristem, characters and types based on origin, position and plane of division, functions.

4.2: **Permanent tissues:** Simple tissues - parenchyma, collenchymas, chlorenchyma and sclerenchyma.

4.3: **Complex/Vascular tissues:** Components of xylem and phloem, types of vascular bundles and functions.

4.4: **Epidermal tissues:** Epidermis, structure of typical stomata, trichomes, motor cells; functions.

5. INTERNAL ORGANIZATION OF PRIMARY PLANT BODY: **5 L**

5.1: Internal structure of dicotyledon and monocotyledon root.

5.2: Internal structure of dicotyledon and monocotyledon stem.

5.3: Internal structure of dicotyledon and monocotyledon leaf.

REFERENCES:

1. Chandurkar, P.J. (1989). Plant Anatomy. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Dutta, A.C. (2003). Botany for Degree students. Oxford University Press, New Delhi.
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11. Pandey, B.P. (2009). A Text Book of Botany- Angiosperms. S. Chand and Co. Ltd. New Delhi.
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15. Singh, Gurucharan (2005). Systematics- Theory and Practice. Oxford IBH.
16. Sutaria, R.N.A. Text Book of Systematic Botany.
17. Tayal, M.S. (2012). Plant Anatomy. Rastogi Publications.

BO 113: PRACTICALS BASED ON BO 111 & BO 112 (1.5 CREDITS)

1. Study of Life Cycle of *Spirogyra.* 1 P
2. Study of Life Cycle of *Agaricus.* 1 P
3. Study of Life Cycle of *Riccia* 1 P.
4. Study of forms of Lichens- Crustose, Foliose and fruticose. 1 P
5. Study of Mushroom Cultivation. 1 P
6. One day visit to study Algae, Fungi, Bryophytes and Lichens. 1 P
7. Study of Inflorescence. 2 P
   a. Racemose: Raceme, Spike, Spadix, Catkin, Corymb, Umbel and Capitulum
   b. Cymose: Solitary cyme, Uniparous cyme: helicoid and scorpiod, Biparous cyme and Multiparous cyme.
   c. Special type: Verticillaster, Hypanthodium and Cyathium.
8. Study of flower with respect to Calyx, Corolla and Perianth, Androecium and Gynoecium. 2 P
9. Study of fruits with suitable examples. 2 P
   a) Simple fruit: Dry: Achene, Cypsella and Legume; Fleshy: Berry and Drupe.
   b) Aggregate fruit: Etaerio of follicles and Etaerio of Berries.
   c) Multiple fruit: Syconus and Sorosis.
10. Study of internal primary structure of dicotyledonous root and stem e.g. Sunflower. 1 P
11. Study of internal primary structure of monocotyledonous root and stem e.g. Maize. 1 P
12. Study of internal primary structure of dicotyledonous and monocotyledonous leaf e.g. Sunflower and Maize. 1 P

SEMESTER-II: PAPER-I

BO-121: PLANT LIFE AND UTILIZATION-II (30 Lectures)

CREDIT-I

15 Lectures (15 hours)

1. **INTRODUCTION:** Introduction to plant diversity- Pteridophytes, Gymnosperms and Angiosperms with reference to vascular plants. 3 L
2. **PTERIDOPHYTES:** General characters, Outline classification according to Sporne (1976) up to classes with reasons. Life cycle of *Nephrolepis* w.r.t. Habit, habitat, distribution, morphology, anatomy of stem and leaf, Reproduction – vegetative and sexual. 10 L
3. Utilization and economic importance of Pteridophytes. 2 L

CREDIT-II

15 Lectures (15 hours)

1. **GYMNOSPERMS:** General characters, Outline classification according to Sporne (1977) up to classes with reasons. Life cycle of *Cycas* w.r.t. Habit, Habitat, Distribution, Morphology and Anatomy of Stem, leaf and reproductive organs- Male cone, Microsporophyll, microspores and megasporophyll, megaspore; structure of seed; Utilization and economic importance of gymnosperms. 8 L
2. **ANGIOSPERMS:** General characters, Outline of classification of Bentham and Hooker's system up to series, comparative account of monocotyledons and dicotyledons.
3. Utilization and economic importance of Angiosperms: In food, fodder, fibers, horticulture and medicines. 4L 3L

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3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
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8. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
9. Parihar, N.S. (1976). Biology and Morphology of Pteridophytes. Central Book Depot.
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11. Sharma, O.P. (1990). Text Book of Pteridophyta. McMillan India Ltd. Delhi.
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SEMESTER-II: PAPER-II

BO-122: PRINCIPLES OF PLANT SCIENCE (30 Lectures)

CREDIT-1: PLANT PHYSIOLOGY AND CELL BIOLOGY

15 Lectures (15 Hours)

1. Introduction, definition and scope of plant physiology. 1 L
2. Diffusion – definition, importance of diffusion in plants, imbibition as a special type of diffusion. 1 L
3. Osmosis – definition, types of solutions (hypotonic, isotonic, hypertonic), endosmosis, exo-osmosis, osmotic pressure, turgor pressure, wall pressure, importance of osmosis in plants. 2 L
4. Plasmolysis – definition, mechanism and significance. 1 L
5. Plant growth - introduction, phases of growth, factors affecting growth, 2 L
6. Structure of plant cell, differences between prokaryotic and eukaryotic cell. 2 L
7. Plant cell wall – components of primary cell wall, structure and functions. 1 L
8. Ultrastructure and functions of chloroplast 2 L
9. Cell cycle in plants- importance of cell cycle in plants, divisional stages of mitosis and meiosis. 3 L

CREDIT-II: MOLECULAR BIOLOGY **(15 Lectures) 15 Hours**

1. Introduction and scope of molecular biology, central dogma of molecular biology. 2 L
2. Structure of DNA, nucleoside and nucleotide 2 L
3. Watson Crick model of DNA and its characteristic features, types of DNA (A, B and Z DNA). 3 L
4. Types of chromosomes. 2 L
5. Structure and types of RNA. 3 L
6. DNA replication- Types of replication (conservative, semi-conservative and dispersive), enzymes involved, leading and lagging strands, Okazaki fragments. 3 L

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4. Devlin, R.M. (1983). Fundamentals of Plant Physiology. Mc. Millan, New York.
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11. Pandey, S.N. and Sinha, B.K. (2014). Plant Physiology. Vikas Publishing House Pvt. Ltd., India.
12. Salisbury, F.B. and Ross, C.B. (2005). Plant Physiology. 5th Edition. Wadsworth Publishing Co. Belmont California, USA.
13. Watson, James D., Baker, Tania; Bell, Stephen P.; Alexander Gann; Levine, Michael and Lodwick, Richard (2008). Molecular Biology of the Gene. 6th Edition, Pearson Education, Inc. and Dorling Kindersley Publishing, Inc. USA.
14. Weaver, R. (2011). Molecular Biology. 5th Edition, Publisher- McGrew Hill Science. USA.

BO 123: PRACTICALS BASED ON BO 121 & BO 122 (1.5 CREDITS)

1. Study of life cycle of *Nephrolepis*. 1 P
2. Study of life cycle of *Cycas*. 1 P
3. Study of Bentham and Hooker's system of classification outline up to series with example 1 P
4. Study of comparative account of Dicotyledonous and Monocotyledonous plants w.r.t to external morphological characters. 1 P
5. Study of utilization and economic importance of Angiosperms- food, fodder, fibers, horticulture and medicines. 1 P
6. One day visit to study diversity of vegetation. 2 P
7. To observe characteristic features of prokaryotic and eukaryotic plant cell. 1 P
8. Staining of suitable nuclear material by Basic Fuchsin 1 P
9. Study of mitosis- preparation of slides using onion root tips to observe divisional stages. 1 P
10. Study of meiosis- preparation of slides using *Tradescantia/ Rhoeo/* Maize / Onion flower buds to observe divisional stages. 2 P
11. Estimation of chlorophyll-a and chlorophyll-b by using suitable plant material. 1 P
12. Plasmolysis- endosmosis, exosmosis, incipient plasmolysis using *Rhoeo* leaf peeling and Demonstration of Osmosis- curling experiment. 1 P
13. Study of DPD by using suitable plant sample 1 P

S.Y.B.Sc. Botany CBCS Pattern
(Semester III, Paper I) 2020-2021
BO 231: Taxonomy of Angiosperms and Plant Ecology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Introduction to Angiosperms Taxonomy** Definition, scope, objectives and importance of taxonomy Exploration, Description, Identification, Nomenclature and classification Concept of Systematics with brief historical background	**02**
2.	**Systems of classification** Comparative account of various systems of classification Artificial system- Carl Linnaeus Natural system- Bentham and Hooker Phylogenetic system- Engler and Prantl APG system- A brief review	**05**
3.	**Study of Plant Families** Study of following families with reference to systematic position (As per Bentham and Hooker's system of classification), salient features, floral formula, floral diagram and any five examples with their economic importance – Annonaceae, Brassicaceae, Myrtaceaee, Rubiaceae, Solanaceae, Apocynaceae, Nyctaginaceae and Amaryllidaceae	**08**
	Credit-II	**15**
4.	**Botanical Nomenclature** Concept of nomenclature, brief history, Binomial nomenclature International Code for Nomenclature of Algae, Fungi and Plants (ICN)- Principles, Rules and Recommendations; 'Type' specimen and its types (Holotype, Paratype, Isotype, Lectotype, Neotype). Concept of Typification. Ranks and endings of taxa names, Coining of Genus and Species names Single, double and multiple authority citations	**05**
5.	**Introduction to ecology** Definition, concept, scope, and interdisciplinary approach, autecology and synecology. Species diversity: definition, concept, scope, and types: Alpha, Beta and Gamma diversity. Methods of vegetation sampling: quadrat method, transect method, plot less method Genetic Diversity: definition, nature and origin of genetic variations Species Diversity: definition, origin of species diversity, diversity indices, species abundance Ecosystem Diversity: definition, major ecosystem types of the world, Hotspots in India – concept and basis of 'hotspot' identification.	**06**
6.	**Ecological grouping of the plants** Ecological grouping of the plants with reference to their significance of adaptive external and internal features: a) Hydrophytes, b) Mesophytes c) Xerophytes d) Halophytes with examples.	**04**

S.Y.B.Sc. Botany CBCS Pattern
(Semester III, Paper II) 2020-2021
BO 232: Plant Physiology - 2 Credits (30 Lectures)

Credit I:

1. Introduction to Plant Physiology — 2L

Scope and applications of plant physiology

2. Absorption of water — 3L

2.1 Role of water in plants
2.2 Mechanisms of water absorption with respect to crop plants
2.3 Factors affecting rate of water absorption

3. Ascent of sap — 3L

3.1 Introduction and definition.
3.2 Transpiration pull or cohesion-tension theory, evidences and objections
3.3 Factors affecting ascent of sap

4. Transpiration — 7L

4.1 Definition
4.2 Types of transpiration – cuticular, lenticular and stomatal
4.3 Structure of stomata
4.4 Mechanism of opening and closing of stomata –Steward's hypothesis, active K+ transport mechanism
4.5 Factors affecting the rate of transpiration
4.6 Significance of transpiration
4.7 Antitranspirants
4.8 Guttation
4.9 Exudation

Credit II:

5. Nitrogen metabolism — 7L

5.1 Introduction and role of nitrogen in plants
5.2 Nitrogen fixation by *Rhizobium* and BGA
5.2.1 Symbiotic nitrogen fixation, nitrogenase enzyme- structure and function
5.2.2 Non-symbiotic nitrogen fixation
5.3 Importance and production technique of BGA
5.4 Denitrification, ammonification and nitrification
5.5 Reductive amination and transamination

6. Seed dormancy and germination — 4L

6.1 Definition, types of seed dormancy and germination
6.2 Methods to break seed dormancy
6.3 Metabolic changes during seed germination
6.4 Role of phytohormones to improve seed germination
6.5 Vigor Index

7. Physiology of flowering — 4L

7.1 Photoperiodism – Concept, definition, short day plants, long day plants and day neutral plants.

S.Y.B.Sc. Botany CBCS Pattern
Practical (Semester III Paper III) 2020-2021
BO 233: Practical based on BO 231 & BO 232

Practical based on Taxonomy of Angiosperms and Plant Ecology, and Plant Physiology

Sr. No.	Title	No. of Practical
	Taxonomy of Angiosperms and Plant Ecology	
1	Study of tools of taxonomy and ecological instruments (any four each)	1
2	Description of flowering plant in botanical terms	1
3	Study of plant families (any four)	3
4	Study of ecological adaptations in Hydrophytes with any two examples	1
5	Study of ecological adaptations in Xerophytes with any two examples	1
6	Study of vegetation by list count quadrat method.	1
	Plant Physiology	
7	Perform phytochemical test for starch and protein in germinating and non germinating seeds	1
8	Isolation of Leaf Protein Concentration (LPC) from suitable plant material.	1
9	Determination of Diffusion Pressure Deficit (DPD)	1
10	Determine rate of transpiration under different conditions of Sunlight, Shade and Wind	1
11	Demonstration of the following a. Commercial biofertilizers b. Imbibition in seeds c. Ringing experiment d. Arc Auxanometer e. Spectrophotometer f. Nitrogen fixing bacteria / BGA (specimen/ slide)	1
12	Calculate seed germination percentage and vigor index	1
13	Botanical excursion tour and visit to Floriculture industry / Soil testing center / Seed testing center	1

N.B. Botanical excursion tour and submission of report along with herbarium of any five weeds of the following (List of Weeds attached).

List of weeds

Acanthospermun hispidum DC. Asteraceae
Aerva javanica (Burm.f.) Juss. ex Schult. Amaranthaceae
Aeschynomene americana L. Fabaceae Tropical America
Ageratum conyzoides L. Asteraceae America
Alternanthera paronychioides St. Hill. Amaranthaceae Tropical America
Alternanthera philoxeroides (Mast.) Griseb. Amaranthaceae America
Alternanthera pungens Kunth Amaranthaceae Tropical America
Alternanthera sessilis (L.) R.Br. ex DC. Amaranthaceae Tropical America
Amaranthus spinosus L. Amaranthaceae Tropical America
Antigonon leptopus Hk. & Arn. Polygonaceae America
Argemone mexicana L. Papaveracae West Indies

SEMESTER IV

S.Y.B.Sc. Botany CBCS Pattern
(Semester IV, Paper I) 2020-2021
BO 241: Plant Anatomy and Embryology- 2 Credits (30 Lectures)

Credit-I Plant anatomy:

1. Introduction **(15 Lectures)**

1.1 Definition **2L**

1.2 Scope of plant anatomy

2. Epidermal tissue system

2.1 Structure, types and functions of epidermis **3L**

2.2 Structure, types and functions of Stomata

2.3 Epidermal outgrowths- non-glandular and glandular

2.4 Motor cells

3. Mechanical tissue system

3.1 Principles involved in distribution of mechanical tissues with one example each **3L**

a) Inflexibility,

b) Incompressibility,

c) Inextensibility and

d) Shearing stress

3.2 Vascular tissue system: Structure and function of xylem, phloem and cambium

4. Normal secondary growth

4.1 Introduction **3L**

4.2 Normal secondary growth in dicotyledonous stem

4.3 Development of annual rings, periderm, bark, tyloses and lenticel

5. Anomalous secondary growth

5.1 Introduction **4L**

5.2 Causes of anomalous secondary growth

5.3 Anomalous secondary growth in:

a) Dicotyledonous stem (*Bignonia*),

b) Dicotyledonous root (*Raphanus*),

c) Monocotyledonous stem (*Dracaena*)

Credit-II Plant Embryology

7. Introduction **(15 Lectures)**

7.1 Definition and scope of plant embryology **1L**

8. Microsporangium and male gametophyte

8.1 Structure of tetrasporangiate anther **4L**

8.2 Types of tapetum

8.3 Sporogenous tissue

8.4 Microsporogenesis: process and its types

8.5 Types of microspore tetrad

8.6 Male gametophyte: structure and development of male gametophyte

S.Y.B.Sc. Botany CBCS Pattern
(Semester IV, Paper II) 2020-2021
BO 242: Plant Biotechnology (2 Cr- 30 Lectures)

Credit I:

Chapter 1 Introduction to Plant Biotechnology 3L

1.1 History and definition

1.2 Scope and importance of plant biotechnology

1.3 Current status of biotechnology in India.

Chapter 2 Plant Tissue Culture 8L

2.1 Concept of plant tissue culture and cellular totipotency

2.2 Basic techniques: Types of culture, Media preparation, sterilization, inoculation, incubation, hardening

2.3Applications with reference to: Micropropagation, Somaclonal variation, Haploid production, Protoplast fusion & Somatic hybrids, Embryo rescue, Production of secondary metabolites.

2.4 Commercial Plant Tissue culture laboratories in Maharashtra and India.

Chapter 3 Single Cell Protein (SCP) 4L

3.1 Concept and definition

3.2 Importance of proteins in diet

3.3 Production of SCP from *Spirulina* and Yeast

3.4 Importance & acceptability of SCP

Credit II:

Chapter 4 Plant Genetic Engineering 5L

4.1 Introduction, concept

4.2 Tools of genetic engineering (restriction enzymes, ligases, plasmid vectors)

4.3 Gene cloning Technique

4.4 Applications of plant genetic engineering: insect pest resistance, abiotic stress tolerance, herbicide resistance

Chapter 5 Genomics, Proteomics and Bioinformatics 5L

5.1 Genomics- concept, types, methods used for whole genome sequencing

5.2 Proteomics-concept, types, methods used in proteome analysis

5.3 Bioinformatics-concept, database and its classification, data retrieval tools.

Chapter 6 Bioremediation 2L

6.1 Introduction and concept

6.2 Microbial remediation

6.3 Phytoremediation

Chapter 7 Biofuel technology 3L

7.1 Definition, Concept and types of Renewable and nonrenewable energy sources

7.2 Definition and concept of Biogas, Bioethanol, Biobutanol, Biodiesel & Biohydrogen

9 Megasporangium and female gametophyte **4L**

9.1 Structure
9.2 Types of ovules
9.3 Types of megaspore tetrads
9.4 Female gametophyte: structure of typical embryo sac
9.5 Types of embryo sacs – monosporic, bisporic and tetrasporic

10. Pollination and Fertilization: **3L**

10.1 Introduction and definition
10.2 Types of pollination
10.3 Germination of pollen grain
10.4 Entry of pollen tube- porogamy, mesogamy and chalazogamy
10.5 Double fertilization and its significance.

11. Endosperm and embryo **3L**

11.1 Endosperm: Types – nuclear, helobial and cellular.
11.2 Structure of Dicotyledonous and Monocotyledonous embryo.

References:

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2. B P Pandey, Plant Anatomy. S Chand and Co. Ltd, New Delhi 1978
3. Greulach V A and Adams J E Plant- An introduction to Modern Biology, Toppen Co. Ltd, Tokyo,
4. Eams and Mc Daniel,An Introduction to Plant Anatomy, McGraw –Hill Book Co. Ltd and Kogakusha Co, Tokyo, Japan
5. Adriance S Foster Practical Plant Anatomy, D Van Nostrand Co. INC, New York
6. Esau, Plant Anatomy, Wiley Toppan Co. California, USA
7. Pijush Roy, Plant Anatomy. New Central Book Agency Ltd, Kolkata
8. Pandey S N and Ajanta Chadha, Plant Anatomy and Embryology, Vikas Publishing House, Pvt, Ltd, New Delhi
9. Bhojwani S S and Bhatnagar S P, An Embryology of Angiosperms
10. Maheshwari P, An introduction to Embryology of Angiosperm
11. Nair P K K Essentials of Palynology.

S.Y.B.Sc. Botany CBCS Pattern
Practical (Semester IV Paper III) 2020-2021
BO 243: Practical based on BO 241 & BO 242

Sr. No.	Title	No. of Practical
	Plant Anatomy and Embryology	
1	Study of epidermal tissue system – non-glandular and glandular trichomes, multilayered epidermis, typical stomata (Dicotyledonous and Monocotyledonous).	2
2	Study of mechanical tissues and their distribution in root, stem and leaves.	1
3	Study of normal secondary growth in dicot stem – *Annona* /*Moringa* (Double stained temporary preparation).	1
4	Study of anomalous secondary growth in *Bignonia* and *Dracaena* stem (Double stained temporary preparation).	1
5	Study of tetrasporangiate anther and types of ovules with the help of permanent slides	1
6	Study of dicot and monocot embryo.	1
	Plant Biotechnology	
7	Instruments/equipments used in plant tissue culture laboratory: Principle and working of Autoclave, oven, laminar air flow cabinet, micropipette, culture bottles/tubes with cotton plug	1
8	Preparation & sterilization of MS medium	1
9	Surface sterilization and Inoculation of nodal sector, leaf, anther and maize embryo	2
10	Laboratory cultivation of *Spirulina*	1
11	Demonstration practical on transgenic crops viz; Bt-Cotton, Golden rice	1
12	Demonstration of principle and working of agarose gel electrophoresis, centrifuge, spectrophotometer	1
13	Visit to plant tissue culture laboratory	1

T.Y.B.Sc. Botany CBCS Pattern

(Semester V, Paper I) 2020-2021

BO 351: Cryptogamic Botany (Algae and Fungi)- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I Alagae	**15**
1.	Introduction: Cryptogams- meaning. Types- Lower Cryptogams, brief Review with examples	01
2.	Algae: General characters, distribution, Thallus organization, habit and Habitat reproduction and Classification (G.M.Smith 1955) up to classes.	04
3.	Study of life cycle of algae with reference to taxonomic position, Occurrence, Thallus structure, and reproduction of *Nostoc, Oedogonium Chara, Sargassum* and *Batrachospermum.*	08
4	Economic importance of algae- Role in industry, agriculture, fodder and medicine.	02
	Credit-II Fungi	**15**
5	Fungi: General characters, Habit and habitats, thallus organization, cell wall composition, nutrition and Classification. (Alexopoulos and Mims 1979) up to classes.	03
6.	Study of life cycle of fungi with reference to taxonomic position, thallus structure, and reproduction of *Mucor (Zygomycotina), Saccharomyces (Ascomycotina), Puccinia (Basidiomycotina), Penecillium and Cercospore (Deuteromycotina) [Two members of Deutero.]*	08
7.	Symbiotic Associations - Lichens, Mycorrhiza and their significance	04

Suggested readings:

1. Vashistha B. R. et al., Botany for degree students-Algae
2. Das, Datta and Gangulee-College Botany Vol. I
3. Sharma, O.P. –Algae
4. Kumar H.D. 1988. Introductory Phycology. Affiliated East-West Press Ltd New Delhi.
5. Vashishta B.R. et al., Botany for degree students- Fungi
6. Sharma, P.D.-The Fungi

7. Sharma, O.P.-Fungi Economic importance of fungi

8. Alexopoulus C. J , Mims C.W. and Blacwel M.I 1996. Introductory Mycology. John Wiley and Sons Inc.

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper II) 2020-2021
BO 352: Archegoniate- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I Bryophytes	**15**
1.	Introduction to Archegoniate	01
2.	Introduction, general characters, distribution of Bryophytes to land habit, classification of Bryophytes according to G.M. Smith (1955) up to classes with reasons	02
3.	Range of thallus organisation, origin of Bryophytes - Pteridophytes and Algal hypothesis, evolution of sporophyte	02
4	Study of Life Cycle of Bryophytes with respect to Taxonomic position, Morphology, Anatomy, Reproduction, Gametophytes and sporophytes of *Marchantia, Anthoceros and Funaria*	09
5	Ecological and economic importance of Bryophyte	01
	Credit-II Pteridophytes	**15**
6	Introduction, Vascular Cryptogams, General characteristics, Classification according to K.R. Sporne (1975) up to classes with reasons, Diversity and Distribution of Pteridophytes.	02
7.	Resemblances of Pteridophytes with Bryophytes, Differences between Pteridophytes and Bryophytes, Origin of Pteridophytes -Algal and Bryophytes, Evolution of Pteridophytes- Telome Theory and Enation Theory.	03
8.	Study of Life Cycle of Pteridophytes with respect to Taxonomic position, Morphology, Anatomy, Reproduction, Sporophytes and Gametophytes of *Psilotum, Selaginella* and *Equisetum*	09
09	Ecological and Economical Importance of Pteridophytes	01

Note:development of sex organs and Sporophytes is not expected.)

Suggested readings:

1. Chopra G.L. and Yadav D.L. A Text book of Bryophytes.
2. Das, Datta and Gangulee-College Botany Vol I
3. Parihar, N.S. An introduction to Embryophyta: Bryophyte-I
4. Puri Prem. Brayophytes, Atmaram and Sons. Delhi.
5. Parihar N.S. 1991. Bryophyta. Central Book Depot, Allahabad.
6. Sporne K.R. 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. LtdBombay.
7. Vashishta B.R. Botany for degree students Bryophytes- Vol-III
8. Vashishta B.R. Botany for degree students Pteridophytes.

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper III) 2020-2021
BO 353: Spermatophyta and Paleobotany - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I ANGIOSPERMS	**15**
1.	**Origin of angiosperms:** with reference to time, place and ancestry- 1) Pseudanthial theory 2) Transitional-Combinational Theory	02
2.	**Speciation & Endemism** Species concept (Biological, Taxonomic & Phylogenetic Species Concept), Speciation (Allopatric, Sympatric & Parapatric), Endemism and its types (Palaeoendemism, Holoendemism and Neoendemism)	04
3.	**Classification:** Outline, Merit and Demerits of Cronquist's System and APG IV system of classification. Study of following families with reference to systematic position (As per Bentham & Hooker), Diagnostic characters, floral formula, floral diagram and any five examples with their economic importance – Nymphaeaceae, Oleaceae, Amaranthaceae, Cannaceae	06
4	**Herbaria and Botanical Gardens** Functions of Herbarium, Important herbaria (World: Kew herbarium; India: Central National Herbarium, Kolkata). Botanic gardens of the world (Royal Botanic Garden, Kew) and India	03
	Credit-II GYMNOSPERMS and PALEOBOTANY	**15**

6	Introduction, general characters, economic importance and classification according to Chamberlain (1934).	02
7.	Study of life cycle of Pinus and Gnetum with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte, seed structure and alternation of generations.	10
8.	Fossil- Definition, process of fossil formation, types of fossils.-Impression, Compression, Petrifaction, Pith cast and Coal ball.	03

Suggested readings:

1. Cronquist, A. 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons, Ltd. London.
2. Lawrence, G.H.M 1951. Taxonomy of Vascular Plants.
3. Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
4. Swingle D.B. 1946. A Text book of Systematic Botany. Mc Graw Hill Book Co. New York.
5. Takhtajan A. 1969. Flowering Plants; Origin and Disposal.
6. Pande B.P 1997. Taxonomy of Angiosperms. S.Chand.
7. Gurucharan Singh 2005- Plant systematics
8. Naik V.N. - Taxonomy of Angiosperms.
9. Shivrajan V.V. -Introduction to Principles plant taxonomy
10. V. V. Sivarajan, N. K. P. Robson 1991. Introduction to the Principles of Plant Taxonomy IInd Edi.
11. Sharma O.P. Plant Taxonomy Tata McGraw-Hill
12. Botanical Journal of the Linnean Society, 2009, 161, 105–121.
13. http://www.mobot.org/MOBOT/research/APweb/

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper IV) 2020-2021
BO 354: Plant Ecology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	Introduction, interrelationship between the living world and the environment, levels of organization, components and dynamism of ecosystem, homeostasis, niche concept, concept of limiting factors	03
2.	**Biogeography:** Floristic realms, speciation and its types, biogeographic regions of India,Plant indicators	03

3.	**Population ecology:**Definition, characteristics, population growth form, r and k selection	03
4.	**Community ecology:** Introduction and Definition, community structure, physiognomy, Raunkiaer's life form classification, keystone species, edge and ecotone	04
5.	**Biogeochemical cycles:** The carbon cycle, Nitrogen cycle, Phosphorus cycle, and Hydrologic cycle	02
	Credit-II	**15**
6.	**Ecological Impact Assessment (EIA)** Introduction, Historical Review of EIA, Objectives of EIA, Stages of EIA process: Screening; Scoping; Baseline study; Impact prediction and assessment; Mitigation; Producing Environmental Impact Statement (EIS); EIS review; Decision making; Monitoring, Compliance and Enforcement; Benefits of EIA.	05
7.	**Environmental Audit** Meaning and concept, need, objectives, benefits, types, audit protocol, process, certification, personnel environmental audit	04
8.	**Remote Sensing** Definition, basic principles, process of ecological data acquisition and interpretation, global positioning system,application of remote sensing in ecology.	04
9.	**Ecological management:** Concepts, sustainable development, sustainability indicators	2

References:

1. Current sciences special issue remote sensing for national development Volume 61 numbers 3 and 4 August 1991
2. DaubenmireR.F. 1974. Plants and Environment- A Text Book of Plant Ecology (3rd edition). John Wiley & Sons. New York.
3. E.P. Odum. 1996. Fundamentals of Ecology. Natraj Publishing, Dehradun.
4. G.J. Rau and C.D. Weeten, "Environmental Impact Analysis Hand book, McGraw Hill, 1980.
5. George Joseph Fundamentals of remote sensing (Second edition, 2005) by Universities press (India) Private Ltd., Hyderabad.
6. John R. Jensen (2000)Remote sensing of the environment, Dorling Kindersley India Pvt. Ltd,
7. KendeighS.C. 1980. Ecology with Special Reference to Animals and Man. Prentice Hall of India Pvt. Ltd., New Delhi.
8. KermondyF.J. 1996. Concepts of Ecology.Prentice Hall of India Pvt. Ltd. New Delhi.
9. Kumar H.D. 1996. Modern Concepts of Ecology (3rd edition). Vikas Publishing House Pvt., Ltd. Delhi.

10. Kumar H.D. 1997. General Ecology. Vikas Publishing Pvt. Ltd., Delhi.
11. Larry W. Canter," Environment Impact Assessment", McGraw-Hill Book Company, New York
12. M. Anji Reddy Textbook of Remote sensing and GIS (Third edition, 2006) by BS Publication, Hyderabad
13. Singh JS, Singh SP, & Gupta SR, (2006) Ecology, Environment and Resource Conservation. Anamayapubl, New Delhi
14. Smith L.R. 1996. Ecology and Field Biology (5th edition). Harper Collns College Publishers, USA.
15. Smith L.R. and Mith T.M. 1998. Elements of Ecology. (4th edition). An imprint of Addison Wesley, Longman ink., California
16. Weaver. J.E. and Clements. S.E. 1966. Plant Ecology. Tata McGraw Publishing Co. Ltd. Bombay.

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper V) 2020-2021
BO 355: Cell and Molecular Biology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I Cell Biology	**15**
1.	**Introduction to Cell Biology:** Definition, Brief history of Cell Biology, Units of measurement for cell, Interdisciplinary nature of Cell Biology	01
2	**Cell organelles**: Ultrastructure, components and functions of Cell wall and cell membranes, mitochondria and Chloroplast, endoplasmic Reticulum, Golgi apparatus, Lysosomes, Vacuoles, Peroxisomes & Glyoxysomes	06
3.	**Nucleus:** Morphology and ultrastructure of nucleus, nucleolus and nucleolar organizer Nuclear envelope – structure of nuclear pore complex, transport of molecules across nuclear envelope.	03
4.	Chromosomes: Euchromatin and heterochromatin Histones, Packing of DNA into chromosomes in eukaryotes, Karyotype and ideogram, Polytene chromosomes and lampbrush chromosomes.	03
5	**Cell signaling:** Introduction and definition, Signaling molecules and receptors, Calcium signaling pathway in plants	02
	Credit-II Molecular Biology	**15**
5	**Genetic material** DNA: historical perspective from 1953 to 2020, Griffith's and Avery's transformation experiments, Hershey-Chase bacteriophage experiment.	02

6.	**DNA replication (Prokaryotes and Eukaryotes):** Molecular mechanism of DNA replication. Enzymes involved in both prokaryotic and eukaryotic DNA replication and their inhibitors (antibiotics).	03
7.	**Gene expression:Transcription (Prokaryotes in details and passing remarks on Eukaryotes)** Types of RNA: mRNA, tRNA, rRNA; types of promoters; types of RNA polymerase enzymes in eukaryotes; molecular mechanism of transcription.	04
8	**Translation (Prokaryotes and Eukaryotes):** Definition, concept and properties of genetic code; molecular mechanism of translation.	03
9	**Regulation of gene expression:** Concept of operon, *lac* operon and *trp* operon, positive and negative control, one gene one enzyme hypothesis.	03

Suggested readings:

1. Cell and Molecular Biology , S. C. Rastogi
2. Cytology, T. S. Verma and V. K. Agarwal 3. Cell Biology, C. B. Pawar
4. Cell and Molecular Biology, P. K. Gupta
5. Fundamentals of Molecular Biology, Veer Bala Rastogi
6. Fundamentals of Molecular Biology, G. K. Pal and Ghaskadabi
7. Cell Biology, Molecular Biology, Genetic, Evolution and Ecology, Verma and Agarwal
8. Cell and Molecular Biology, Robertis and DeRobertis
9. Molecular Cell Biology, 4th Edition, Lodish S. Baltimore
10.Molecular Biology of Gene, Watson J. D.
11.Biochemistry and Molecular Biology of Plants, Buchanan B. B.
12. Molecular and Cell Biology, Wolfe S.L.

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper VI) 2020-2021
BO 356: Genetics - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Introduction to Genetics.** History, Definition, Concept, branches and applications of Genetics.	01
2	**Mendelism** Genetical terminology, Monohybrid cross, Law of dominance, Incomplete dominance, Law of segregation, Dihybrid cross, Dihybrid ratio, Law of	04

	independent assortment, Back cross and Test cross.	
3.	**Neo Mendelism (Gene Interaction)** Genetic interaction, Epistatic interactions –supplementary gene (recessive epistasis 9:3:4), Inhibitory genes (13:3), Masking genes (12:3:1), Non-Epistatic inter-allelic genetic interactions-Complementary genes (9:7), Duplicate genes (15:1)	03
4.	**Multiple alleles** Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – Blood group in human and self-incompatibility in Nicotiana.	02
5	**Linkage, Recombination and Crossing Over** Linkage- Definition and Types, Crossing over: Definition and Types, Construction of a linkage map by two point test cross and three point test cross, Recombination: Concept, definition and types	04
6	**Mutation:** Concept, definition and types	01
	Credit-II	**15**
5	**Numerical alterations of chromosomes.:** Euploidy, Aneuploidy-Concept and Types, Aneuploidy in Plants and Human, Polyploidy in Plants & Animals, Induced Polyploidy, applications of Polyploidy	03
6.	**Structural alterations of chromosomes.:** Types, cytology and genetic effects of Deletion, Duplication Inversion and Translocation with examples.	04
7.	**Cytoplasmic & Quantitative Inheritance:** Concept of quantitative inheritance, Inheritance of quantitative trait in Maize (Cob length), Cytoplasmic inheritance Definition and concept, Chloroplast- Varigation in Four O'clock plants, Mitochondria- Petite mutants in yeast.	04
8	**Sex Linked Inheritance:** Concept of Sex chromosomes and autosomes, Inheritance of X- linked genes –Inheritance of colour blindness in humans, Inheritance of Y-linked (Holandric genes) in humans, Sex influenced genes, Sex-limited genes.	04

Suggested readings:

22. Darbeshwar Roy Crop Evolution & Genetic Resources.

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper VII) 2020-2021
BO 357: Practical based on BO351 and BO352 (2 Credits)

Sr. No.	Title	No. of Practical
1.	Study of Algae with respect to systematic position, thallus structure and reproduction of *Nostoc, Oedogonium, Chara, Sargassum, Palmaria/Chondrus.*	04
2	Study of Fungi respect to systematic position, thallus structure and reproduction of *Mucor, Saccharomyces, Penicillium, Puccinia* and *Cercospora.*	04
3.	Study of *Marchantia* with respect to systematic position,morphology of thallus –rhizoids and scales,Gemma Cup, structure of sporophyte, reproduction.	01
4.	Study of *Anthoceros* with respect to systematic position, structure of gametophyte, anatomy of thallus, structure of Sporophytes, reproduction.	01
5	Study of *Funaria* with respect to systematic position, morphology of thallus- leaf, rhizoids, operculum, Anatomy of axis, leaf, reproduction	01
6	Study of Sporophyte evolution in Bryophytes with the help of permanent slides.	01
7	Study of *Psilotum* with respect to Taxonomic position, Morphology of sporophyte, anatomy and reproductive structure	01
8	Study of *Selaginella* with respect to Taxonomic position, Morphology of sporophyte, Anatomy and reproductive structures.	01
9	Study of *Equisetum*with respect to taxonomic position, Morphology of Sporophyte, anatomy and reproductive structure	01
10	Study of Stelar evolution in Pteridophytes with the help of permanent slides	01

Note: Botanical Excursion and submission of Tour Report with Photograps is compulsory.

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper VIII) 2020-2021
BO 358: Practical based on BO353 and BO354 (2 Credits)

Sr. No.	Title	No. of Practical
1.	Study of following families with reference to systematic position (following Bentham & Hooker), Diagnostic characters, floral formula, floral diagram of Nymphaeaceae, Oleaceae, Amaranthaceae, Cannaceae	04
2	Preparation of Botanical keys: Indented and bracketed keys by using vegetative and reproductive characters	01
3	Study of internal and external morphology of Gnetum	01
4.	Study of internal and external morphology of Pinus	01
5.	Study of the following with the help of slides and/ or specimens. i) Impression ii) Compression iii) Petrifaction	01
6	Study of polluted water body with ref. to BOD (D zero day and D fifth day).	02
7	Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter	02
8	Acquisition of ecological data of particular locality by using GPS/ altimeter/geographicloa maps etc	02
9	Study of suitable ecosystem by line/belt transect method/ nested quadrate method	02

Note: Excursion tours of long and short duration are compulsory

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper IX) 2020-2021
BO 359: Practical based on BO355 and BO356 (2 Credits)

Sr. No.	Title	No. of Practical

1.	Cytological techniques-preparation of Fixatives, preparation of stains (Aceto˘ carmine and Aceto-orcein).	01
2	Isolation of nuclei and characterization	01
3	Study of various stages of mitosis and meiosis	01
4	Induction of C metaphase in suitable plant material	01
4	Study of Chromosomes Morphology (from colchicines pretreated Onion root tip cells)	01
6	Isolation of plant genomic DNA by suitable method.	01
7	Estimation of Plant DNA by DPA method	01
8	Extraction and estimation of RNA by Orcinol Method	01
9	To study the monohybrid and dihybrid crosses with suitable data and its analysis by Chi-Square test.	01
10	Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells.	01
11	Preparation of salivary gland chromosomes in *Chironomous* larvae.	01
12	Study of human genetic traits viz. PTC taste sensitivity, earlobe and rolling tongue, height, Skin colour, Hair colour, Eye colour in known population.	01
13	Genetic problems on gene mapping using three point test cross data.	01
14	Study of structural heterozygotes (multiple translocations) in *Rhoeo*.	01
15	Problems on quantitative inheritence. (Cob length in Maize)	01
16	Problems on Multiple Alleles. (Blood group in Human)	01

Skill Enhancement course

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper X) 2020-2021
BO 3510: Medicinal Botany - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Medicinal Plants:** History, Scope and Importance	01
2	**Indigenous Medicinal Sciences;** Definition and Scope	01
3.	**Ayurveda:** History, origin, panchamahabhutas, saptadhatu and tridosha concepts, Rasayana, plants used in ayurvedic treatments	04
4.	**Siddha:** Origin of Siddha medicinal systems, Basis of Siddha system, plants used in Siddha medicine.	02
5	**Unani:** History, concept: Umoor-e- tabiya, tumors treatments/ therapy, polyherbal formulations.	02
6	**Conservation of endangered and endemic medicinal plants:** Definition: endemic and endangered medicinal plants, Red list criteria; In situ conservation: Biosphere reserves, sacred groves, National Parks; Ex situ conservation: Botanic Gardens, Ethnomedicinal plant Gardens.	05
	Credit-II	**15**
5	**Propagation of Medicinal Plants:** Objectives of the nursery, its classification, important components of a nursery, sowing, pricking, use of green house for nursery production, propagation through cuttings, layering, grafting and budding.	05
6.	**Ethnobotany and Folk medicines:** Definition; Ethnobotany in India: Methods to study ethnobotany; Applications of Ethnobotany: National interacts, Palaeo-ethnobotany.	05
7.	**Folk medicines** of ethnobotany, ethnomedicine, ethnoecology, ethnic communities of India. Application of natural products to certain diseases- Jaundice, cardiac, infertility, diabetics, Blood pressure and skin diseases.	05

Suggested Readings

1. Trivedi P C, 2006. Medicinal Plants: Ethnobotanical Approach, Agrobios, India.

2. Purohit and Vyas, 2008. Medicinal Plant Cultivation: A Scientific Approach, 2nd edn. Agrobios, India.

Skill Enhancement course

T.Y.B.Sc. Botany CBCS Pattern
(Semester V, Paper XI) 2020-2021
BO 3511: Plant Diversity and Human Health - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Plant diversity** and its scope- Genetic diversity, Species diversity, Plant diversity at the ecosystem level,	03
2	**Agrobiodiversity** and cultivated plant taxa, wild taxa. Values and uses of Biodiversity: Ethical and aesthetic values, Precautionary principle, Methodologies for valuation, Uses of plants, Uses of microbes.	05
3.	**Loss of Biodiversity:** Loss of genetic diversity, Loss of species diversity, Loss of ecosystem diversity, Loss of agrobiodiversity, Projected scenario for biodiversity loss,	04
4.	Management of Plant Biodiversity: Organizations associated with biodiversity management-Methodology for execution-IUCN, UNEP, UNESCO, WWF, NBPGR; Biodiversity legislation and conservations.	03
	Credit-II	**15**
5	**Conservation of Biodiversity:** Conservation of genetic diversity, species diversity and ecosystem diversity, In situ and ex situ conservation, Social approaches to conservation, Biodiversity awareness programmes, Sustainable development.	08
6.	Role of plants in relation to Human Welfare; a) Importance of forestry their utilization and commercial aspects b) Avenue trees, c) Ornamental plants of India. d) Alcoholic beverages through ages. Fruits and nuts: Important fruit crops their commercial importance. Wood and its uses.	07

Suggested Readings

Krishnamurthy, K.V. (2004). An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper I) 2020-2021
BO 361: Plant Physiology and Metabolism - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Mineral nutrition:** Classification of mineral elements, macro and micronutrients; Role of essential elements; Transport of ions across cell membrane, Ionophores , Carriers and Channels	03
3.	**Photosynthesis:** Mechanism of photosynthesis- Electromagnetic spectrum Ultra-Structure of Chloroplast, Organization of Light-Absorbing Antenna Systems, Light Reaction: (Cyclic and Non-cyclic photophosphorylation), Dark Reaction: Calvin–Benson Cycle, Photorespiration, C4 cycle and CAM pathway of carbon fixation).	07
4.	**Respiration:** Types of respiration (Aerobic and anaerobic), Mechanism of aerobic respiration (Glycolysis, TCA cycle, Terminal oxidation and phosphorylation in respiratory chain); Pentose Phosphate Pathway.	05
	Credit-II	**15**
5	**Stomatal Biology:** Light-dependent Stomatal Opening, Mediation of Blue-light Photoreception in Guard Cells by Zeaxanthin, Reversal of Blue Light–Stimulated Opening by Green Light, The Resolving Power of Photophysiology (Overview).	04
6.	**Translocation in phloem:** Composition of phloem sap, girdling experiment; Pressure flow model.	03
7.	**Plant growth regulators:** Discovery and physiological roles of auxins, gibberellins, cytokinins, ABA, ethylene.	05
8	**Photomorphogenesis:** Red and far red light responses on photomorphogenesis; Phytochrome (discovery and mode of action).	03

Suggested Readings:

1. Lincoln Taiz, Eduardo Zeiger, Ian Max Moller and Angus Murphy 2015. Plant Physiology and Development (Sixth Edition) Sinauer Associates, Inc Publishers Sunderland, Massachusetts U.S.A.

2. Epstein, E., and Bloom, A. J. (2005) Mineral Nutrition of Plants: Principles and Perspectives, 2nd ed. Sinauer Asso˘ ciates, Sunderland, MA.
3. Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
4. V. K. Jain (2017) Fundamentals of Plant Physiology S. Chand Publications.

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper II) 2020-2021
BO 362: Biochemistry - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Foundation of Biochemistry:** From molecules to the first cell (origin of a cell), Miller and Urey experiment. Biomolecules of a cell, functional groups in biomolecules, conformations and configurations of biomolecules.	03
2	**Water: The solvent of life:** Physical properties of water, structure of water molecule, polarity of water molecule, weak interactions in aqueous solutions.	02
3.	**Amino acids and proteins:** Structure, classification, properties and functions of amino acids. Structure (primary, secondary, tertiary and quaternary), properties and functions of proteins. Biological disorders of amino acid metabolism. Commercial applications.	05
4.	**Enzymes:** Definition, nature of enzymes and co-factors, classification and properties of enzymes, active site. Mechanism of enzyme action: free energy, activation energy, binding energy, transition state, lock and key hypothesis, induced fit theory. Factors affecting enzyme activity: pH, temperature, substrate concentration, enzyme concentration. Enzyme inhibition: Competitive, uncompetitive, non-competitive.Reversible and irreversible inhibition, feedback inhibition.	05
	Credit-II	**15**
5	Carbohydrates: Definition, classification of carbohydrates-Monosaccharides: aldoses and ketoses, configurations, linear to ring structure; Oligosaccharides: glycosidic bond, reducing and non-reducing sugars; Polysaccharides: homopolysaccharides, heteropolysaccharides,	08

	examples, their structures, locations and role. Properties and functions of carbohydrates. Commercial applications.	
6.	**Lipids:** Definition, classification of lipids: simple, conjugate and derived lipids, properties and functions of lipids. Biological disorders of lipid metabolism. Commercial applications.	**05**
7.	**Vitamins:** Definition, classification of vitamins. source and functions of vitamins.	**02**

Suggested Readings:

1. **Nelson, D. L., & Cox, M. M.** (2017). *Lehninger principles of biochemistry* (7th ed.). W.H. Freeman.
2. **Buchanan, B. B., Gruissem, W., & Jones, R. L.** (2000). *Biochemistry & molecular biology of plants.* Rockville, Md.: American Society of Plant Physiologists.
3. **Taiz, L. Zeiger, E., Moller, I.M. and Murphy, A.** (2015) *Plant Physiology and Development.* 6th Edition, Sinauer Associates, Sunderland, CT.
4. **Jain, J. L., Jain, S. & Jain, N.** (2020) *Fundamentals* of *Biochemistry*, Revised edition, S. Chand Publishing
5. **Verma S.K. and Verma M.** (2007) *A text book of Plant Physiology, Biochemistry and Biotechnology*, S. Chand Publishing.

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper III) 2020-2021
BO 363: Plant Pathology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1.	**Fundamentals of Plant Pathology:** Introduction, Important terminology- Incitants, Host, Symptoms, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease. Economic importance of plant diseases, History of plant pathology, Introduction to Indian Agriculture Research Institute (IARI),International Crop Research Institute for Semi-Arid Tropics (ICRISAT), Contribution of Anton De Bary and Prof. B.B. Mundkur.	**02**
2	Disease Development: Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics-Forms,	**02**

	Decline, Exponential model.	
3.	**Defense Mechanisms:** Concept and Definition, Types-Preexisting-Structural and chemical, Induced- Structural and Biochemical.	**02**
4.	**Methods of Studying Plant Diseases.** Macroscopic study, Microscopic study, Koch"s postulates. Types of culture Media, Pure culture methods-Streak plate, Pour plate, Spread plate.	**02**
5	**Fungal Plant Diseases** Introduction to fungi as plant pathogens. Study of Diseases- Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut with reference to causal organism, symptoms and disease management.	**04**
6	**Bacterial Plant Diseases.** Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and disease management.	**03**
	Credit-II	**15**
5	**Mycoplasma Plant Diseases:** Introduction to Mycoplasma as plant pathogens, Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to causal organism,symptoms and disease management.	**03**
6.	**Nematodal Plant Diseases:** Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot diseases of vegetables, Soyabean cyst Nematodes with reference to causal organism,symptoms, Integrated management of Nematodal diseases.	**02**
7.	**Viral Plant Diseases:** Introduction of Virus as plant pathogens. Study of Diseases- Papaya Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and causal organism	**02**
8	**Non-Parasitic Diseases.** The impact and abiotic causes- Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies. Herbicidal injury, Study of Mango necrosis, Black Heart of Potato.	**04**
9	**Principles of plant diseases control:** General account, Quarantine,	**04**

	Eradication, cultural control practices, Biological control. Curative measures, chemical control, Use of Effective Microorganism solution (EMS), Microbial Pesticides.	

Suggested Readings:

1. Singh R. S. (2019) Introduction to Principles of Plant Pathology 4Ed (PB2019) Paperback.
2. Plant Pathology 2/e PB....Sharma PD Paperback – 1 January 2016
3. A.V.S.S. Sambamurty (2010) Principles of plant pathology, Wiley distributor
4. George Agrios (2004)Plant Pathology 5th Edition, Academic Press

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper IV) 2020-2021
BO 364: Evolution and Population genetics- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1	**Organic Evolution:** Distinction between Origin of life and Organic Evolution, Historical account of Origin of life, Origin of Earth Vs Origin of life: Gaia Hypothesis, Earliest Fossils, Prebiotic Evolution, Abiotic synthesis of organic matter, Primordial soup, origin of membranes, Oparin's Coacervate model, Theory of Panspermia, Early life and RNA and Origin of genetic code	06
2	**Organic Evolution:**The concept of organic evolution, Theories of Evolution, Pre-Darwinian period, Theory of Inheritance of acquired characters (Lamark's), Darwinism- Theory of Natural Selection, Post-Darwinian period- Modern synthetic theory	05
2	**Evidences of Evolution** Direct evidences and conclusions from fossil records, Indirect evidences, Evidences from Genetics, Evidences from bio-geographical relations	04
	Credit-II	**15**
4	**Evolution Through Ages:** Fossils and Geological Time scale: Fossils and	05

	Fossilization, Conditions of fossilization, Dating of fossils: Uranium Lead method, Radio-carbon method, U-series and ESR method, Geological Time scale: Eras, Periods, epochs, and duration in millions of years and plant life.	
5.	**Population Genetics and Evolution:** Concept of Mendelian population, Gene Pool and its models, Hardy-Weinberg law of gene frequencies, Factors affecting allelic frequency, Genetic polymorphism	**04**
5.	**Speciation and Isolating Mechanisms:** Introduction, Morphological Criteria for Species and Races, Allopatric and Sympatric Populations, Isolating Mechanisms: Pre zygotic Isolation mechanisms: Concept, Spatial & Ecological;, Seasonal Isolation, Ethological Isolation, Mechanical Isolation, Post zygotic Isolation mechanisms: Concept, Hybrid in viability, Hybrid sterility & Hybrid breakdown.	**06**

Suggested readings:

1. P. K Gupta, Cytology, Genetics and Evolution , Rastogi Publications
2. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S. Chand and Company, New Delhi
3. Shukla R.S. & Chandel P.S. Cytogenetics, Evolution & Biostatistics. S. Chand Publications,
4. Tomar & Singh, Evolutionary Biology, Rastogi Publications
5. Suryaprakash Mishra. A textbook of Cell Biology, Genetics and Evolution, Kalyani Publication
6. N Shukla, Population Genetics, DISCOVERY PUBLISHING, PVT. LTD.
7. Veer Bala Rastogi .Organic Evolution (Evolutionary Biology), Scientific Inernational Pvt. Ltd.
8. N. Anurgam, Evolution, Saras Publications
9. N. Anurgam, Organic Evolution, Saras Publications

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper V) 2020-2021
BO 365: Advanced Plant Biotechnology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1	**Biotechnology:**	**02**

	Introduction, Traditional and modern Biotechnology. Impact of Biotechnology on Health care, Agriculture, and Environment	
2	**Plant Tissue Culture:** Concepts of Cell theory & Cellular totipotency, Landmarks in plant tissue culture. Pluripotency, Differentiation, dedifferentiation, redifferentiation, Hormones used in PTC, 'Explant' for plant tissue culture and Response of explants in vitro– callus formation, organogenesis (direct and indirect) and embryogenesis (direct and indirect). Micro propagation of Banana (in detail from Selection of explant to hardening and marketing)	06
3.	**Techniques of Genetic Engineering and Methods of gene transfer in Plants-** Introduction to Molecular tools: Definition and role of Nucleases, Polymerases, Ligases, Polynucleotide kinases, Alkaline Phosphatases. Types of vectors- Definition and characters (2-4) of Plasmids, Phages, Cosmids, BAC, YAC, Plant viruses, Animal viruses. Methods of gene transfer in Plants – Direct gene transfer – Definition and concept of Electroporation, Microinjection, and Gene gun Indirect gene transfer- Agrobacterium mediated gene transfer method, Ti-plasmid: structure and functions, T-DNA Gene amplification technique -Polymerase chain reaction DNA finger printing	07
	Credit-II	**15**
4	**Cryopreservation and Germplasm Conservation** Definition and concept, techniques of cryopreservation, cold storage, long term and short term storage, applications. **Germplasm Conservation:** Preservation of Cell, tissue, organ, whole organism. Concept of Gene Bank, DNA Bank, Seed Bank, Pollen Bank etc.	03
5.	**Biotechnology and Society**	05

	Biotechnology- Benefits, GM foods and its safety, Recombinant foods and religious beliefs, Recombinant therapeutic product for human health care. Patenting of biotechnological inventions and Intellectual property rights.	
5.	**Microbial Biotechnology:** Biochemistry of fermentation, Microorganism used in fermentation, fermentable substrate, Ethanol fermentation methods, Distilleries producing alcohols. Commercial production: Alcoholic beverages, organic acids, citric acids. Advantages of fermentation. **Transgenic Plants as Bioreactors:** Metabolic engineering of starch, cyclodextrins, fructans, Bioplastics, Genetically engineered plants as protein factories, Production of therapeutic proteins from plants.	06
6	**Nano-biotechnology** Definition and concept, Applications of nanotechnology in agriculture (fertilizers and pesticides).	01

Suggested readings:

1. R. C. Dube (2008) - A Text Book of Biotechnology, S. Chand
2. P.K. Gupta-Elements of Biotechnology
3. Satyanarayana-Biotechnology
4. Kalyan Kumar De-Plant tissue culture
5. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.
6. Verma and Agrawal- Molecular Biology
7. Devi P.2008-Principle and Methods of plant Molecular Biology, Biochemistry and Genetics Agrobios, Jodhpur, India.
8. Glick B.R. and Tompson J.E. 1993 Methods in Plant Molecular Biology and Biotechnology CRC Press Boca Raton, Florida.
9. Hall R.D. (Ed.) 1999 Plant cell culture Protocol human press Inc., New Jersey, USA

10. Kumar H.D. 2002 A Text Book of Biotechnology 2nd Edn. Affiliated Easyt˘ West Press Private Ltd New Delhi.

11. Ramawat K.G. 2003 Plant Biotechnology, S. Chand & Co. Ltd . Ramnagar New Delhi. 110055

12. Trivedi P.C.2000 Plant Biotechnology, Panima Publishing Carpation, New Delhi.

13. Rajdan- Plant tissue culture.

13. Kalyan Kumar De-Plant tissue culture

14. Pal J.K. and Ghaskadabi S.S. (2008) Fundamentals of Molecular Biology.

15. .Razdan M.K. - Introduction to Plant Tissue culture (Oxford & IBH Publ, New Delhi)

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper VI) 2020-2021
BO 366: Plant Breeding and Seed Technology - 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I –Plant Breeding	**15**
1	**Introduction:** Definition, Scope and objectives and History of Plant breeding in India	01
2	**Techniques and practices of plant breeding** **A. Plant Introduction** • Definition • Types (Primary and Secondary) • Procedure • Merits and Demerits • Important Achievements	02
	B. Selection methods • Concept, • Types of selections –mass selection, pure line selection and clonal selection. • Advantage and disadvantages of selection • Achievements of selection breeding	03
	C. Hybridization • Definition, Concept and Objectives • Precaution to be taken during hybridization • Types: Intervarietal and Distant • General procedure of hybridization • Methods of hybridization: Pdigree and bulk • Hybrid vigour and heterosis	04
3	**Advanced techniques in Plant breeding** **A. Mutation breeding**	03

	• Definition and concept • Mutagens (Physical and Chemical) • Mutants • Types of mutation (Spontaneous and Induced) • Application of mutation breeding • Limitations of mutation breeding	
	B. Tissue Culture • Definition and concept • Totipotency • Application of tissue, embryo and anther culture in seed production	02
	Credit-II - SEED TECHNOLOGY	**15**
4	**Introduction to Seed Technology** • Seed as a basic input in agriculture • Classes of seed 1. Nucleus 2. Breeder 3. Foundation 4. Certified Role of seed technology	02
5.	**Seed legislation** • Introduction • Seed legislation in India (Seed Act)	01
6	**Seed Production** • Introduction • National Seed Corporation (NSC) and its objectives • State Seed Corporation (SSC) and its objectives • General procedure for Seed Production ○ Location and Season ○ Land requirement ○ Importance of soil and water testing ○ Cultural practices ○ Isolation distance ○ Plant protection ○ Weed Control ○ Rouging ○ Harvesting ○ Threshing ○ Seed Processing	03
7	**Seed Certification** • Definition, Objectives and Concept • Phases of Seed Certification • General procedure of seed certification • Field inspection • Dutics of seed inspector	02
8	**Seed Testing**	03

	A. Physical Purity Analysis • Definition of purity components • Physical Purity Work Board • Procedure **B. Moisture Testing** • Concept • Air oven method • Digital Moisture Meter **C. Germination testing** • Definition and objectives • Procedure and methods for germination testing (Paper, Sand and Soil) • Seedling evaluation (Normal Seedlings, Abnormal Seedlings, Multigerm Seed Units and Non-germinated Seeds)	
9	**Seed Pathology and Entomology** • Definition • Seed Borne pathogens ○ Fungi ○ Bacteria ○ Viruses • Influence of seed borne pathogens on seed production • Common insect pest and its impact on seed production	**02**
10	**Seed Storage** • Definition and Concept • Seed treatment • Management of seed storage structures ○ Sanitization ○ Dehumidification ○ Fumigation	**02**

Suggested readings:

1. Laxmi lal somani and Devidas patel (2020) Textbook of seed science and technology, Agrotech publishing co.
2. Vijay Pal Singh Panghal and Axay Bhuker (2020) Seed Science and Technology. Kalyani publisher
3. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
4. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw Hill Publishers Company Ltd., New Delhi.
5. Singh B.D 1996 Plant Breeding – Principles and methods. Kalyani Publications, Ludhiana.
6. Allard R.W 1995. Priniples of Plant Breeding. John Wiley and Sons, Ice., Singapore.
7. Agarwal R.L. --- Seed Technology, Oxford & IBH Publishing Co Pvt.Ltd

8. TNAU (ICAR) Principles of Seed technology (2020)

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper VII) 2020-2021
BO 367: Practical based on BO361 and BO362 (2 Credits)

Sr. No.	Title	No. of Practical
1.	Determination of osmotic potential of plant cell sap by plasmolysis method	01
2	Calculation of stomatal index and stomatal frequency of a mesophyte and a xerophyte.	01
3	Demonstrate the activity of catalase and study the effect of pH and enzyme concentration.	01
4	To study the effect of light intensity and bicarbonate concentration on O2 evolution in photosynthesis.	01
5	Comparison of the rate of respiration in any two parts of a plant.	01
6	Separation of amino acids by paper chromatography.	02
7	Demonstration experiments (any four) i). Bolting. ii). Effect of auxins on rooting. iii). Suction due to transpiration. iv). R.Q. v). Respiration in roots.	01
8	Estimation of total free amino acids by spectrophotometry	01
9	Separation of amino acids by paper chromatography.	01
10	Estimation of soluble proteins by Lowery *et. al.* method.	01
11	Demonstration of Enzyme activity: Amylase /invertase /catalase	01

12	Estimation of reducing sugars by DNSA method.	01
13	Estimation of Vitamin C (Ascorbic acid) from plants.	01
14	Qualitative tests for starch, lipids and proteins.	01
15	Determination of the iodine number of lipids using Hanus method.	01

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper VIII) 2020-2021
BO 368: Practical based on BO363 and BO364 (2 Credits)

Sr. No.	Title	No. of Practical
1.	Preparation of any one culture media for isolation of plant pathogens.	01
2	Culture technique- Streak plate methods, pour plate methods, Spread plate methods.	01
3	Study of any two of fungal (Downy mildew of Grapes, Head smut of Jowar, Tikka diseases of Groundnut) diseases	01
4	Study of any two of each bacterial and mycoplasma diseases	01
5	Study of any two of each viral and non-parasitic diseases of plants.	01
6	Preparation of 1% Bordeaux mixture and Bordeaux paste 10%.	01
7	Preparation of Jivamruta.	01
8	Study of Koch's Postulates.	01
9	Study of Fungicides and Microbial pesticides.	01
9	Study of Geological time scale	01
10	Study of types of Fossils : i) Coal ball ii) Rhynia vii) Lyginopteris iii) Pentoxylon iv) Nipaniophyllum v) Lepidodendron	01
11	Demonstration of any three evidences of Organic Evolution	01
12	Numerical Problems based on Allele frequency and Genotype frequency	01
13	Numerical Problem based on Hardy-Weinberg Equilibrium	01

14	Study of Sympatric and Allopatric speciation with suitable example	01
15	Study of Isolation mechanism : Prezygotic & Postzygotic(Any one example from each)	01
16	Submission of Report on Visit to Paleobotany Laboratory/Museum/Fossil Garden	01

T.Y.B.Sc. Botany CBCS Pattern
Practical (Semester V Paper IX) 2020-2021
BO 369: Practical based on BO365 and BO366 (2 Credits)

Sr. No.	Title	No. of Practical
1.	Preparation and sterilization of MS Medium and Callus Induction using leaf primordia	01
2	Production of secondary metabolites in any suitable plant material	01
3	Artificial seed production by Sodium Alginate method encapsulation (somatic embryogenesis)	01
4	Demonstration to equipments used in genetic engineering like gene gun, PCR, gel doc, microcentrifuge, electrophoresis, micropipettes, incubator, shaker etc. (live/videos/photographs/visit to research labs)	01
5	Study of Transgenic plants- Arabidopsis thaliana as a model plant, Bt-Brinjal, Flr-svr Tomato, and other GM crops like soybean, maize, tobacco as a pharmaceuticals, banana as a edible vaccine etc. (live/videos/photographs/visit to research labs)	01
6	Preparation of plant based nano-particles	01
7	Demonstration to Fermentation of fruit juice and wine production from grapes/pomegranate/jamun/ apple/ber (live/videos/photographs/visit to research labs)	01
8	Problems on genetic engineering (set of problems will be given on restriction enzymes, vectors etc.)	01

9	Demonstration of Hybridization Techniques (Emasculation, Hand Pollination, Bagging and Tagging) in cotton and tomato.	01
9	Effect of chemical mutagens on seed germination and seedling growth.	01
10	Study of pollen viability and floral morphology of crops	01
11	To test seed moisture by hot air oven method	01
12	To study germination methods (Paper, Sand and Soil)	01
13	Physical purity analysis of seed sample	01
14	Visual examination of dry seeds for disease symptoms	01
15	To study any one common seed insect pest w.r.t to their life cycle, way of infestation/damage, symptoms and control measures.	01
16	Visit to a Plant Breeding Research Centre/ Seed Industry and report submission	01

Note: Submission of minimum 10 seed samples along with their botanical names, family, variety etc. to the department at the time of final practical examination

Skill Enhancement course

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper X) 2020-2021
BO 3610: Nursery and Gardening Management- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I Nursery Managment	**15**
1	**Nursery:** definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.	03
2	**Seed:** Structure and types - Seed dormancy; causes and methods of breaking dormancy - Seed storage: Seed banks, factors affecting seed viability, genetic erosion –Seed production technology - seed testing and certification.	03
3.	**Vegetative propagation:** air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants– greenhouse - mist chamber, shed root, shade house and glass house.	09

	Credit-II Gardening Management	**15**
4	Gardening: definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design -computer applications in landscaping - Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting.	**08**
5.	Sowing/raising of seeds and seedlings - Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes,and carrots - Storage and marketing procedures.	**07**

Suggested Readings

1. Bose T.K. & Mukherjee, D., Gardening in India, Oxford & IBH Publishing Co., New Delhi.1972.
2. Sandhu, M.K., Plant Propagation, Wile Eastern Ltd., Bangalore, Madras. 1989.
3. Kumar, N., Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 1997.
4. Edmond Musser & Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal, P.K. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation,National Seed Corporation Ltd., New Delhi. 1993.
6. Janick Jules. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.1979.

T.Y.B.Sc. Botany CBCS Pattern
(Semester VI, Paper X) 2020-2021
BO 3611: Biofertilizers- 2 Credits (30 Lectures)

Sr. No.	Topic Details	No. of Lectures
	Credit-I	**15**
1	**Introduction:** 1.1 Introduction, Scope and importance of Biofertilizers 1.2 General account of the microbes used as Biofertilizers	**02**
2	**Bacterial Biofertilizers** 2.1.Isolation of Rhizobium, Identification, Mass multiplication, Carrier based inoculants. 2.2.Azospirillum isolation and mass multiplication, carrier based	**09**

	inoculants and associative effect of different organisms 2.3.Azotobacter, classification and characteristics 2.4.Crop response to Azotobacter inoculums, Mass multiplication of Azotobacter 2.5.Applications of Azospirillum 2.6.Phosphate solubilizing Bacteria	
3.	**Algal Biofertilizers** 3:1. Cyanobacteria (Blue Green Algae): Isolation of Anabaena from Azolla, Mass Multiplication of Anabaena 3.2. Azolla - Anabaena relationship 3.3. Biological Nitrogen fixation 3.4. Blue Green algae in a rice cultivation. 3.5. Applications of BGA	**04**
	Credit-II	**15**
4	**Fungal Biofertilizers** 4.1. Introduction, Occurrence and Distribution of Mycorrhizal association. 4:2. Types of Mycorrhizal association, growth and yield - colonization of VAM - Vesicular Arbuscular Mycorrhiza 4.3. Mycorrhizal applications in agriculture	**09**
5.	**Compost and Manure** 5.1. Organic Farming, green manuring, organic manures and their uses 5.2. Recycling by composting method of biodegradable, municipal, agricultural and industrial wastes 5.3. Biocompost making methods, Types and methods of vermicomposting 5.4. Benefits of vermicompost, field applications	**06**

Suggested readings

Structure for M. Sc. Botany First Year:

Year	Semester	Course Type	Course code	Course Name	Credits
1	1	Core Compulsory Theory paper	BOUT 111	Botany Theory Paper 1-Plant Systematics I	4
			BOUT 112	Botany Theory Paper 2- Cell Biology and Evolution	4
			BOUT 113	Botany Theory Paper 3- Cytogenetics and Plant Breeding	4
		Choice Based optional paper	BODT 114	Botany Theory Paper 4- a) Biofertilizer and Algal Technology OR b) Pomoculture and Fruit Processing Technology	2
			BODP 114	Botany Practical Paper 4-based on BO 114	2
		Core Compulsory practical paper	BOUP 115	Botany Practical Paper based on BOUT 111, BOUT 112 and BOUT 113	4
1	2	Core Compulsory Theory paper	BOUT 121	Botany Theory Paper 1-Plant Systematics II	4
			BOUT 122	Botany Theory Paper 2- Molecular Biology	4
			BOUT 123	Botany Theory Paper 3- Biochemistry	4
		Choice Based optional paper	BODT 124	Botany Theory Paper 4- a. Floriculture and Nursery Management OR b. Mushroom Cultivation and Biopesticide Technology	2
			BODP 124	Botany Practical paper 4- based on BODP 124	2
		Core Compulsory practical paper	BOUP 125	Botany Practical paper based on BOUT 121, BOUT 122 and BOUT 123	4

Semester I

BOUT 111: Botany Theory Paper I-Plant Systematics I
(4 Credit- 60 Lectures)

Credits-1.5: Algae

22 Lectures

1. Systematics and Taxonomy – Principles, Concept of species and hierarchical taxa, Classification of algae up to order level as per Fritsch system (1935). **3 L**
2. Algological studies – Algal habitats, Pigment constitution in algae, Reserve food, Modes of perennation in algae, Origin and evolution of sex, Contribution of algal studies in India and world (any three Phycologists). **4 L**
3. Cyanophyta – Distinguishing characters, thallus organization, ultra-structure of heterocyst and its significance. **3 L**
4. Chlorophyta- Thallus organization, reproduction – asexual and sexual **3 L**
5. Introduction, Comparative structure and reproduction in Charophyta, Euglenophyta, Xanthophyta, Bacillariophyta and Chrysophyta. **4 L**
6. Phaeophyta and Rhodophyta–Morphology, Reproduction and life cycle pattern in any one from each. **3 L**
7. Applications of algae- Commercial applications of algae- Biofertilizer, Medicine, and Pollution. **2 L**

Credit-1.5: Fungi

23 Lectures

1. Thallus structure, Nutrition, Cell structure, Hyphal modifications in Fungi. Classification of fungi as per Ainsworth et al system (1973), Contribution of fungal studies in India and world. **3 L**
2. Myxomycotina- Distinguishing characters, types of Plasmodium and fruit bodies, Life cycle pattern **3L**
3. Mastigomycotina- Distinguishing characters, Thallus structure in Chytridiomycetes and Oomycetes. **3 L**
4. Zygomycotina - Distinguishing characters, Thallus structure, Heterothallism and sexual reproduction. **3 L**
5. Ascomycotina- Thallus structure, Fructifications, Comparative study of Hemiascomycetes and Euascomycetes. **3 L**

6. Basidiomycotina – Distinguishing characters, thallus structure, types and structure of basidia and basidiocarps. **3 L**
7. Deuteromycotina – Distinguishing characters, thallus structure, fructifications, types of conidia, conidial ontogeny. **3 L**
8. Applications of fungi- Biofertilizers, biocotrol, food and medicine. **2L**

Credit -1: Bryophytes

15 Lectures

1. Introduction, characters, Affinities with thallophytes and pteridophytes,Contributions of bryologists in world and India (any three), system of classification according to G.M. Smith 1955. Pteridophytean and algal hypothesis, evolution of sporophyte, theory of sterilization and reduction, apogamy and apospory. **3 L**
2. Distribution, Distinguishing characters, morphology and anatomy of gametophyte and sporophytes of following orders **11 L**
   Takakiales, Calobryales and Sphaerocarpales (1L), Marchantiales (1L), Jungermanniales (2L), Anthocerotales (1L), Sphagnales (1L), Polytrichales (1L), Funariales (1L), Andreaeales (1L), Eubryales (2L).
3. Applications of bryophytes- Antimicrobial properties, secondary metabolites, therapeutical, horticultural applications. **1 L**

References:

Algae:

1. Brodie J. and Lewis J. (2007). (Ed.) Unravelling the algae: the past, present and future of algal systematics. CRC press, New York, pp 335.
2. Bellinger E.G. and Sigee D.C. (2010). Freshwater algae: Identification and use as bioindicators, Willey-Blackwell, UK, pp. 271.
3. Cole K.M. and Sheath R.G. (1990). Biology of the red algae. Cambridge University Press.USA. pp. 503.
4. Desikachary T.V. (1959). Cyanophyta. ICAR, New Delhi.
5. Graham L.E. and Wilcox L.W. (2000). Algae.Penticce-Hall,Inc, pp. 640
6. Krishnamurthy V. (2000). Algae of India and neighboring countries I.Chlorophycota, Oxford & IBH, New Delhi.
7. Lee R.E. (2008). Phycology. Cambridge University Press, pp.547.
8. Misra J.N. (1996). Phaeophyceae in India. ICAR, New Delhi.
9. Prescott G.W. (1969). The algae.
10. Smith G.M. (1950). The fresh water algae of the United States, Mc-graw Hill

Book Depot, Allahabad.

6. PremPuri(1981). Bryophytes: Morphology, Growth and Differentiation. Atma Ram and Sons, New Delhi.
7. Udar R. (1975). Bryology in India.ChronicaBotanica, New Delhi.
8. Udar R. (1970). Introduction to Bryophytes.ShashidharMalaviyaPrakashan. Lucknow.
9. Watson E.V. (1971). Structure and Life of Bryophytes.3rd Edn. Hutchinson University Library, London.
10. Vashista B.R., Sinha A.K., Kumar A. (2008). Botany for degree students – Bryophyta, S.Chands Publication.

Semester I

BOUT 112: Botany Theory Paper II- Cell Biology and Evolution

(4 Credit- 60 Lectures)

Credit-I : Dynamic organization of the cell **15 L**

1. Universal features of cells: cell chemistry and biosynthesis, chemical organization of cells. 1L
2. Internal organization of the cell:
   - i. Cell Wall: Biogenesis, Ultra Structure and functions, primary and secondary wall, glycocalix. 1L
   - ii. Cell membrane: structure of cell membranes and concepts related to compartmentalization in eukaryotic cells. 1L
   - iii. Biogenesis, ultra structure and functions of endoplasmic reticulum and Golgi apparatus, lysosomes, vacuoles, glyoxysomes and peroxisomes, ribosomes, cellular cytoskeleton, mitochondria, chloroplasts and cell energetics; nuclear compartment: nucleus, nucleolus and chromosomes . 10L
   - iv. Giant chromosomes- lampbrush chromosomes, polytene chromosomes 2L

Credit-II : Cellular signaling, transport and trafficking **15L**

1. Types of receptors, G-proteins and G-protein coupled receptors, Phospholipid signaling, Ca^{2+}, Calmodulin cascade. 2L
2. Diversity in protein kinases and phosphatases, secondary messengers, regulation of signaling pathways. 2L
3. Specific signaling mechanisms with suitable examples- Biotic and abiotic stress, ABA induced stomatal closure, Stomatal guard cells signaling. 3L
4. Receptor Serine/ Threonine kinase, Ethylene mediated two component systems. 1L
5. Molecular mechanisms of membrane transport, nuclear transport, transport across mitochondria and chloroplasts; intracellular vesicular trafficking from endoplasmic reticulum through Golgi apparatus to lysosomes/cell exterior. Communication between cells and environment. 4L
6. Signaling at cell surface, signaling molecules, hormones and receptors signaling pathways that control gene activity, signal transduction and second messengers. 3

15

Credit-III : Cellular Processes

1. Cell cycle and its regulation; cell division: mitosis, meiosis and cytokinesis; cell differentiation: stem cells, their differentiation into different cell types and organization into specialized tissues. 3
2. Phases of cell cycle, functional importance of each phase, Molecular events during cell cycle, Regulation of cell cycle, Cyclins and protein kinase, MPF (Maturation promoting factor). 4
3. Method of study of cell cycle- labeled mitotic curve, flow cytometry, use of mutants, Cell aging and cell senescence. 4
4. Programmed cell death-molecular aspects, regulation of cell death, PCD in response to stress, Apoptosis- Role of different genes, cell organelles during apoptosis, genetic control of apoptosis. 4 L

15 L

Credit-IV (1 Cr): Evolution

1. Theories of Evolution: (3 L)

Steps and preview of evolution, Lamarckism, Darwinism- Concepts of variation, adaption, struggle for fitness and natural selection; Neo-Darwinism, Spontaneity of mutations, the evolutionary synthesis,

2. Origin of cells and cellular evolution:(3L)

Origin of basic biological molecules, abiotic synthesis of organic monomers and polymers, Concepts of Oparin and Haldane, Experiment of Miller (1953), The first cell, evolution of prokaryote, origin of eukaryotic cells, evolution of unicellular

eukaryotes, anaerobic metabolism, photosynthesis and aerobic metabolism, RNA world theory

3. Molecular Evolution: (3L)

Concepts of natural evolution, molecular clocks, molecular tools in phylogeny, classification and identification, protein and nucleotide sequence analysis, origin of new genes and proteins, gene duplication and divergence

4. Paleontology and Evolutionary History: (3 L)

Evolutionary time scale; Eras, periods and epoch; Major events in the evolutionary time scale; Multicellular evolution, Major groups of plants & Animals; Fossils-Formation, Nature, Types, Geological time scale

5. The Mechanisms: (3 L)

Population genetics – Populations, Gene pool, Gene frequency; Hardy-Weinberg Law; concepts and rate of change in gene frequency through natural selection, migration and random genetic drift; Adaptive radiation; Isolating mechanisms; Speciation; Allopatricity and Sympatricity; Convergent evolution; Sexual selection; Co-evolution.

4L

References :

1. Gerald Karp. (2010) ,Cell Biology, 6th edition, John Wiley & Sons., USA.
2. Geoffrey M. Cooper, Robert E. Hausman (2013), The Cell: A Molecular Approach, 6th edition, Sinauer Associates, Inc. USA
3. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2008). *Molecular Biology of the Cell* (5th Ed.). New York: Garland Science.
4. Lodish, H. F. (2016). *Molecular Cell Biology* (8th Ed.). New York: W.H. Freeman.
5. Krebs, J. E., Lewin, B., Kilpatrick, S. T., & Goldstein, E. S. (2014). *Lewin's Genes XI*. Burlington, MA: Jones & Bartlett Learning.
6. Cooper, G. M., & Hausman, R. E. (2013). *The Cell: a Molecular Approach* (6th Ed.). Washington: ASM ; Sunderland.
7. Hardin, J., Bertoni, G., Kleinsmith, L. J., & Becker, W. M. (2012). *Becker's World of the Cell*. Boston (8th Ed.). Benjamin Cummings.
8. Watson, J. D. (2008). *Molecular Biology of the Gene* (5th ed.). Menlo Park, CA: Benjamin/Cummings.
9. Alberts B., Bray D., Lewis J., Raff M., Roberts K., Watson J.D. (1989). Molecular Biology of the Cell. 2nd Edn. Garlan Publ. Inc. New York.

Semester I

BOUT 113: Botany Theory Paper III-Cytogenetics and plant breeding (4 Credits- 60 Lectures)

Credit I: Classical Genetics **15 Lectures**

1. Principles of Mendelian inheritance and Interaction of genes: 3 L

- Introduction,
- Mendel's Laws- Dominance, Segregation, Independent assortment
- Chromosomal theory of inheritance
- Interaction of genes- Complementary, epitasis, inhibitory, polymeric and additive
- Concept of gene, allele, multiple alleles
- Applications of mendelian genetics
- . Introduction to Model systems in Genetics- E.*coli*, Yeast, *Drosophila, Arabidopsis*

3 L

2. Cytoplasmic inheritance:

- Maternal effect (*Limaneaperegra*)
- Plastid Inheritance (*Mirabilisjalapa* and *Zeamays*)
- Mitochondrial Inheritance (Yeast petite and Maize-Cytoplasmic male sterility)
- Interaction between nuclear and cytoplasmic genes

3 L

3. Quantitative inheritance:

- Multiple Factor Hypothesis, Polygenic Inheritance
- Quantitative traits, Continuous variation
- Inheritance of quantitative traits, (Corolla length in *Nicotiana*, Cob length in Maize)
- Heritability and its measurement
- QTL mapping

4 L

4. Linkage, Recombination and Crossing Over:

- Linkage and crossing over
- Linkage maps, lod score for linkage testing, mapping by 3 point test cross
- Mapping by tetrad analysis in Yeast and *Neurospora*
- Recombination: RecA, RecB, RecC, RecD; homologous and non-homologous
- Somatic cell Genetics
- Sex linkage, sex limited and sex influenced characters

2 L

5. Mutation:

- Mutation- types, causes and dctection
- Mutant type- lethal, conditional, biochemical; loss of function, gain of function
- Germinal versus somatic mutants
- Insertional mutagenesis, Point mutagenesis

Credit-II: Microbial Genetics & Cytogenetics

15 Lectures

1. Microbial & Phage Genetics: 5 L

- Methods of genetic transfers- transformation, conjugation and transduction in bacteria and genetic recombination
- Mapping of bacterial genome by interrupted mating
- Lytic and lysogenic cycles in phages, Types of transduction: Generalized and Specialized
- Site specific recombination in phage, Mapping the bacteriophage genome
- Fine structure analysis of rII gene in T_4 bacteriophage

2. Karyotype and Chromosome Banding: 2 L

- Preparation of chromosome for karyotype; Ideogram
- Role of karyotype in chromosome evolution and plant species identification
- Chromosome Banding Techniques

4. Structural alterations of chromosomes: 4 L

- Deletion, duplication, inversion, translocation,
- Complex translocation heterozygotes
- Robertsonian translocations, BA translocations,

3. Numerical alterations of chromosomes: 4 L

- Aneuploids: method of production, meiotic behavior, applications
- Polyoploids: cytological and genetical method of identification of autopolyploids and allopolyploids, Applications.
- Evolutionary advantages of autopolyploids versus allopolyploids and their maintenance and utilization in gene mapping and gene.

Credit-III (1 Cr): Plant breeding

1. Plant Breeding:

15 Lectures

Concept, Objectives and applications of plant breeding,Patterns of evolution in cultivate crop species, modern concepts in plant breeding : Targeting induced local lesions in genomes (TILLING), Unigenes, Pyramiding of genes and Phenomics 3 L

2. Plant Genetic Resources 5L

Historical perspectives and need for PGR conservation; Importance of plant genetic resources; Gene pool: primary, secondary and tertiary;Centres of origin and global pattern of diversity; Basic genetic resources and transgenes. Principles, strategies and practices of exploration, collection, characterization, evaluation and cataloging of PGR; Plant quarantine and phytosanitary certification; Principles of *in vitro* and cryopreservation. Germplasm conservation- *in situ, ex situ*, Registration of plant genetic resources and importance of NBPGR. 4 L

3. Methods in plant breeding:

Introduction, Selection, Hybridization, Back Cross, Test Cross,modes of pollination- Self & cross pollination mechanism,Pure line theory, pure line selection and mass selection methods; Line breeding, pedigree, bulk, single seed descent and multiline method; Inter-varietal and wide/distant crosses, Principles of combination breeding and its application.

4. Asexual reproduction in crop plants-

Reproduction and apomixes. Types and Applications of Apomixis, Selection methods in asexually propagated crops, *In vitro* Double haploids, Triploids 3 L

15 lectures

Credit IV : 6 L

5. Mutation Breeding:

Mutation Breeding and its history - Nature and classification of mutations: spontaneous and induced mutations, micro and macro mutations,- Detection of mutations in lower and higher organisms – paramutations.

Mutagenic agents: Physical mutagens, Chemical mutagens mechanism of action of mutagens. Dose determination and factors influencing chemical mutagenesis, - Treatment methods using physical and chemical mutagens, Mutagen effects in M1 generation: plant injury, lethality, sterility, chimeras *etc.*, - Observing mutagen effects in M2 generation - Estimation of mutagenic efficiency and effectiveness. *In vitro* mutagenesis – callus and pollen irradiation; Handling of segregating genrations and selection procedures; Validation of mutants.

6. Mutation breeding for various traits (disease resistance, insect resistance,quality improvement,etc) in different crops- Procedures for micromutations(oligogenic) breeding/polygenic mutations. Use of mutagens in genomics, allele mining, TILLING 4 L

7. Breeding for nutritional traits 5 L

Breeding for special traits viz. oil, protein, vitamins, amino acids, elimination of toxic substances ; Concept of biopharming and development of varieties producing targeted compounds, nutraceuticals and industrial products; Success stories in vaccines, modified sugars, gums and starch through biopharming.

REFERENCES: -

1. Atherly, A.G., Girton, J.R. and McDonald, J.F 1999. The Science of Genetics Saunders College Publishing, Frot Worth, USA.
2. Hartle D.L and Jones, E.W 1998 Genetics: Principles and Analysis (Fourth Edition). Jones and Bartlett Publishers, Massachusetts, USA.
3. Khush, G.S 1973. Cytogenetics of Aneuploids. Academic Press, New York, Lewis, R. 1997. Human Genetics: Concepts and Application (Second Edition). WCB McGraw Hill, USA.
4. Malacinski, G.M and Freifelder, D. 1998: Essentials of Molecular Biology (Third Edition). Jones and B. Artlet Publisher, Inc., London.
5. Russel, P.J. 1998. Genetics (Fifth Edition). The Benjamin/Cummings Publishing Company IND., USA.
6. Snustad, D.P and Simmons, M.J 2000. Principles of Genetics (Second Edition). John Wiley and Sons Inc., USA.
7. Gardner and Simmons Snustad 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.
8. Sarin C 2004 (Sixth Edition) Genetics. TATA McGraw-Hill Publishing Company Ltd., New Delhi.
9. Ahluwalia K.B 2005 (First Edition). Genetics. New Age International Private Ltd. Publishers, New Delhi.
10. Burus and Bottino 1989. (Sixth Edition). The Science of Genetics. Macmillan Publishing Company, New York (USA).
11. Pawar C.B 2003 (First Edition). Genetics Vol. I and II. Himalaya Publishing House, Mumbai.
12. Strickberger 2005. (Third Edition). Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
13. Allard R.W 1995. Priniples of Plant Breeding. John Wiley and Sons, Ice., Singapore.

14. Sharma J.R 1994 Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers Company Ltd., New Delhi.
15. Singh B.D 1996 Plant Breeding Principles and methods. Kalyani Publications, Ludhiana.
16. Chahal G.S and Gosal S.S 2002. Principles and Procedures of Plant Breeding, Narosa Publishing House, New Delhi.
17. Verma and Agarwal, Genetics, S. Chand Co, New Delhi.
18. Toun N and Trempy Janire 2004 (First Indian Reprint). Fundamental of Bacterial Genetics. Blackwell Publishing Co.
19. Singh B.D 2004. Genetics. Kalyani Publication, Ludhiana.
20. Gupta P.K Genetics and Cytogenetics, Rastogi Publications.
21. Gupta P. K. Genetics Rastogi Publications
22. Phundan Singh Genetics, Kalyani Publications
23. Phundan Singh Plant Breeding Kalyani Publications
24. Verma P.S and Agarwal V.K. (2006) Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
25. Shukla R.S. & Chandel P.S. Cytogenetics, Evolution & Biostatistics. S.Chand Publications,
26. Tomar & Singh Evolutionary Biology, Rastogi Publications
27. Darbeshwar Roy Crop Evolution & Genetic Resources

Semester I

BODT 114: Botany Theory paper 4-Biofertilizer and Algal Technology

(2 Credits- 30 Lectures)

15 Lectures

Credit I (1 Cr): Biofertilizer

1. Introduction, Definition, need and significance of biofertlizers in agriculture 2 L
2. Types and scope of biofertilizers: Rhizobium, Azotobactor, Azospirillum, Phosphate solubilizing microorganisms, Cyanobacteria, Azolla, Mycorrhizae. 5 L
3. Production technology: Strain selection, multiplication, sterilization, large-scale biomass production of various strains. 3 L

4. Methods of Applications: Application for field and other crops, methods of application, quality control, agronomic importance. Application methods for different biofertilizers. 4 L
5. Use of Genetically Engineered Microorganisms for improvement of biofertilizers. 1 L

Credit II (1 Cr): Algal Technology

15 Lectures

1. Introduction to Algal Technology 2 L
2. Potential of algae as food and feed, pigments, pharmaceuticals and neutraceuticals, fine chemicals and fuel. 4 L
3. Algal biofertilizers, seaweed fertilizers – method of preparation and application 2 L
4. Biodiesel from algae- cultivation and extraction methods 2 L
5. Biohydrogen production from algae. 1 L
6. Algal Products- SCP-Spirulina mass cultivation & applications, Agar production. 4 L

References:

1. Bio-fertilizers in Agriculture and Forestry, 1995, by N.S. SubbaRao
2. Biofertilizer Manual 2006 FNCA Biofertilizer Project Group Forum for Nuclear Cooperation in Asia (FNCA)
3. N.S. SubbaRao. 1995. Bio-fertilizers in Agriculture and Forestry.
4. N.S.SubbaRao. Soil microorganism.Oxford and IBH Publication Co. New Delhi
5. N.S. Subbarao, Advances in Agril. Microbiology by, Oxford and IBH Publication Co, New Delhi
6. Tilak, K.K. Pal, RinkuDey. Microbes For Sustainable Agriculture
7. Bergy's manual of systematic bacteriology by Krieg N.R. and J.G. Holt, 1984, Williams and Witkins, Baltimore, U.S.A.
8. Rangaswamy G. and D.J. Bhagyaraj 1988.Agricultural Microbiology, Oxford and IBH Publication Co. New Delhi.

Semester I

BODT 114: Botany Theory paper 4- Pomoculture and Fruit Processing Technology

(2 Credits- 30 Lectures)

Credit-I (1 Cr): Introduction to Pomology

15 Lectures

1. Scope and Importance of Fruit crops, Nutritive value of fruits in human nutrition, Classification of Fruits based on : climate adaptability, fruit morphology, Botanical Classification 3L

2. Present status of fruit growing :- In India and Maharashtra, Scope of fruit growing in India and Maharashtra, Importance of fruit growing 2L
3. Planning and Lay out of orchards: Location & site, Soil, Climate, Planning, Layout: Square system, Rectangular system, Hexagonal system, Quincunx system, Contour system 2L
4. Growth & Fruiting Habits: Growth & fruiting habits, Fruit bud differentiation, fruit setting, fruit drop, Seedlessness, cracking of fruits, problems of fruiting, Bahar treatment, Unfruitfulness, Pruning and Training, role of plant growth substances. 5L
5. Methods of Propagation: Vegetative and sexual Methods of propagation of Fruit trees, its advantages & Disadvantages 3L

15 Lectures

Credit-II (1 Cr): Fruit Processing Technology

1. Harvesting: Maturity indices, Estimation of Maturity, Harvesting, Method of harvesting technology for ripening, greening, Post-Harvest Handling, 5L
Packaging, Storage 2L
2. Preservation of Fruits :
Principles of Preservation, Methods of Preservation 6L
3. Processing of Fruits :
   a. Value addition:
   Preparation and preservation of Fruits: JAM, Jelly, Marmalade, Candy, Sauce & Ketchup, Pickle, fruit based carbonated juices, canning, pulp extraction, chutney, beverages like squashes, ready to serve (RTS) drinks and appetizer etc. from different fruits
   b. Fermented products:
   Production of alcoholic drinks like cider, wine, vermouth, vinegar etc is now an accepted practice for utilization of different fruits.Manufacture of champagne (sparkling wine), still wine and brandy from grapes
   c. By Product Waste Utilization:
   Pomace, Seeds, Stones/Pits skin, Peel : I)Pomace II) Vinegar Extracted from Mango peel, High fibre biscuits, Peel oil, pectin powder, peel candy and animal feed are some of the citrus peel products. Oil and fiber from oil palm.

4. Marketing of fruits: systems of marketing, export potential, air transport, transport by sea, cold storage of fruits 2L

References:

1. D. P Singh 2015. Fruit Crops : Published by Agrotech Press, Jaipur & New Delhi
2. Jitendrasingh 2014. Basic Horticulture, Published by Kalyani Publishers
3. S. N Gupta 2015. Instant Horticulture, 11th Edition, published by Jain Brothers.
4. Kunte Y. N, M. P Kawthalkarand K.S Yawalkar, 2005, Principles of Horticulture and Fruit Growing 10th edition, published by Agro-horticulture Publishing House, New Delhi
5. George Acquaah, 2009. HORTICULTURE: Principles & Practices, published by PHI Learning Pvt. Ltd.

Semester I

BODP 114: Botany practical4 based on BODT 114Biofertilizer and Algal Technology

Practical (2 Credits) **60 Hours**

1. Study of microorganisms used in biofertilizer production 1P
2. Isolation of Nitrogen fixing cyanobacteria 1P
3. Isolation of Phosphate solubilizing micro-organisms from rhizosphere 1P
4. Isolation of Rhizobium from root nodules of leguminous crop 1P
5. Culture establishment and production of Azolla biofertilizers. 2P
6. Mass multiplication of Rhizobium, Azotobacter, and Azospirillum inoculum 2P
7. Estimation of Phycobiliproteins from Cyanobacteria 1P
8. Study of production of algal fertilizers. 1P
9. Study of any six sea weeds with applications 1P
10. Isolation and culture of Spirulina. 1P

BODP 114: Botany practical 4 based on BODT 114 Pomoculture and Fruit Processing Technology

1. Study of Growth and Fruiting habit in any one locally cultivated fruit crop. 1P
2. Study of methods of Pruning and Training of fruit plants. 1P
3. Study of effect of Growth regulators in fruit ripening in Banana/Grapes/Mango. 1P
4. Study of methods of Propagation of fruit trees. 1P
5. Study Maturity indices and estimation of Maturity in locally grown Fruit plant. 1P
6. Study of Methods of Harvesting. 1P
7. Preparation of Jam, Jelly & Marmalade from Locally available fruits. 1P
8. Preparation of Squash, Candy. 1P
9. Demonstration of any one by-product of wastes of fruits. 1P
10. Visit to Fruit Processing Industry and preparation of Case study report on any one. 1P
11. Visit to fruit market and prepare report. 1P
12. Visit to Vineyard preparation of case study report on Vine Industry. 1P

Semester I

BOUP 115: Botany practical paper based on BOUT 111, BOUT 112, and BOUT 113

Practical based on BOUT 111-Plant Systematics I

Practical on Algae:

1. Morphological observations, documentation (description and illustrations) and classification according to Fritsch (1935) with reasons of taxa belonging to:

a. Any one member from Charophyta, Euglenophyta, Bascilariophyta and Chrysophyta, Cyanophyta. 1 P

b. Any three members from Phaeophyta, Chlorophyta and Rhodophyta. 2 P

Practical on Fungi:

2. Study of the representative genera belonging to following sub-divisions of fungi with respect to vegetative, reproductive structures and classification with reasons according to Ainsworth *et al* (1973). 1P

a. Any one member from each Sub-divisions: Myxomycotina, Mastigomycotina and Zygomycotina

b. Any three members of each Sub-divisions: Ascomycotina and Basidiomycotina and Deuteromycotina. 2P

Practical on Bryophytes:

3. Morphological, anatomical and reproductive studies of the following members:

a. Any three members from Hepaticopsida and one member from Anthocerotopsida 1 P

b. Any four members from Bryopsida (Musci). 1 P

Practical based on BOUT 112: Cell Biology and Evolution

4. Study of mitosis and meiosis 2P
5. Study of polytene chromosome from Chironomous larvae 1P
6. Differential centrifugation for isolation of cell fractions- Nuclear fraction 1P
7. Isolation of Chloroplasts to study
   a. Hill reaction to measure intactness, 1P
   b. Chlorophyll estimation
8. Isolation of mitochondria for:
   a. Estimation of succinic dehydrogenase activity 1p
   b. Microscopic observations using MitoTracker Green FM/ MitoTracker Red 580/ Janus green B
9. Isolation of Lysosomal fraction and estimation of acid phosphatase activity 1P
10. Study of induced cell senescence in leaf discs &Study of programmed cell death in plants
11. Study of different plant fossils & Geological Time Scale. 1P

Practical based on BOUT 113: Cytogenetics and Plant Breeding 1P

12. Karyotype analysis, preparation of C- metaphase chromosomes of appropriate material (*Allium / Aloe*). 1P
13. Study of Meiotic configuration in *Rhoeo* buds 1P
14. Study of polygenic inheritance in any suitable material (Wheat/Maize etc.) 1P
15. Problems of population genetics: Estimation of gene and genotypic frequencies, PTC testing ability in humans 1P
16. Gene mapping, *Neurospora* tetrad analysis 1P
17. Problems on Mendelian Inheritance and analysis of F_2 data by Chi-quare Test. 1P
18. Study of Polytene / Salivary gland Chromosomes from *Drosophilla / Chironomous* larva, with Balbiani rings, puff balls, bands & inter bands. 1P
19. Floral Biology, Study of Pollen Viability (any two major crops). Use of Colchicine for induction of polyploidy in appropriate plant material. 1P

Note: Visit to different plant diversity regions and visit to any plant breeding centre. Submission of report is Compulsory.

Semester II

BOUT 121: Botany Theory Paper 1- Plant Systematics II (4 Credit- 60 Lectures)

15 Lectures

Credit I (1 Cr): Pteridophytes

1. Distinguishing Characters, Classification as per Sporne System (1975), Apospory, Apogamy, Stelar evolution, Heterospory and seed habit, Contributions of Indian and world Pteridologist (any three) **3L**
2. Distribution, Distinguishing Characters, Morphology and anatomy of sporophyte and gametophyte of following orders **11L**
   Psilotales, Lycopodiales, Selaginellales, Isoetales, Equisetales, Ophioglossales, Marattiales, Osmundales, Filicales, Marsileales and Salviniales.
3. Applications of Pteridophytes: medicinal, horticultural, biotechnological and secondary metabolites **1L**

22 Lectures

Credit II (1.5 Cr) Gymnosperms

1. Classification of gymnosperms by Raizada and Sahni (1960). 2 L
2. Affinities of gymnosperms with Pteridophytes and Angiosperms. 2 L
3. Distribution of gymnosperms worldwide and India. 1 L
4. Economic aspects of gymnosperms 1 L
5. General characters, morphology and affinities of 10L
   Pteridospermales - *Glossopteris*
   Cycadcoidales - *Cycadeoidea*
   Pentoxylales - *Pentoxylon*
   Cordaitales - *Mesoxylon*
   Cycadales
   Ginkgoales
   Coniferales
   Gnetales
   Ephedrales
   Welwitschiales
6. Comparative account of morphology, anatomy, sporogenesis, gametogenesis, embryology, and interrelationship of Cycadales and Ginkgoales 4 L

7. Seed development in Gymnosperms 2 L

Credit 1.5 III Angiosperms **23 Lectures**

1. Characteristic features of angiosperms, Angiosperm as a dominant group 2 L
2. Importance and need for classification, hierarchical classification. Criteria used for classification; phases of plant classification. Overview on pre- and post-Darwinian systems of classification. 3 L
3. Phylogenetic systems of classification as per Cronquist (1981). 1 L
4. APG IV system of classification. 1 L
5. Phylogeny of Angiosperms: homology and analogy, parallelism and convergence, monophyly, paraphyly, polyphyly and clades, Phylogenetic tree and cladogram, Origin and evolution of angiosperms. 3 L
6. Study of plant families with respect to general characters, morphology, economic importance and affinities following Bentham and Hooker and APG system of classification

Amborellaceae, Nymphaeaceae, Hydatellaceae, Magnoliaceae, Araceae, Arecaceae, Papaveraceae, Amaranthaceae, Leguminosae, Malvaceae, Satalaceae, Acanthaceae, Asteraceae 13 L

References-

1. Balfour Austin (2016). Plant Taxonomy. Syrawood Publishing House
2. Chapman, J.L. and Reiss, M.J. (1998). Ecology: Principles and applications. Cambridge, University Press.
3. Chopra G.L. (1984). Angiosperms: Systematics and Life-Cycle., Pradeep Publications
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6. Datta S.C. (1988). Systematic Botany. New Age Publ.
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10. Kormondy Edward (1995). Concepts of Ecology, Pearson Publ.
11. Lawrence G.H.M. (1955). An Introduction to Plant Taxonomy. McMillan, New York.
12. Lawrence, G.H.M. (1951). Taxonomy of Vascular Plants. McMillan, New York.
13. Michael P. (1984). Ecological Methods for field and Laboratory investigations TMH Co. ltd. Bombay.
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15. Naik V.N. (1988) Taxonomy of Angiosperms. Oxford and IBH
16. Odum E.P., (2004). Fundamentals of Ecology, Publ. Cengage Learning, Australia
17. Pande B.P. (1997). Taxonomy of Angiosperms. S. Chand.
18. Pande B.P. (2001) Taxonomy of Angiosperms. S. Chand.
19. Radford A.E. 1986. Fundamentals of Plant Systematics, Harper and Row N Y.

Semester II

BOUT 122: Botany Theory Paper II- Molecular Biology (4 Credit- 60 Lectures)

Credit I (1 Cr): Techniques and Tools in Molecular Biology **15 Lectures**

1. Introduction, Scope and Applications 1 L
2. Enzymes in molecular Biology 3 L

1.1: DNA Degrading Enzymes: Nucleases- Endo-nucleaes and Exo-nucleases
1.2: DNA modifying enzymes: Polymerases, Ligases, Phosphatases and polynucleotide kinases, Phosphorylase, Methylase

3. Minor equipments: 2 L

Vortex, magnetic stirrer, Micropipettes, Incubator, Microfuge, microwave oven, pouch sealer and refrigerator. 5 L

4. Major equipments:

PCR - Thermal Cycler, Gel Documentation System, ELISA reader, Millipore Distillation Apparatus, Lyophilizer, Refractometer, Liquid handling system and Gene sequencer 4 L

5. Molecular Techniques:

5.1. Polymerase Chain Reaction: quality of template DNA and overall reaction conditions

5.2 Sequencing Techniques: DNA sequencing 1. Sanger's dideoxy chain termination sequencing method and 2.Maxam –Gilbert sequencing method

5.3 Blotting techniques- Southern, Northern and Western blotting

Credit –II (1 Cr): DNA – Structure, Functions and Damage **15 Lectures**

1. DNA Structure, Forms of DNA (A, B, Z), Properties of DNA: chemical, physical, spectroscopic and thermal properties of DNA (e. g. Buoyant density, effect of acid and alkali, UV- absorption, hyperchromicity and hypochromicity),Dissociation and association kinetics, Cot – curve, C-value paradox. 4 L
2. Packaging of (DNA) genome e.g. Viruses, prokaryotic, eukaryotic, Organelles genome (Mitochondria and Chloroplast), structure of Nucleosome . 4 L
3. Replication: General factors of DNA replication, Replication apparatus, structure of DNA polymerases, Mechanism of replication in Prokaryotes and Eukaryotes, Regulation of replication and fidelity. 4 L
4. DNA damage and repair: Types of DNA damages, multiple repair pathway- Nucleotide excision repair, Base excision repair and Mismatch repair system. 3 L

Credit- III (1 Cr) Gene structure and Function **15 Lectures**

1. Gene Structure
   a. Organization and structure of Prokaryotic and Eukaryotic gene: 3 L
   b. Promotor, Inititiater, Enhancer, Terminater, Classes of Promoter
2. Transcription
   a. Transcription apparatus, Enzymes and factors involved in transcription 6 L
   b. Transcription in Prokaryotes and Eukaryotes
   c. RNA processing - m-RNA, r-RNA and t-RNA editing
   d. Post – transcriptional events : Capping, Methylation, Polyadenylation, Splicing, Structure of spliceosome and Fidelity
3. Translation
   a. Structure of m-RNA, r-RNA and t-RNA, Ribosomal assembly, Genetic code – Concept and Properties 6 L
   b. Coenzymes and factors involved in translation
   c. Mechanism of protein synthesis: Initiation, elongation and termination
   d. Post – translational control, Protein folding and processing, Protein targeting, Chaperons and Post – translational modifications

Credit- IV (1 Cr):

15 Lectures

1. Gene Regulation: Concept and importance , Positive and Negative regulation,Mechanism of regulation and concept: Lactose, Tryptophan and Arabinose 5 L
2. Transposable elements: Concept of Mobile DNA elements: Prokaryotes and Eukaryotes, Transposons, IS elements, SINES and LINES, Ac-Ds system in Maize, Examples of transposable elements, Importance of Transposons in Transposons mediated gene tagging. 5 L
3. Genomics and Proteomics: The human genome project: Clone by clone Strategy and Shotgun sequencing and applications of genomics, Objectives of Proteomics and Methodologies of proteomics (2D Gel Electrophoresis). 5 L

References

1. Pal Jayanta and Saroj S. Ghaskadabi Fundamentals of Molecular Biology, Oxford Higher Education.
2. Lewin B. (2000). Genes VII. Oxford University Press, New York.
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4. Wolfe S.L (1993) Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
5. Buchanan B.B, Gruissm W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plant.American Society of Plant Physiologist, Maryland, USA.
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9. Malacinski G.M (2006) (Fourth Edition).Freifelders Essentials of Molecular Biology, Narosa Publishing House, New Delhi.
10. Rastogi V.B Concepts in Molecular Biology.
11. Twyman R.M (2003) (Third Reprint).Advanced Molecular Biology. Viva Books Pvt. Ltd., New Delhi.
12. Watson J.D. et al. Molecular Biology of Gene. Forth Edition, Benjamin and Cummings Publishing Co., California.

Semester II

BOUT 123: Botany Theory Paper III- Biochemistry
(4 Credit- 60 Lectures)

15 Lectures

Credit-I (1 Cr): Fundamental aspects

1. Water: Properties of water, Ionization of water 3 L
2. Buffers: pH, weak acids and weak bases, Handerson - Hasselback equation, buffers, buffer concentration & Biological Buffers. 5 L
3. Solutions: Molarity, Normality, Molality 2 L
4. Bioenergetics:Laws of Thermodynamics, free energy, energy changes, Redox reactions, chemical bonds. 5 L

15Lectures

Credit- II (1 Cr): Biomolecules

1. Carbohydrates: General classification, structure and properties of carbohydrates, synthesis and breakdown of glucose, starch and glycogen. 5 L
2. Lipids: General classification, structure and properties of lipids, types of lipids, biosynthesis and oxidation of lipids. 4 L
3. Nucleic acids: Structure and biosynthesis of purines and pyrimidines, structure of DNA and RNA 6 L

15Lectures

Credit III (1 Cr): Protein Biochemistry

1. Amino Acids: Classification, structure and properties of amino acids. 2 L
2. Proteins – Structure and Function, General classification, primary, secondary, tertiary and quaternary structures, Structure and function of myoglobin, keratin, haemoglobin, Ramchandran plot. 5L
3. Enzymology: General classification, mechanism of action, factors affecting enzyme activity, enzyme kinetics, Michaelis-Menton equation, competitive, non-competative, uncompetitive inhibition. 4L
4. Nitrogen Metabolism: Nitrate and ammonium assimilation, nitrogen uptake, biological nitrogen fixation, NOD factors, *nif* genes, root nodulation and nitrogen fixation, leg heamoglobin. 4L

Credit-IV (1 Cr): Phytochemistry and Metablomics **15Lectures**

1. Metabolomics: Overview of primary and secondary metabolites, integration of metabolism. 5L
2. Phytochemistry: Primary metabolites as precursors of secondary metabolites, study of secondary metabolites – structure, classification, properties and therapeutic plant sources, biosynthetic pathways - alkaloids, phenols, terpenes, glycosides, pigments. 6L
3. Phytochemical investigation: Extraction methods, qualitative and quantitative analysis of alkaloids, glycosides, terpenes, phenols, pigments. 4L

References:

1. Buchanan B. B., Gruissem W. and Jones R. L. (2000), Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis D. T., Turpin D. H., Lefebvre D. D. and Layzell D. B. (eds) (1997), Plant Metabolism (second edition), Longman, Essex, England.
3. Galstone A. W. (1989), Life Processes in Plants, Scientific American Library, Springer - Verlag, New York, USA.
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12. Hapse and Acharya (1999), Treaties on AgroElectronics and Agrophysics, VSI.

Semester II

BODT 124: Botany Theory paper 4- Floriculture and Nursery Management

(2 Credits- 30 Lectures) **15 Lectures**

Credit-I (Cr 1): Floriculture

1. Floriculture : Concept, definition, Scope and Importance of floriculture, global scenario of flowers, scope of floriculture in India 2L
2. Pre-requisites of commercial floriculture: soil and climate requirements, field preparation, systems of planting, water and nutrient management, weed management, rationing, training and pruning, pinching and disbudding, special horticultural practices, use of growth regulators, physiological disorders and remedies 3L
3. Harvesting and processing of flowers: harvesting indices, harvesting techniques, postharvest handling and grading, pre cooling, packing and storage, value addition, concrete and essential oil extraction, transportation and marketing, export potential, agri-export zones 5L
4. Commercial production of flowers: varietal wealth and diversity, climate, soil preparation, aftercare and manuring, pruning and training, harvesting, yield, important pests and diseases, control measures, harvesting, grading, packing and marketing , storage and transport, export potential of cut flowers: Chrysanthemum, Gerbera, Tuberose, Anthurium; Loose flowers- Scented Rose and Jasmine 5L

15 Lectures

Credit II (Cr 1): Nursery Management

1. Introduction 1 L
2. Nursery Site: Types of Nurseries, Water, Location, Topography, Size of Nursery, Soil 2 L
3. Preparation of the Site: Clearing of surface, Removal of Top Soil, Erosion Control and Wind Damage, Surface Dressing, Shape, Fencing. 2 L
4. Design and Layout of Nursery: Administration Area, Operations Area, Production Areas, Germination Section, Transplanting Area. 2 L
5. Producing Plants from Seed: Seed Handling, Seed Procurement and Storage, Seed Dormancy and Pre-Treatment, Germination Process, Time of Sowing, Method of Sowing, Care of Seed Bed and Direct Sown Container, Transplanting the Young Seedlings, Light and Shade, Transplanting Natural Regeneration Seedlings, Tending the Seedlings, Watering, Germination Beds and Transplants, Weed Control. 4 L
6. Producing Plants Vegetatively: Cuttings, Air Layering, Grafting and Budding, Cleft or V Grafting, Shield or Inverted T-budding. 2 L
7. Growing Media: Growing Media for Propagation and Germination Beds, Growing Media for Transplant Beds, Growing Media for Container Seedlings, Organic Material, Compost, Mixing the Growing Media, Media Compaction in Pots, Mulching. 2 L

References:

1. Arora JS. 2006. Introductory Ornamental horticulture. Kalyani.
2. Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.

3. Bose TK & Yadav LP. 1989. Commercial Flowers. NayaProkash.
4. Bose TK, Maiti RG, Dhua RS & Das P. 1999. Floriculture and Landscaping. NayaProkash.
5. Chadha KL & Choudhury B.1992. Ornamental Horticulture in India. ICAR.
6. Chadha KL. 1995. Advances in Horticulture. Vol. XII. Malhotra Publ. House.
7. Chaudhary RC. 1993. Introduction to Plant Breeding. Oxford & IBH.
8. Singh BD. 1990. Plant Breeding. Kalyani.
9. Lauria A &Ries VH. 2001. Floriculture – Fundamentals and Practices. Agrobios.
10. Prasad S & Kumar U. 2003. Commercial Floriculture. Agrobios
11. Keats C. Hall 2012. Manual onNursery Practices, Forestry Department, 173 Constant Spring Road, Kingston 8, Jamaica
12. Evans Julian1992. Plantation Forestry in the Tropics, Ch 10. Clarendon Press. Oxford.
13. Jacnicke, H. 1999.Practical Guidelines for Research Nurseries. International Centre for Research in Agroforestry. Nairobi, Kenya.
14. Mc.Donald, B. 1986. Practical Plant Propagation for Nursery Growers.
15. Schmidt, L. 2000.Guide to Handling of Tropical and Subtropical Forest Seed. DANIDA Forest Seed Centre.

Semester II

BODT 124: Botany Theory paper 4- Mushroom cultivation and Bio-pesticides

(2 Credits- 30 Lectures)

Credit-I (1 Cr): Mushroom culture

15 Lectures

1. History of mushroom cultivation — 1 L
2. Present status of mushroom cultivation in India and abroad — 1L
3. Edible and Poisonous mushrooms — 1L
4. Nutritional and medicinal values of mushrooms — 2L
5. Mushrooms spawn- spawning, running and cropping — 1L
6. Cultivation of paddy straw mushroom- *Volvariella* and wood mushroom-Lentinus. — 2L
7. Cultivation of Wheat straw mushroom- *Pleurotus* — 1L
8. Cultivation of Button mushroom- *Agaricus* — 2L
9. Management of pest in mushroom cultivation — 1 L
10. Recipes of edible mushrooms — 1 L
11. World commerce of mushrooms — 2 L

Credit-II (1 Cr): Bio-pesticides

15 Lectures

1. Biological control of plant pathogens- concept and brief history — 2 L
2. Antagonism- Mechanism of biocontrol- Amensalism, Predation, Parasitism — 2 L
3. Applications of biological control in field- Crop rotation, irrigation, alteration of soil pH, Organic amendments, Introduction of Antagonists, Seed inoculation, Use of Mycorrhizal fungi and biofertilizers — 3 L

4. Bacterial pesticides, Viral pesticides, Mycopesticides, Mycoherbicides, Mycoweedicides, Myconematicides, Insects as biocontrol agents — 3 L
5. Botanical pesticides- Pyrethrum, Nicotine, Rotenone, Neem, Karanja — 3 L
6. Commercialization of biopesticides — 2 L

References

1. A Textbook of Biotechnology - R.C. Dubey
2. Biopesticides and pest management - Dhaliwal and Kaul
3. Introduction to mushroom science - T. N. Kaul
4. Benificial fungi and their utilization - M. C. Nair
5. Benificial fungi - S. K. Sharma
6. Mushroom cultivation - Nita Bahl

Semester II

BODP 124: Practical based on BODT 124 Floriculture and Nursery Management

Practical (2 Credits):

1. Study of methods of post harvest technology for flowers (cut flowers) — 1P
2. Study of different protective structures with respect to design, components, orientation and construction for cut flower production — 1P
3. Study of special cultural practices for flower crops under protected structure — 1P
4. Gerbera–identification and description of species/varieties – propagation and planting –pruning management — 1P
5. Study of response of micronutrients and macronutrients on growth of cut flowers. — 1P
6. Preparation of project on Cut flower production including diseases and Pests management. — 1P
7. Preparation of Bed for nursery — 2P
8. Study of different method of seed germination — 1P
9. Preparation of growing media — 1P
10. Study of Grafting and budding method — 1P
11. Study of Air Layering and cutting method

Note: Visit to any Local Nursery and Preparation of report is compulsory

BODP 124: Practical based on BODT 124 Mushroom cultivation and bio-pesticides Practical (2 Credits):

1. Morphology of any six mushrooms — 1 P
2. Preparation of spawn for mushroom cultivation — 2 P
3. Cultivation of Dhingri mushroom — 3 P
4. Any six recipes of mushroom — 2 P
5. Visit to mushroom industry and report preparation — 1 P
6. Any six botanical pesticides — 2 P
7. Mycoherbicides- *Aspergillus, Penicillium* to control *Alternanthera, Fusarium* to control water hyacinth. — 2 P
8. Mycofungicides- Mycorrhizal fungi to control soil borne pathogens-*Trichoderma* to control soil borne pathogens. — 2 P

Semester II

BOUP 125: Botany practical paper based on BOUT 121, BOUT 122, and BOUT 123

Practical based on BOUT 121: Plant Systematics II **(4 Cr)**

1. Studies on the families as per Bentham and Hooker's system of classification– any one example from each series available locally and their identification up to Genus and species level with the help of Regional Flora — 4P
   Dicotyledonae:
   a) Polypetalae: Thalamiflorae, Disciflorae, Calyciflorae
   b) Gamopetalae: Inferae, Heteromerae, Bicarpellatae
   c) Monochlamydae: Curvembryae, Microembryae, Unisexuales
   Monocotyledonae:
   Epigynae, Coronariae, Calycinae, Glumaceae
2. Morphological, anatomical and reproductive studies of the following with the help of live material/or herbarium specimens and/or museum specimens and/or permanent slides of the following orders: — 2P
   i) Cycadales
   ii) Coniferales
   iii) Gnetales
3. Morphological, anatomical and reproductive studies of the following *Psilotum, Lycopodium, Selaginella, Equisetum, Pteris, Adiantum,* and *Marsilea* — 2P
4. Study of available fossils - At least 5 specimens from Gymnosperms and Pteridophytes. — 1P

Practical Based on BOUT 122: Molecular Biology

1. Isolation and quantification of plant genomic DNA — 2 P
2. Effect of temperature and alkali on absorption of DNA : hyperchromicity — 1 P

3. Separation of seed storage proteins from legumes and its quantitative study and qualitative study by SDS-PAGE. 1 P
4. Electrophoretic separation of plasmid isoforms 1 P
5. Restriction digestion study of plasmid DNA and separation by Electrophoresis 2 P
6. Study of instruments or equipment's used in Molecular Biology techniques (by photographs / by power point / by Animation): PCR thermal cycler, Gel documentation system, ELISA reader, Millipore distillation apparatus, Lyophilizer, Refractometer 1 P

Practical Based on BOUT 123: Biochemistry

1. Preparation of solutions and buffers. 1P
2. Thin Layer chromatography- sugars, amino acids. 1P
3. Spectrophotometry: Absorption spectra of protein and nucleic acid. 1P
4. Effect of pH and enzyme concentration on enzyme activity. 1P
5. Defatting and dialysis of proteins 1P
6. Separation of seed storage proteins by SDS PAGE 2P
7. Estimation of proteins by Lowry and Bradford Method 1P

BOUT 231 Computational Botany (60 L)

Credit I-Basic Biostatistics (15 L)

1. Introduction to Statistics : Measures of central tendency – mean, mode, median and their properties Measures of dispersion – variance, standard deviation, coefficient of variance Symmetry and skewness, measures of skewness, kurtosis Sampling and sampling distributions – concept of sample and population, statistic, standard error, methods of sampling 9L
2. Correlation and regression Bivariate correlation, positive correlation, negative correlation Measures of correlation – Scatter diagram, Karl-Pearson's coefficient of correlation, Spearman's rank correlation coefficient Regression – Equations of regression lines using least square method, regression estimate and its standard error 6L

Experimental Statistics (15 L)

1.1 Statistics using R, SPSS and Excel : Introduction , features, installation, starting and ending of the sessions, R commands and case sensitivity (08L)

a. Data types: Logical and Numerical
b. Vectors and vector arithmetic
c. Data frames: Creation using data, frame, subset and transform commands
d. Statistical methods using R : Sampling methods, Diagrams, graphs: : Measures of central tendency, Dispersion, Skewness and Kurtosis
e. Probability Distributions: Hypergeomertric distribution, Binomial. Normal and poison distribution
f. Correlation and Regression

1.2. SPPS (Statistical Package for the Social Sciences) Software: Concept and applications in Means, t – test, ANOVA and Correlation and linear regression

1.3 Excel : concept and applications on Biology

2. Testing of Hypothesis : critical difference for pairs of treatments Tukey's test for pairwise comparison of treatments Dunnet's test for comparison of treatment means with control Duncan's multiple range test Mann–Whitney U test 7L

3. Testing of hypothesis Hypothesis, statistical hypothesis, critical region, level of significance, p-value, normal distribution T-test: t-test for mean, equality of two means, paired t-test, unpaired t-test, chi-square test: chi square test for goodness of fit, independence of attributes, non-parametric test

Credit III – Scientific Communication (15 L)

1. Importance of scientific communication Types of scientific communications Logical organization of scientific data and documentation
2. Different modes of scientific communication Details of – Steps involved in Proposal writing, Research paper writing, Thesis writing
3. Oral forms of scientific communication Popular and Scientific talks, Poster presentations
4. Legal forms of communication of science 4 Ethics in scientific communication IPR, patent submissions

Credit IV: Bio-analytical techniques & Bioinformatics (15L)

1. Making solutions – moles and molarity, stock solutions and dilutions, making media and reaction mixtures

2. pH measurements and preparation of buffers (4 L)

3. Measuring concentrations using spectrophotometry, Cell counting using serial dilutions, haemocytometry (2L)

4. Bioinformatics: What is Bioinformatics, What is database, Classification of database, Sequences and nomenclature, IUPAC symbols, Types of sequences used in Bioinformatics, Information sources: NCBI, the GDP, MGD. (2L)

5. Data Retrieval tools – ENTREZ, OMIM, PubMed, Taxonomy Browsers, LocusLink, SRS. Database Similarity Searching – BLAST, FASTA, Resources for Gene Level Seqoences, Use of Bioinformatics tools in analysis (4L)

NOTE – Emphasis be given on methodology and numerical problem solving rather than derivations and proofs. (3L)

Suggested Reading:

1. P.N. Arora and P.K. Malhan (2002) Biostatistics, Himalaya publishing House.
2. Rama Krishnan, P. (1995) Biostatics, Saras publication A.R.P. camp Road, Periavilai, Kottar, po. Nagercoil, Kanyakumari- Dist. Pin- 629 002.
3. Banerjee, P.K. (2005) Introduction to Biostatics' S. Chand and Company Ltd. Ram Nagar, New Delhi- 110 055.
4. Norman T.J. Bailey (2004), Statistical methods in biology (Third Edition) Cambridge University press (Low price Editions).
5. Dr. Mungikar A.N. (1997) an introduction to Biometry, Saraswati publication, Aurangabad.
6. Mungikar, A. M. (2003) Biostatistial Analysis. Saraswati Printing Press. Aurangabad.
7. Lab Math – Adams, D.S. I.K. InternationsPvt Ltd. New Delhi, 2004
8. T. M. Apostol: Mathematical Analysis (Narosa publishing house)

BOUT 232 Botany Theory paper 2

BOUT 232 Developmental Botany (4 Cr - 60 L)

Credit I: Basic concepts of Plant development (15L)

1. Potency, commitment, specification, induction, competence, determination and differentiation; morphogenetic gradients; cell fate and cell lineages; stem cells; genomic equivalence and the cytoplasmic determinants; imprinting; mutants and transgenics in analysis of development, 7L

2. Polarity & Symmetry 2L

3. Difference between Plant and Animal development 2L

4. Factors for development- intrinsic and extrinsic 2L

5. Juvenility -Characteristics,Transition to Adult phase. 2L

Credit II: Embryology (15L)

1. Reproductive structure in plant 1L

2. Gametophyte development- Stamen and Microsporogenesis, Male gametophyte or male germ unit development, Carpel and Megasporogenesis, Female gametophyte or female germ unit development 4L

3. Fertilization-Pollen tube growth and its path,it sentry into embryo sac, gametic fusion, significance of double fertilization, abnormalities in fertilization. 2L

4. Development of embryo in dicots and monocot 2L

5. Development of Endosperm 2L

6. Polyembryony- concept and classification of polyembryony, special cases and causes of polyembryony. 2L

7. Apomixis - concept, categories- agamospermy and vegetative reproduction apospory, parthenogenesis 2L

Credit III: Physiological & Molecular Basis of Plant Development (15L)

1. Physiology of plant development - Photo-morphogenesis, Light mediated development, Photoreceptors, Hormonal Signaling in development 4L

2. Molecular and Cellular Events in –

a. Embryogenesis 1L

b. Leaf development 2L

c. Stomatal development 2L

d. Root development 2L

e. Root Hair Development 2L

f. Shoot development 2L

Credit IV: Molecular and Cellular Events in – **15L**

g. Inflorescence development 2L

h. Flower development 2L

3. Mutants in Developments 3L

4. Genetic and Epigenetic Mechanisms Underlying Vernalization 4L

5. Radial and Axial Pattern of development 2L

6. Process of Senescence 2L

References:

1. Embryology of Angiosperm by Maheswari
2. Embryology of Angiosperm by BhojwaniandBhatnagar
3. Plant Physiology by Taize and Zeiger
4. Arabidopsis Book
5. Current Trends in the Embryology of Angiosperms by SS Bhojwani
6. Developmental Biology of Flowering Plants by V. Raghavan
7. Flowering Plant Embryology By Nels R. Lersten

Semester III

M Sc Syllabus, 2020-2021

BOUT 233 Theory Paper 3-Plant Physiology (4 Credit)

15L

Credit I: Plant Nutrition:

- Soil- Formation, structure, composition, classification and role 2L.
- Essential elements- Mineral and nonmineral, criteria of essentiality, role-structural, catalytic osmotic and others; influence of pH, mineral elements interaction and microbes on availability of essential elements 3L
- Mechanism of absorption of mineral elements; mechanism of assimilation of sulfur, phosphorus and nitrogen 2L
- Active and passive transport, Transporters, role of ATPase and PPase 2L
- Merits and demerits of use of natural and chemical fertilizers, conventional and modern methods of application of fertilizers 2L
- Properties of water, water potential and factor influencing transport of water 2L
- Mechanism of opening and closing of stomata, transpiration ratio and water conservation strategies in plants 2L

15L

Credit II: Photosynthesis:

- Photosystem I and II (composition, light harvesting mechanism and functioning). 2L
- Organization of Photosynthetic electron transport system(evidence from Membrane chemical composition, electro-potential gradient and use of ETS Component inhibitors) 3L 2L
- Photo-oxidation of water
- Mechanism of establishment of proton gradient across the thylakoid membrane. Production of assimilatory powers of photosynthesis (ATP and NADPH) 3L
- Fixation of CO2: Calvin (C3), steps and regulation, Photorespiration-mechanism and significance 3L
- Fixation of CO2: C4 cycle, Kranz anatomy, biochemical sub-types, Single cell C4 Photosynthesis. 2L

15L

- CAM pathway

Credit III: Respiration and lipid metabolism:

- Schematic presentation of Glycolysis, TCA cycle and PPP (Home assignment). Release of energy in Glycolysis, TCA cycle and PPP and their significance 7L
- Organization of respiratory electron transport system(evidence from membrane chemical composition, electro-potential gradient and use of ETS component inhibitors) 2L

- Mechanism of NADPH and NADH oxidation, establishment of proton gradient across the membrane and ATP formation 1L
- Cyanide resistance pathway 1L
- Fatty acid biosynthesis 1L
- Synthesis of membrane lipids 1L
- Catabolism of storage lipids 1L
- Significance of lipids(energy storage, defense, structure and others) 1L

Credit IV: Solute transport, Growth and development: **15L**

- Seed dormancy, types of dormancy, causes, and methods of break dormancy. 1L
- Growth- Relative growth rate and net assimilation rate, IRGA 1L
- Physiology of flowering- photoperiodism, mechanism of vernalization. 4L
- Physiological organization phloem element for transport (Home assignment), Loading and unloading of phloem and mechanism of transport of solutes (Munch hypothesis); Source and sink relationship 3L
- Plant growth regulators-types and the physiological roles of auxin and cytokinin. 2L
- Stress physiology: Definition, Types: biotic and abiotic stress, effect of stress on Plants and elaborate any one abiotic and biotic tolerance mechanism. 2L
- Schematic presentation of secondary metabolite synthesis pathways (home assignment), Classification, biosynthesis and significance of alkaloidsin plants. 2L

REFERENCES:

- Berg J.M., Tymoczko J.L., Stryrer L. (2002) Biochemistry. 5th Ed. Wlt. Freeman and Company, New York.
- Biology of Plants. American Society of Plant Physiologists Maryland, USA.
- Buchanan B.B, Gruissem W. and Jones R.L 2000. Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologistsm Maryland, USA.
- Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi.
- Davis P. J. (Eds.)(2004) Plant Hormones.Kluwer Academic Publishers, Dordrecht, Netherlands.
- Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant Metabolism (Second Edition) Longman, Essex, England.
- Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA.
- Goodwin T.W., Mercer E.I. (1998) Introduction to Biochemistry. CBS Publishers, New Delhi.
- Heldt H. W. (2004) Plant Biochemistry. Academic Press, California.
- Hopkins W. G. 1995. Introduction to Plant Physiology. John Wiley and Sons, Inc., New York, USA
- Lawlor D.W. (2001) Photosynthesis in C3 and C4 Pathway. 3rd Ed. Viva. New Delhi.

Botany Theory paper -4

M.Sc. Botany – II

Semester –III

BODT- 234: f) SEED SCIENCE- 2 Credit (30 Lectures)

15 L

Credit -1 **1 L**

1. **Introduction:**
   - Scope, Importance and Definition of Seed Technology **4 L**
2. **Seed:**
   - Definition
   - Difference between seed and grain
   - Orthodox and Recalcitrant seed
   - Classes of seed **2 L**
   - Seed quality characteristics
3. **Seed Morphology:**
   - Seed structure (embryo, endosperm and seed coat)
   - Chemical composition of seed (carbohydrates, proteins, oils, fats and other) **6 L**
4. **Seed Dormancy and Seed Germination:**
   - Definition of dormancy
   - Types of dormancy
   - Causes of seed dormancy
   - Methods of breaking dormancy
   - Definition of seed germination
   - Types of germination
   - Factors affecting seed germination **2 L**
   - Seed vigour, Seed ageing and Seed viability,
5. **Genctic Purity**
   - GOT (grow out test).
   - Germination testing, its methods (paper, sand and soil), evaluation and reporting of results **15L** **3 L**

Credit 2

1. **Quality testing**
   - Moisture testing: Moisture Meter and Air oven method.
   - Physical purity analysis
   - Biochermical tests (Quick viability test (Tz), Peroxidase and Phenol colour test)
   - Aids for varietal identification: PCR, RAPD, RFLP, DNA finger printing, ELISA test. **8 L**
2. **Seed Production:**
   - General Principles of seed production
   - Artificial pollination (Hand pollination, Dusting and Honey bee)

- Seed production techniques in hybrids (use of Male Sterility, Self Incompatability and gametocides)
- Procedure of seed production in tomato, okra, soybean, cotton and maize (Land requirements, isolation requirements, brief cultural practices, plant protection-physical, chemical and biological, types of chemical pesticides-systemic and contact, roguing, harvesting and threshing)
- True potato seed (TPS), Artificial Seed Production

3. Seed Testing: **4 L**

- Objectives and Definition
- ISTA, CSTL and SSTL
- Seed Sampling: Definition, Sampling, Dividing and Mixing equipments
- Procedure of sampling, (Kinds-Primary, composite, submitted and working)
- Types of seed samples (Service, official and certification sample)

Reference:

1. Ovcharov, K.E. 1977. Physiological Basis of Seed Germination. Amerind Publishing Co., New Delhi and New York.
2. Thompson, J.R. 1977. Advances in Research and Technology of Seeds. Part - 1, 3 & 4. Centre for Agrl. Publishing and Documentation, Washington.
3. Anonmyous. 1997. Seed Technology in Tropics. ISTA Zurich.
4. Sinclair, T.R. and F.P. Gardner. 1997. Principles of Ecology in Plant Production, CAB international, G.K.
5. Rai. M. and S. Mauria. 1995. Hybrid Research and Development. Indian Society of Seed Technology. IARI. New Delhi.
6. Agrawal, R.L. 1996. Seed Technology, IBH publishing Co., New Delhi.
7. Mayer, A.M. and A.P. Mayber. 1989. Germination of Seeds. Pergamon Press, Oxford.
8. Desai. B.B., P.M Kotecha and D.K. Salunkha. 1997. Seeds Hand Book - Biology Production, Processing and Storage. Marcel Dekker. New York.
9. Khairwal. P.S., C. Ram and A.K. Chabra. 1997. Pearl millet Seed Production and Technology. Manohar book service, New Delhi.
10. Jaima Kigel, J. and G. Galili. 1997. Seed Development and Germination. Marcel Dekker, New York.
11. Bewley, J.D. and M. Black. 1982. Physiology and Biochemistry of Seeds in relation to Germination, Vol. I & II. Springer Verlag, Berlin, Heidelberg, New York.
12. Justice, O.L. and L.N. Basu. 1978. Principles and Practices of Seed Storage. Castle House Publications Ltd, Great Britain.
13. Khan, A.A. 1977. The Physiology and Bio-chemistry of seed Dormancy and Germination. North Holland Publishing Co., Amsterdam, New York.
14. Kozlowski, T.T. 1972. Seed Biology, Vol. 1 Academic Press, London.
15. Purseglove, J.W. 1977. Tropical crops of Monocotyledons, Longmans, Green and Co., Ltd., London.

Compulsory Activities:

1. Preparation of various chemicals to be used for, fixation, dehydration, embedding, different chromosomal staining, cleaning etc. and understanding use of various types of microscopes.
2. Case studies of IPR and Visit to Plant breeding station and Genetic laboratory.

Note: Use suitable software for problem solving in Genetics and Plant breeding

M. Sc II Botany Practical Paper

BODP 234 Practical Paper based on BODT 234

BODP 234 based on BODT 234 f) Seed Science

Sr. No	Title of practical	No.
1	Study of chemical composition and seed structure	1
2	Study of methods of breaking seed dormancy	2
3	Study of Sampling, dividing and mixing equipments	1
4	Grow Out Test	1
5	Study of seed germination (epigeal, hypogeal and viviparous types).	2
6	Study of seed germination testing methods (Paper, soil and sand).	2
7	Study of physical purity test	1
8	Biochemical tests (Quick viability test (Tz), Peroxidase and Phenol colour test)	2
9	Moisture Testing by moisture meter and oven method	1
10	Visit to a seed industry and research institute/apiculture	2

M. Sc II Botany Practical Paper

BOUP 235 based on BOUT 231, BOUT 232, BOUT 233

Sr. No	Title of practical	No.
	BOUT 231 Computational Botany (Any 10 Practical)	
1	Measurement of central tendency (mean, mode and median), variance, standard deviation, coefficient of variance and standard error from the given grouped and ungrouped data.	1
2	Measures of skewness and measures of Kurtosis (grouped and ungrouped data).	1
3	Determination of regression lines and calculation of correlation coefficient – grouped and ungrouped data.	1
4	Examples based on t – test	1
5	Drawing a simple random sample with the help of table of random numbers	1
6	Chi-square test for goodness of fit and independent attributes.	1
7	Analysis of variance on the given data (ANOVA) using R/ SPPS/Excel	1
8	Tukey's test for pairwise comparison of treatments using R/ SPPS/Excel	1
9	Dunnet's test for comparison of treatment means with control using R/ S PPS/Excel	1
10	Duncan's multiple range test for comparing treatment means using R/ SPPS/Excel	1
11	Determination of Karl-Pearson's coefficient of correlation from the given grouped and ungrouped data.	1
12	Databases and database searching and DNA/protein sequence comparisons	1
13	Pair wise comparison of DNA and protein sequences using BLAST	1
	BOUT 232 Developmental Botany	
1	Histochemical analysis of secondary growth primary to secondary axis)	1
2	Histochemical comparison between vegetative And reproductive induced SA	1
3	In-Vitro Germination of Spore/Pollen	1
4	Dissection & Isolation of Developing Embryo	1
5	Dissection Isolation of Endosperm	1
6	Stomatal development and observations on Stomatal types	1
7	Study of Induced Leaf Senescence	1
8	Observations on Microsporogenesis and Development of Male Gametophyte	2
9	Observations on Megasporogenesis and Development of Female Gametophyte	1
	BOUT 233 Plant Physiology (Any 10 Practical)	1
1	Preparation of standard solutions(%, ppm, molar, normal) of different concentrations, Preparation of buffers solutions, EC and pH measurements	1
2	Study of deficiency symptoms of essential elements on different crop plants.	1
3	Study of transpiration and stomatal physiology under abiotic stress	1
4	Detection of amino acids/sugars from the phloem sap using paper chromatography	1
5	To determine the chlorophyll a/chlorophyll b ratio in C3 and C4 plants.	1
6	Estimation of soluble proteins in germinating and non-germinating seed by Lowry / Bradford's method	1
7	Survey of C4 plants and CAM plants. Find out C4 pathways from the given plants	1
	by titration method(TAN)	1
8	To determine the activity of enzyme amylase in germinating seeds and its induction by GA.1P	1
9	Determination of activity of nitrate reductase.	1
10	Effect of salt /Drought stress on accumulation of proline and its estimation.	1

SEMESTER IV

M.Sc. II Semester IV

BOUT 241 Botany Theory paper 1

BOUT 241: BOTANICAL TECHNIQUES

(4 CREDITS) (60 Lectures)

(15 Lectures)

Credit 1 =

Microscopic Techniques

A. Image formation (properties of light), Lens- refraction, dispersion of light, objects, images, image quality, magnification concept, resolution **1L**

B. Optical microscopy- Light microscopy, Confocal microscopy, Phase Contrast microscopy, Fluorescence microscopy, Electron microscopy (SEM TEM and STEM), Flow cytometery and Atomic force microscopy **7L**

C. Dissection, maceration, squash, peeling and whole mount- pretreatment and procedures **1L**

D. Microtomy- serial sectioning, double or multiple staining, Lesser assisted Microtomy **2L**

E. Histochemical and cytochemical techniques- Localization of specific Compounds/ reactions/ activities in tissues and cells **3L**

F. Micrometry and camera lucida **1L**

(15 Lectures)

Credit 2 =

A. Chromatography techniques:-

a) Introduction, Types, Peak Area, Solvent systems, immobilized and mobilized phase, retention time
b) Principle, method and applications of: Paper, TLC, Column Chromatography — 2L
c) Gel filtration, Affinity, Ion exchange — 2L
d) HPLC, Gas chromatography — 2L — 2L

B. Elctrophoretic techniques:-

a) History, Principles, Horizontal and Vertical Electrophoresis. — 1L
b) Agarose gel electrophoresis — 1L
c) Pulsed Field Gel Electrophoresis, Polyacrylamide Gel Electrophoresis (PAGE/ Native), Sodium Dodecyl Sulphate polyacrylamide gel electrophoresis (SDS-PAGE/ Denaturing) — 4L
d) Isoelctric focusing, 2 Dimensional Gel Electrophoresis (2-D method) — 1L

Credit 3 = **(15 Lectures)**

A. Spectroscopic techniques:-

a) General principles, Beer and Lambert's Law, Molar extinction coefficient, Electromagnetic radiations (Dual nature), Wavelength, Frequency, Properties of Electromagnetic radiations, electromagnetic spectra, Light absorption and excitation of spectra — 2L
b) Spectrophotometer — 1L
c) Principle, working and applications of-UV-Visible spectroscopy — 1L
d) Nuclear Magnetic Resonance (NMR) spectroscopy, — 2L
e) X-ray crystallography, — 1L
f) Spectroflurometry, — 1L
g) AAS, MS, IR Spectroscopy — 2L

B. Radioactive techniques:-

a) Radioisotopes used in biology and their properties, Units of radioactivity. — 1L
b) Interaction of radioactivity with matter, — 1L
c) Detection and measurement of radioactivity, Scintillation counter — 1L
d) Autoradiography, Safe handling of radio isotopes, — 1L
e) Flurochromes, Green Fluorescent Proteins — 1L

Credit 4 =

A. Centrifugation techniques:- **(15 Lectures)**

a) Principles, Rotors, Speed and Unit, Factors affecting centrifugation, — 1L
b) Ultra-centrifugation, Density Gradient Centrifugation — 1L

B. Electrochemical techniques:- — 2L

Electrical conductivity, pH meter, Oxygen electrode

C. Immunological techniques:-

a) Introduction and Principles, — 1L
b) Antigen–antibody interaction, Immuno diffusion, — 1L
c) Immuno precipitation, — 1L
d) Radio-immuno assay, Rocket immumo-electrophoresis, ELISA — 2L

D. Bioinformatics-

a) Introduction to databases and retrieving information from databases: NCBI, EMBEL — 2L
b) Molecular tools in protein and nucleotide sequence analysis; origin of new genes and Proteins, gene duplication and divergence — 3L

E. Herbarium Techniques- Digital herbarium — 2L

REFERENCES:-

1. **SrivistavaM.L.** (2008). Bioanylatical Techniques. Narosa Publishing House (P) Ltd.
2. **Plummer David** (1987). An Introduction to Practical Biochemistry. 3rd Eds. Tata McGraw-Hill Publishing Company Ltd.
3. **Sadasivam S.,Manickam A.** (1996). Biochemical Methods. 2nd Edn. New Age International (P) Ltd.
4. **Khasim S.M.** (2002). Botanical Microtechniques: Principles and Practice. Capital Publishing Company.
5. **Harborne J.B.** (1998). Phytochemical Methods. Springer (I) Pvt. Ltd.
6. **Wilson K., Walker J.** (2005). Principles and Techniques in Biochemistry and Molecular Biology. Cambridge University Press.
7. **Wilson K., Walker J.** (2000). Practical Biochemistry Principles and Techniques. Cambridge University Press.
8. **Bisen P.S. Mathur S.** (2006). Life Science in Tools and Techniques. CBS Publishers, Delhi.
9. **Marimuthu R.** (2008). Microscopy and Microtechnique. MJP Publishers, Chennai.
10. **Sharma V.K.** (1991). Techniques in Microscopy and Cell Biology. Tata McGraw-Hill Publishing Company Ltd.
11. **Prasad and Prasad** (1984). Outline of Microtechnique. Emkay Publications, Delhi.

12. **Srivastava S. and Singhal V.** (1995). Laboratory Methods in Microbiology. Anmol Publication Pvt. Ltd. Delhi.

13. **Pal and Ghaskadabi** (2009). Fundamentals of Molecular Biology.Oxford Publishing Co.

M.Sc. II Botany Semester IV

BOUT 242: Theory Paper-2: Advanced Plant Ecology
Semester-IV (4 Credits- 60 Hrs)

Topic Details	Lectures
Credit-I	
Levels of species diversity and its measurement, indices of α-diversity, species rarefaction; β-diversity similarity & dissimilarity indices.	2
Basis of Ecosystem classification. Types of Ecosystem: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic.	2
Aquatic Ecology: Freshwater and marine, ecology of estuaries and intertidal zones, mangroves	2
Ecosystem Stability: Concept (resistance and resilience), ecological perturbations (natural and anthropogenic) and their impact on plants and ecosystems	2
Biomes: Concept, basis of classification; Holdrige life zone classification; Characteristics of different biomes: Tundra, Taiga, Grassland, Deciduous forest biome, Alpine Biome, Chapparal, Savanna, Tropical Rain forest; adaptations in plants in various biomes	3
Agro-ecological zones of India: basis of classification and characteristics	2
Forest types of India (Champion and Seth, 1968): basis of classification and characteristics	2
Credit-II	
Methods in field ecology: Methods of estimating population density of plants, ranging patterns through direct, indirect and remote observations, sampling methods in the study of habitat characterization: ground and remote sensing methods.	3
Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity; Principles of conservation, major approaches to management; methods of conservation with examples; Indian case studies on conservation and management strategy (Sanctuaries/Sacred groves/National Parks/Botanical Gardens). Concept and basis of identification of 'Hotspots'; hotspots in India.	5
Concepts of gene pool, bio-piracy and bio-prospecting; Concept of restoration ecology; Extinct, Rare, Endangered and Threatened flora of India.	2
Environmental Biotechnology: Phytoremediation – definition, types and role of plants for in-situ and ex-situ remediation; bio-indicators, bio-fertilizers, biofuels and biosensors.	2
Environmental issues: Local, regional and global; air, water, and soil pollution - kinds, sources, quality parameters; climate change and its relationship with plants; Use of plants in mitigation of pollution, effect on plants and ecosystems	3
Credit-III	
Plant relations (eco-physiology) with climatic factors such as water, precipitation, temperature, light and radiation. Plant relations with edaphic factors: types of soil, soil moisture and water holding capacity of the soil, soil nutrients, soil microbes	4
Plant-plant interaction, concept of allelopathy; Plant-animal interaction, herbivory, carnivorous plants; Plant- microbes interaction: Mutualism, parasitism	3
Ecological/Environmental Ethics: Definition, concept, nature and origin of environmental ethics, ecological consciousness, views of developed and developing countries, environment community and equity, integrating ethical values and knowledge, self centered development and environment	4
Restoration ecology, plants in conservation of soils, restoration of land and degraded water bodies	2
Overview of Environmental Laws in India: Wildlife Protection Act, 1972; Forest Conservation Act, 1982 (revised); Biological Diversity Act, 2002: National Forest Policy, 1988; National Environmental Policy, 2006	2
Credit-IV	
Environmental Impact Assessment: Aims and objectives of Environmental Impact Assessment; concept, scope, process and necessity; Environmental Impact Statement (EIS) and Environmental Management Plan (EMP).	4
EIA Guidelines; Impact Assessment Methodologies.	1
Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost-benefit analysis. Guidelines for Environmental Audit. Environmental Planning as a part of EIA and Environmental Audit;	3
Human impact on ecosystem and its consequences- Agriculture societies, degradation of natural resources. Impact of fertilizers, pesticides, fungicides and weedicides on crops and plants	2
Bio-indicators of environmental degradation- Concept of Bio-indicators, bio indicators plants, role of bio-indicators in pollution control.	2

4. Michael J. Waites, Neil L. Morgan, John S. Rockey Gary Higton. Industrial Microbiology: An Introduction. Blackwell Science Ltd
5. M Nduka Okafor odern Industrial Biotechnology & Microbiology., SCIENCE PUBLISHERS, Edenbridge Ltd.,
6. H.J. Peppler and D. Perlman. Microbial Technology .Vol 1&2 . Academic Press.
7. L E Casida Jr. Industrial Microbiology. John Wiley and Sons Inc.
8. Wulf Cruger and Anneliese Cruger, "A Textbook of Industrial Microbiology",Panima Publishing Corporation
9. Michael J. Waites, Neil L.Morgan, John.S. Rockey and Grey Higton, "Industrial Microbiology": An Introduction, Blackwell science publishing house.
10. Presscott. Dunn, "Industrial Microbiology", Agrobios (India).Trevor Palmer "Enzymes", Affiliated East West Press Pvt Ltd, New Delhi,2004
11. Harvey W. Blanch, Douglas S. Clark, "Biochemical Engineering", Marcel Dekker Inc, 1996
12. James M. Lee, "Biochemical Engineering", PHI, USA, 1992
13. James. E. Bailey & David F. Ollis, "Biochemical Engineering Fundamentals", McGraw Hill, 1986
14. Christ of M.Niemeyer,Chad A.Mirkin, "Nanobiotechnology: Concepts", Applications and Perspectives, (eds.), Wiley-VCH, Weinheim, (2004)
15. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, "Nanotechnology: basic science and emerging technologies" , Overseas Press (2005)
16. B. Roszek,, W.H. de Jong, and R.E. Geertsma: "Nanotechnology in medical applications": state-of-the-art in materials and devices (2005)
17. Tuan Vo-Dinh, "Nanotechnology in Biology and Medicine": Methods, devices and applications, ISBN no. 1249329494
18. Mark Ratner and Daniel Ratner, "Nanotechnology - A Gentle Introduction to the Next Big idea", Pearson Education, Inc.2005
19. Handbook of "Nanostructured Biomaterials and Their Applications in Nanobiotechnology" - Hari Singh Nalwa

M.Sc. II Botany Semester IV

BODT- 243: BOTANY THEORY PAPER 3 (2 Credit)

BODT- 243: e) SEED TECHNOLOGY

Credit 1= **(30 Lectures)**

1. Field Inspection: **15 lectures**

- Seed inspector, powers and duties **2 L**
- Number of inspection with reference to stage of crop
- Procedure and observations during field inspection

2. Seed Pathology:

- Definition
- Mechanism of seed transmission and entry point of seed infection (soil, air, insect and nematodes)
- Quarantine for seed
- Integrated management of seed borne diseases
- Seed health testing methods **3 L**

3. Seed entomology:

- Relation of insects and plants
- Pest of fibre crop, pulses, vegetable and storage grain pest (Any one example from each) with respect to their life cycle, way of infestation and control measures (Physical, Chemical and Biological) **6 L**

1. Seed Processing:

1. Objectives of seed processing
2. General layout of seed processing unit
3. Steps in Seed Processing (Receiving, Drying, Pre-cleaning, Grading, Treatment, weighing, Packing and Storage)
4. Study of Seed processing machineries and its working:
   1. Pre-cleaners
   2. Scalper, Debearder and Huller
   3. Seed dryers
   4. Air screen cleaner
   5. Specific gravity separator
   6. Magnetic separator
   7. Colour separator **15 lectures**

Credit 2= **2 L**

1. Seed treatment:

- Importance
- Seed treating equipment- slurry, mist-o-matic and drum mixer.
- Chemicals used and precautions in seed treatment. **4 L**

2. Packaging and handling of seeds

- Bagger weighed machine
- Automatic packing machine
- Material used for packing
- Handling of seeds: Conveyor and Elevators **4 L**
- Precautions during packaging

3. Seed Deterioration and Seed Storage:

- Definition, manifestation and causes of seed deterioration.
- Prevention measures of seed deterioration.
- Definition of seed storage
- Factors affecting seed storage
- Ideal ware house for seed storage, sanitation, fumigation and dehumidification **2 L**
- Cold storage

4. Seed legislation:

- Seed legislation in India

- Types of seed legislation.

5. Seed Certification and Quality Control: 3 L

- General procedure for seed certification
- Seed certification Board, Central Seed committee and their functions.
- Minimum seed certification Standards (Field and Seed)

Suggested Readings:

1. Ovcharov, K.E. 1977. Physiological Basis of Seed Germination. Amerind Publishing Co., New Delhi and New York.
2. Thompson, J.R. 1977. Advances in Research and Technology of Seeds. Part - 1, 3 & 4. Centre for Agrl. Publishing and Documentation, Washington.
3. Anonmyous. 1997. Seed Technology in Tropics. ISTA Zurich.
4. Sinclair, T.R. and F.P. Gardner. 1997. Principles of Ecology in Plant Production, CAB international, G.K.
5. Rai. M. and S. Mauria. 1995. Hybrid Research and Development. Indian Society of Seed Technology. IARI. New Delhi.
6. Agrawal, R.L. 1996. Seed Technology, IBH publishing Co., New Delhi.
7. Mayer, A.M. and A.P. Mayber. 1989. Germination of Seeds. Pergamon Press, Oxford.
8. Desai. B.B., P.M Kotecha and D.K. Salunkha. 1997. Seeds Hand Book - Biology Production, Processing and Storage. Marcel Dekker. New York.
9. Khairwal. P.S., C. Ram and A.K. Chabra. 1997. Pearl millet Seed Production and Technology. Manohar book service, New Delhi.
10. Jaima Kigel, J. and G. Galili. 1997. Seed Development and Germination. Marcel Dekker, New York.
11. Bewley, J.D. and M. Black. 1982. Physiology and Biochemistry of Seeds in relation to Germination, Vol. I & II. Springer Verlag, Berlin, Heidelberg, New York.
12. Justice, O.L. and L.N. Basu. 1978. Principles and Practices of Seed Storage. Castle House Publications Ltd, Great Britain.
13. Khan, A.A. 1977. The Physiology and Bio-chemistry of seed Dormancy and Germination. North Holland Publishing Co., Amsterdam, New York.
14. Kozlowski, T.T. 1972. Seed Biology, Vol. 1 Academic Press, London.
15. Purseglove, J.W. 1977. Tropical crops of Monocotyledons, Longmans, Green and Co., Ltd., London.

M.Sc. II Semester IV

BODT 244 Botany Theory paper 4

BODT 244 c) Research Methodology (2 CREDITS) (30 Lectures)

15L

Credit I **8 L**

Unit I: Basic Concepts of Research
Research definition and types of research (Descriptive vs analytical; applied vs fundamental; quantitative vs qualitative; conceptual vs empirical). Research methods vs methodology. Literature-review and its consolidation; Library research; field research; laboratory research. **7 L**

Unit II: Data Collection and Documentation of Observations
Maintaining a laboratory record; Tabulation and generation of graphs. Imaging of tissue, specimens and application of scale bars. The art of field photography.

Credit II: **8 L**

Unit III: Overview of Biological Problems
History; Key biology research areas, Model organisms in biology (A brief overview): Genetics, Physiology, Biochemistry, Molecular Biology, Cell Biology, Genomics, Proteomics-Transcriptional regulatory network. **7 L**

Unit IV: Ethics and Good Practical's and Art of Scientific Writing
Authors, acknowledgements, reproducibility, plagiarism, Numbers, units, abbreviations and nomenclature used in scientific writing. Writing references. Power-point presentation. Poster presentation. Scientific writing and ethics, Introduction to copyright-academic misconduct/plagiarism.

Suggested Readings

1. Dawson, C. (2002). Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. (1995). Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S. E. (1999). Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.

M. Sc II Botany Semester IV

BODP 243 Botany Practical paper

BODP 243 based on BODT 243 d) Industrial Biotechnology (2Cr)

Sr. No	Title of practical (Any 12 practical)	No.
1	Isolation of *Aspergillus niger* from a suitable medium and its maintenance in pure culture.	2
2	Inoculation of Spore suspension of *Aspergillus niger* on a fermentation medium to prepare citric acid broth	1
3	Estimation of citric acid by Spectrophotometric and titration method	1
4	Recovery of citric acid from fermentated broth.	1
5	Fermentative production of Ethanol	2
6	Demonstration practical on microbial food.	1
7	Study of Biosorption using suitable sample	1
8	Demonstration practical on Biosensors and Biochip	1
9	Study of preparation of Biolastic using suitable material	1
10	Demonstration of various nano materials used in bioremediation	1

M. Sc II Botany Semester IV

BODP 243 Botany Practical paper

BODP 243 based on BODT 243 e) Seed Technology (2Cr)

Sr. No	Title of practical (Any 12 practical)	No.
1	Detection and identification of important seed borne fungi by various detection methods- washing, agar and blotter method	2
2	Detection and identification of seed borne bacteria	2
3	Study of important Pest of fibre crop, pulses, vegetable and storage grain (Any two example from each), with reference to their life cycle, damage and control measures	2
4	Demonstration of seed processing and treating equipments	2
5	Demonstration: Aids for varietal identification and Preparation of artificial seed	2
6	Collection, submission of crops and storage pests, different seed varieties of any three-crop plants	2
7	Visit to any two Seed industries and submission of report	2
8	Study of different processes of packaging of dry,liquid and aromatic herbal products.	1
9	Market study of herbal products- cosmetics, medicines, nutraceuticals.	1
10	Visits to industry related to herbal products and quality testing centres related to herbal products.	2

M. Sc II Botany Semester IV

BOUP 244 Botany Practical paper (2Cr)

OR PG Dissertation (2Cr)

BOUP 244 based on BODT 244 c) Research Methodology (2Cr)

Sr. No	Title of practical (Any 12 Practical)	No.
1	Experiments based on chemical calculations.	1
2	Plant microtechnique experiments.	1
3	The art of imaging of samples through microphotography and field photography.	1
4	Poster presentation on defined topics.	1
5	Technical writing on topics assigned.	1
6	Identification of different type of research in day by day life	1
7	Testing of a formulated hypothesis with type I and type II errors	1
8	Curation of relevant scientific literature from Google Scholar, NCBI PubMed etc	1
9	Poster presentation on defined topics	1
10	Demonstration for checking of plagiarism using recommended software	1
11	Technical writing on topics assigned.	1
12	More Practical may be added depending on the local habitats and available facilities	1

M. Sc II Botany Practical Paper (4 CR)

BOUP 245 based on BOUT 241 and BOUT 242

Sr. No	Title of practical	No.
	BOUT 241 Botanical Techniques (Any 12 Practical)	
1	Use of flurochromes to visualize specific cell components	1
2	Micrometry	2
3	Maceration technique	1
4	Electrical conductivity and pH measurements	1
5	Absorption spectra of BSA/DNA and determination of absorption maxima	1
6	Rocket immune electrophoresis	1
7	Separation of leaf pigments by paper chromatography and TLC	1
8	Separation of isozymes by native polyacrylamide gel electrophoresis	2
9	Microtomy- Processing, double staining, sectioning	2
10	Cytochemical analysis- Nucleus, Golgi bodies, Mitochondria	2
11	Databases and database searching and DNA and protein sequence comparison	1
	BOUT 242 Plant Ecology Ecology (Any 12 Practical, 15th is compulsory)	
1	Study of phytoplanktons and macrophytes from clean and polluted water bodies	1
2	Estimation of chlorides and alkalinity of the water sample	1
3	Prepare shoot/canopy profile of tree stand along the line transect.	1
4	Remote sensing techniques for vegetation/ plant diversity assessment using satellite imagery and aerial photographs	2
5	Methods for estimating above-ground biomass for carbon pool assessment	1
6	Find out various diversity indices with the help of computer software.	1
7	Find out the Simpson's Index of Dominance.	1
8	Find out the β-diversity, similarity and dissimilarity indices.	1
9	Comparison of stomatal index and pollen fertility of any two plants from polluted and non-polluted areas	1
10	Compare protected and unprotected herbaceous stand using community coefficients (similarity indices).	1
11	To find out relationship between two ecological variables using correlation and regression analysis.	1
12	To estimate dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Winkler's method.	1
13	To determine percent soil organic carbon and organic matter in soils of cropland, grassland and forest.	1
14	To find out association between important herbaceous species using Chi-square test.	1
15	Visit to different types of ecosystems to understand the species composition and diversity (plateaus/grasslands/forests/wetlands/deserts/mangroves)	1

KopargaonTaluka Education Society`s

K.J.Somaiya college of Arts, Commerce and Science, Kopargaon.

Department of Marathi

List of Courses addresses crosscutting issues as per new syllabus (CBCS- 2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	F.Y.B.A. Marathi	11021 A	मराठी साहित्य : कथा आणि भाषिक कौशल्य विकास (SEM-I)	Human Values, Professional Ethics
2	F.Y.B.A. Marathi	12021 A	मराठी साहित्य : एकांकिका आणि भाषिकौशल्य विकास (SEM-II)	Human Values, Professional Ethics
3	S.Y.B.A. Marathi	23023	भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्य प्रकार :- कादंबरी (SEM-III)	Human Values, Professional Ethics
4	S.Y.B.A. Marathi	24023	भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्य प्रकार :- ललित गद्य (SEM-IV)	Professional Ethics
5	S.Y.B.A. Marathi	23021	आधुनिक मराठी साहित्य : प्रकाशवाटा (SEM-III)	Human Values
6	S.Y.B.A. Marathi	24021	मध्ययुगीन मराठी साहित्य : निवडक मध्ययुगीन गद्य, पद्य (SEM-IV)	Human Values
7	S.Y.B.A. Marathi	23022	साहित्य विचार (SEM-III)	Human Values
8	S.Y.B.A. Marathi	24022	साहित्य समीक्षा (SEM-IV)	Human Values
9	S.Y.B.A. Marathi	23025	प्रकाशन व्यवहार आणि संपादन (SEC 2 A) (SEM-III)	Professional Ethics
10	S.Y.B.A. Marathi	24025	उपयोजित लेखन कौशल्य (SEC 2 B) (SEM-IV)	Professional Ethics
11	T.Y.B.A. Marathi	36023	भाषिक कौशल्य विकास आणि आधुनिक मराठी साहित्य प्रकार : प्रवासवर्णन (SEM-V)	Professional Ethics
12	T.Y.B.A. Marathi	36023	भाषिक कौशल्य विकास आणि आधुनिक मराठी साहित्य प्रकार : कविता (SEM-VI)	Professional Ethics
13	T.Y.B.A. Marathi	35021	मध्ययुगीन मराठी वाङ्मयाचा इतिहास -प्रारंभ ते १६०० (SEM-V)	Human Values
14	T.Y.B.A. Marathi	36021	मध्ययुगीन मराठी वाङ्मयाचा इतिहास - १६०१ ते १८१७ (SEM-VI)	Human Values
15	T.Y.B.A. Marathi	35022	वर्णनात्मक भाषाविज्ञान -भाग - १(SEM-V)	Human Values

16	T.Y.B.A. Marathi	36022	वर्णनात्मक भाषाविज्ञान - भाग – 2 (SEM-VI)	Human Values
17	T.Y.B.A. Marathi	35025	कार्यक्रम संयोजनातील भाषिक कौशल्य भाग - 1(SEM-V)	Professional Ethics
18	T.Y.B.A. Marathi	36025	कार्यक्रम संयोजनातील भाषिककौशल्य भाग – 2 (SEM-VI)	Professional Ethics
19	F.Y.B.Com Marathi	117-B	भाषा साहित्य आणि कौशल्य विकास - उत्कर्षवाटा (SEM-I)	Human Values, Professional Ethics
20	F.Y.B.Com Marathi	127-B	भाषा आणि कौशल्य विकास (SEM-II)	Professional Ethics
21	S.Y.B.Sc. Marathi	22331	मराठी साहित्य (SEM-III)	Professional Ethics
22	S.Y.B.Sc. Marathi	24331	मराठी साहित्य-मराठी कथा दर्शन (SEM-IV)	Human Values

प्रा.डॉ.गणेश देशमुख
सहयोगी प्राध्यापक व मराठी विभाग प्रमुख
के.जे.सोमैया महाविद्यालय
कोपरगांव,जि.अ.नगर

Principal
K.J.Somaiya College of Arts
Commerce & Science,Kopargaon

F.Y.B.A. (प्रथम वर्ष कला)

निवड आधारित श्रेयांक पद्धत (Choice Based Credit System)

पहिले सत्र

विषयाचे नाव : मराठी साहित्य : कथा आणि भाषिक कौशल्यविकास [CC-1 A]

अभ्यासक्रमाची उद्दिष्टे :

१. कथा या साहित्यप्रकाराची ओळख करून देणे.
२. कथा या साहित्यप्रकाराचे स्वरूप, घटक आणि प्रकार यांची ओळख करून देणे.
३. विविध साहित्यप्रवाहांमधील कथा या साहित्यप्रकारातील निवडक कथांचे अध्ययन करणे.
४. भाषिक कौशल्यविकास करणे.

पहिले सत्र :

घटक	तपशील	श्रेयांक	तासिका
१	कथा : स्वरूप आणि वाटचाल कथा : घटक कथा : प्रकार (रचनाप्रकार आणि प्रवाह)	१	१५
२	अभ्यासपुस्तक : समकालीन मराठी कथा अक्षरबंध प्रकाशन, पुणे संपादक : प्रा. डॉ. शिरीष लांडगे, प्रा. डॉ. दिलीप पवार, प्रा. डॉ. संदीप सांगळे	१	१५
३	भाषिक कौशल्यविकास नैसर्गिक : आकलनासह श्रवण अर्जित : संभाषण, वाचन, लेखन, इ-संवाद कौशल्य प्रगत : सारग्रहण, सारांशलेखन	१	१५

संदर्भ ग्रंथ

१. मराठी साहित्य : प्रेरणा आणि स्वरूप, संपादक डॉ. गो. मा. पवार, डॉ. म. द. हातकणंगलेकर

२. साहित्यमूल्य आणि अभिरुची, डॉ. गो. मा. पवार

३. काही साहित्यिक : काही साहित्यकृती, डॉ. भीमराव कुलकर्णी

४. साहित्य अध्यापन आणि प्रकार, वा. ल. कुलकर्णी गौरव ग्रंथ, संपादक श्री. पु. भागवत, डॉ. सुधीर रसाळ

५. कथा : संकल्पना आणि समीक्षा, सुधा जोशी, मौज प्रकाशन

६. मराठी कथा : विसावे शतक, संपादक के. ज. पुरोहित, सुधा जोशी

३३. https://m.maharashtratimes.com/editorial/samwad/predictive-reviews-of-rural problems/amp_articleshow/68120291.cms
३४. https://marathi.pratilipi.com/
३५. https://www.youtube.com/watch?v=uMMRRXj-54Q&feature=youtu.be
३६. https://mr.m.wikipedia.org/wiki/%E0%A4%97%E0%A5%8C%E0%A4%B0%E0%A5%80_%E0%A4%A6%E0%A5%87%E0%A4%B6%E0%A4%AA%E0%A4%BE%E0%A4%82%E0%A4%A1%E0%A5%87
३७. https://www.bbc.com/marathi/india-43021905
३८. https://www.loksatta.com/lekh-news/indian-women-authors-gauri-deshpande-chaturang-anniversary-issue-1761601/
३९. https://mr.m.wikipedia.org/wiki/%E0%A4%AD%E0%A4%BE%E0%A4%B8%E0%A5%8D%E0%A4%95%E0%A4%B0_%E0%A4%9A%E0%A4%82%E0%A4%A6%E0%A4%A8%E0%A4%B6%E0%A4%BF%E0%A4%B5

दुसरे सत्र

विषयाचे नाव : मराठी साहित्य : एकांकिका आणि भाषिक कौशल्यविकास [CC-1 A]

अभ्यासक्रमाची उद्दिष्टे :

१. एकांकिका या साहित्यप्रकाराची ओळख करून देणे.
२. एकांकिका या साहित्यप्रकाराचे स्वरूप, घटक आणि प्रकार यांची ओळख करून देणे.
३. मराठी साहित्यातील निवडक एकांकिकांचे अध्ययन करणे.
४. भाषिक कौशल्यविकास करणे.

घटक	तपशील	श्रेयांक	तासिका
१	एकांकिका : स्वरूप एकांकिका : घटक एकांकिका : संहितामूल्य व प्रयोगमूल्य	१	१५
२	अभ्यासपुस्तक : **मराठी एकांकिका** **(विठ्ठल तो आला आला – पु. ल. देशपांडे, हंडाभर चांदण्या – दत्ता पाटील)** पद्मगंधा प्रकाशन, पुणे संपादक : प्रा. डॉ. शिरीष लांडगे, प्रा. डॉ. बाळकृष्ण लळीत, प्रा. डॉ. भास्कर ढोके	१	१५
३	भाषा उपयोजनाची विविध आविष्कार रूपे संवादलेखन कल्पनाविस्तार घोषवाक्य लेखन भाषांतर	१	१५

द्वितीय वर्ष कला (S. Y. B. A.)

नियमित अभ्यासक्रम

पहिले सत्र

विषयाचे नाव

भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्यप्रकार : कादंबरी [CC – 1 C (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. कादंबरी या साहित्यप्रकाराचे स्वरूप, घटक, प्रकार आणि वाटचाल समजून घेणे.
२. नेमेलेल्या कादंबरीचे आकलन, आस्वाद आणि विश्लेषण करणे.
३. भाषिक कौशल्यविकास करणे.

घटक		तपशील	श्रेयांक	तासिका
१	अ	१ संगणक आणि मोबाईलवर युनिकोडमधून मराठी मुद्रण. २ कळफलक प्रकार : इनस्क्रिप्ट, फोनेटिक ३ मराठी टंकलेखन आणि युनिकोडचा वापर : गुगल इनपुट, मायक्रोसॉफ्ट इनपुट व इतर साधने	१	१५
	ब	१ कादंबरी : स्वरूप आणि घटक २ कादंबरी : प्रकार आणि वाटचाल		
२		अभ्यासपुस्तक **रारंग ढांग – प्रभाकर पेंढारकर** मौज प्रकाशन गृह, मुंबई	२	३०

संदर्भ ग्रंथ :

१. साहित्य अध्यापन आणि प्रकार, संपादक श्री. पु. भागवत आणि इतर.
२. आधुनिक मराठी वाङ्मयाचा इतिहास, खंड ४, ५, ६, संपादक रा. श्री. जोग.
३. आधुनिक मराठी वाङ्मयाचा इतिहास, अ. ना. देशपांडे
४. मराठी कादंबरी : समाजशास्त्रीय समीक्षा, डॉ. रवींद्र ठाकूर
५. मराठी कादंबरीतील प्रादेशिकता, डॉ. भास्कर शेळके
६. मराठी ग्रामीण कादंबरी, डॉ. रवींद्र ठाकूर
७. मराठी कादंबरीचे पहिले शतक, कुसुमावती देशपांडे
८. कादंबरी आणि मराठी कादंबरी, उषा हस्तक
९. मराठी कादंबरी आस्वादयात्रा, संपादक विजया राजाध्यक्ष
१०. मराठी कादंबरी : तंत्र आणि विकास, प्रा. वा. बापट, ना. वा. गोडबोले
११. मराठी प्रादेशिक कादंबरी : तंत्र आणि स्वरूप, डॉ. मदन कुलकर्णी
१२. मराठी कादंबरी : चिंतन आणि समीक्षा, डॉ. चंद्रकांत बांदिवडेकर
१३. कादंबरी : सार आणि विस्तार, डॉ. महेंद्र कदम

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विषयाचे नाव

भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्यप्रकार : ललितगद्य [CC – 1 D (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. ललितगद्य या साहित्यप्रकाराचे स्वरूप, घटक, प्रकार आणि वाटचाल समजून घेणे.
२. नेमलेल्या अभ्यासपुस्तकातील ललितगद्याचे आकलन, आस्वाद आणि विश्लेषण करणे.
३. भाषिक कौशल्यविकास करणे.

घटक		तपशील	श्रेयांक	तासिका
१	अ	गुगल साधनांचा अध्ययनातील वापर : गुगल फॉर्म, गुगल क्लासरूम, यु ट्यूब.	१	१५
	ब	१ ललितगद्य : स्वरूप आणि घटक २ ललितगद्य : प्रकार आणि वाटचाल		
२		अभ्यासपुस्तक साहित्यरंग संपादक प्रा. डॉ. शिरीष लांडगे, प्रा. डॉ. दिलीप पवार, प्रा. डॉ. जया कदम अक्षर वाङ्मय प्रकाशन, पुणे	२	३०

संदर्भ ग्रंथ :

१. लघुनिबंध ते मुक्तछंद, वि. शं. चौगुले
२. ग्रंथ संवाद, वि. शं. चौगुले
३. मराठी लघुनिबंधाचा इतिहास, डॉ. आनंद यादव
४. निबंध : शास्त्र व कला, डॉ. प्र. न. जोशी
५. मराठी निबंध, प्रा. म. वि. फाटक
६. प्रतिभा साधन, ना. सी. फडके
७. प्रदक्षिणा खंड १ आणि २
८. आधुनिक मराठी वाङ्मयाचा इतिहास, म.सा.प.,पुणे.
९. मराठी प्रवासवर्णनाची वाटचाल, नीला पांढरे
१०. प्रवासवर्णन, वसंत सावंत
११. सायबर संस्कृती, डॉ. रमेश वरखेडे
१२. उपयोजित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई
१३. ओळख माहिती तंत्रज्ञानाची, टिमोथी जे. ओ लिअरी
१४. https://play.google.com/store/apps/details?id=org.mkcl.solar.itmarathi&hl
१५. http://www.youtube.com/watch?v=oXAWMH5PDxY

द्वितीय वर्ष कला (S. Y. B. A.)

पहिले सत्र

विषयाचे नाव

आधुनिक मराठी साहित्य : प्रकाशवाटा [DSE 1 A (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. आत्मचरित्र या साहित्यप्रकाराचे स्वरूप, संकल्पना समजावून घेणे.
२. आत्मचरित्र या साहित्यप्रकाराच्या प्रेरणा आणि वाटचाल यांची ओळख करून घेणे.
३. ललित गद्यातील अन्य साहित्यप्रकारांच्या तुलनेत आत्मचरित्राचे वेगळेपण समजावून घेणे.
४. नेमलेल्या या आत्मचरित्राचे आकलन, आस्वाद आणि विश्लेषण करणे.

घटक	तपशील	श्रेयांक	तासिका
१	आत्मचरित्र : संकल्पना, स्वरूप; प्रेरणा आणि वाटचाल अन्य साहित्यप्रकारांच्या तुलनेत आत्मचरित्राचे वेगळेपण	१	१५
२	अभ्यासपुस्तक प्रकाशवाटा - डॉ. प्रकाश आमटे समकालीन प्रकाशन, पुणे	२	३०

संदर्भ ग्रंथ:

१. चरित्र - आत्मचरित्र, अ. म. जोशी
२. चरित्र - आत्मचरित्र, सदा कऱ्हाडे
३. आत्मचरित्र मीमांसा, आनंद यादव
४. मराठीतील आत्मचरित्रपर लेखन, ऊषा हस्तक
५. मराठी वाङ्मय कोश, खंड ४, संपादक, विजया राजाध्यक्ष
६. आत्मचरित्र, मराठी विश्वकोश, खंड २
७. २० व्या शतकातील मराठी आत्मचरित्र,उषा हस्तक

दुसरे सत्र

विषयाचे नाव

मध्ययुगीन मराठी साहित्य: निवडक मध्ययुगीन गद्य, पद्य [DSE 2 A (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. मध्ययुगीन गद्य – पद्य साहित्यप्रकारांची ओळख करून घेणे.
२. नेमलेल्या अभ्यासपुस्तकातील मध्ययुगीन गद्य - पद्याचे आकलन, आस्वाद आणि विश्लेषण करणे.

घटक	तपशील	श्रेयांक	तासिका
१	मध्ययुगीन गद्य : महानुभावीय गद्य, बखर, ऐतिहासिक पत्रे; स्वरूप आणि विशेष मध्ययुगीन पद्य : अभंग, भारूड, गवळण, पोवाडा, लावणी; स्वरूप आणि विशेष	१	१५
२	अभ्यासपुस्तक **निवडक मध्ययुगीन गद्य, पद्य** संपादक प्रा. डॉ. शिरीष लांडगे, प्रा. डॉ. प्रभाकर देसाई, प्रा. डॉ. प्रकाश शेवाळे प्रशांत पब्लिकेशन्स, जळगाव	२	३०

संदर्भ ग्रंथ

१. पाच संतकवी, शं.गो.तुळपुळे
२. महाराष्ट्र सारस्वत, वि.ल.भावे,शं.गो.तुळपुळे
३. संत कवी आणि कवयित्री : एक अनुबंध, सुहासिनी इर्लेकर
४. संत साहित्य दर्शन, उषा देशमुख
५. प्राचीन मराठी वाङ्मयाचा इतिहास, ल. रा. नासिराबादकर
६. संत वचनामृत, रा. द. रानडे
७. ज्ञानेश्वरांची जीवननिष्ठा, गं. बा. सरदार
८. संत नामदेव, हे. वि. इनामदार
९. प्राचीन मराठी वाङ्मयाचा इतिहास, अ. ना. देशपांडे
१०. संत वाङ्मयाची सामाजिक फलश्रुती, गं. बा. सरदार
११. श्री एकनाथ: वाङ्मय आणि कार्य, न. र. फाटक
१२. तुकाराम दर्शन, सदानंद मोरे
१३. संतसाहित्य आकलन आणि अध्यापन, संपादक वसंत आबाजी डहाके आणि इतर, महराष्ट्र राज्य माध्य. व उच्च माध्य. शिक्षण मंडळ, पुणे.
१४. नामदेव गाथा, ह. श्री. शेणोलीकर, साहित्य अकादेमी
१५. महानुभाव आणि वारकरी साहित्य, सुग्राम पुल्ले
१६. महानुभाव आणि वारकरी साहित्याचे अंतरंग, सुग्राम पुल्ले
१७. साहित्याची सामाजिकता, डॉ.सतीश बडवे,शब्दालय प्रकाशन,श्रीरामपूर,अहमदनगर.
१८. मध्ययुगीन साहित्याविषयी, डॉ.सतीश बडवे, मीरा बुक्स व पब्लिकेशन,औरंगाबाद.
१९. संत साहित्य समीक्षेचे बीजप्रवाह, डॉ.सतीश बडवे, गुरुकुल प्रतिष्ठान,पुणे.

द्वितीय वर्ष कला (S. Y. B. A.)

पहिले सत्र

विषयाचे नाव

साहित्यविचार [DSE 1 B (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. भारतीय आणि पाश्चात्य साहित्यविचाराच्या आधारे साहित्याची संकल्पना, स्वरूप आणि प्रयोजनविचार समजावून घेणे.
२. साहित्याची निर्मितिप्रक्रिया समजावून घेणे.
३. साहित्याची भाषा आणि शैली विषयक विचार समजावून घेणे.

घटक	तपशील	श्रेयांक	तासिका
१	• साहित्याचे स्वरूप आणि प्रयोजन १. साहित्याची संकल्पना (भारतीय, पाश्चात्यांच्या व्याख्या), साहित्यातील अनुभवाचे विशेष : वास्तव आणि कल्पित यांचा संबंध, संवेदनात्मकता, भावनात्मकता, वैचारिकता, सेन्द्रीयत्व, सूचकता, विशिष्ट आणि विश्वात्मकता २. प्रयोजन म्हणजे काय? मम्मटाची प्रयोजने; तसेच इच्छापूर्ती, जिज्ञासातृप्ती, विरेचन, आत्माविष्कार, अनुभवविश्वाची समृद्धी, स्वप्नरंजन, उद्बोधन, प्रचार, मनोरंजन, आनंद या प्रयोजनांचा विचार.	१	१५
२	• साहित्याची निर्मितीप्रक्रिया १. प्रतिभा, स्फूर्ती, कल्पना, चमत्कृती यांचे स्वरूप, संकल्पना आणि कार्य; साहित्यिकाचे व्यक्तिमत्त्व : संवेदनक्षमता, शैशववृत्ती, अनुभवसमृद्धी व विद्वत्ता, साहित्यिकाचा जीवनविषयक आणि साहित्य विषयक दृष्टिकोन.	१	१५
३	• साहित्याची सामाजिकता व भाषा १. साहित्य आणि समाज, जीवनमूल्ये आणि साहित्य मूल्ये, साहित्यवाचनाची प्रक्रिया व आवश्यकता २. साहित्याची भाषा : शब्दार्थांचा वक्रव्यापार; वक्रोक्ती, अलंकार, प्रतिमा, प्रतीक, प्राक्कथा ३. शैली विषयक स्थूल चर्चा - लेखक, आशय, साहित्यप्रकार या अनुरोधाने चर्चा	१	१५

द्वितीय सत्र

विषयाचे नाव

साहित्य समीक्षा [DSE 2 B(3)]

अभ्यासक्रमाची उद्दिष्टे :

१. साहित्य समीक्षेची संकल्पना, स्वरूप यांचा परिचय करून घेणे.
२. साहित्य आणि समीक्षा यांचे परस्पर संबंध समजावून घेणे व अभ्यासणे .
३. साहित्यप्रकारानुसार समीक्षेचे स्वरूप समजावून घेणे व अभ्यासणे .
४. ग्रंथ परिचय, परीक्षण व समीक्षण यातील फरक समजावून घेणे.

घटक	तपशील	श्रेयांक	तासिका
१	• समीक्षा : संकल्पना आणि स्वरूप १. समीक्षा : संकल्पना, स्वरूप आणि प्रयोजन २. समीक्षा : व्याप्ती आणि प्रकार ३. साहित्यविचार आणि समीक्षा यातील अनुबंध ४. साहित्यव्यवहारातील समीक्षेचे स्थान व कार्य	१	१५
२	• साहित्य आणि समीक्षा यांचे परस्पर संबंध १. साहित्यकृती आणि वाचक २. साहित्यकृती आणि समीक्षक ३. समीक्षेतील साहित्याच्या आकलन, आस्वाद, विश्लेषण, अर्थनिर्णयन, मूल्यमापन आणि शब्दांकन यांचे स्थान व कार्य	१	१५
३	• समीक्षकाचे गुण व पाळावयाची पथ्ये १. समीक्षकाचे गुण : रसिकता, प्रज्ञा, तुलनाक्षमता, चिकित्सकता, मूल्यविवेक, विश्लेषकता, व्युत्पन्नता, तुलनाक्षमता इ. २. समीक्षकाने पाळावयाची पथ्ये : समीक्षाविषयाचे अवधान व तारतम्य, निकषाचे तारतम्य, व्यक्तिनिष्ठता व वस्तुनिष्ठता यांचे तारतम्य, मांडणी व शैली यांचे तारतम्य, संगती व सुसूत्रता यांचे भान, नेमकेपणा व तार्किकता या संबंधीचा विवेक, वाङ्मयीन मूल्ये व जीवनमूल्ये यांचा परस्परसंबंध आणि त्यांच्या वापराबाबत करावयाचा विवेक. ३. भाषिक, साहित्यिक, सांस्कृतिक संकेत आणि मूल्यव्यवहार ४. उपयोजीत समीक्षा : ग्रंथ परिचय, ग्रंथ परीक्षण, ग्रंथ समीक्षा	१	१५

संदर्भग्रंथ :

१. साहित्य : स्वरूप आणि समीक्षा, वा. ल. कुलकर्णी
२. समीक्षामीमांसा, गंगाधर पाटील
३. मराठीचे साहित्यशास्त्र, मा. गो. देशमुख
४. टीका आणि टीकाकार, वा. भा. पाठक
५. साहित्यविचार आणि सौंदर्यशास्त्र, रा. भा. पाटणकर

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कौशल्याधिष्ठित अभ्यासक्रम

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प्रकाशनव्यवहार आणि संपादन [SEC 2 A (2)]

अभ्यासक्रमाची उद्दिष्टे :

१. प्रकाशनव्यवहार आणि संपादन यासाठी आवश्यक कौशल्ये प्राप्त करणे.
२. प्रकाशनव्यवहार आणि संपादन यासाठी आवश्यक प्रशिक्षण घेणे.
३. प्रकाशनव्यवहार आणि संपादन यासाठी प्रात्यक्षिकासह उपयोजनाची कौशल्ये प्राप्त करणे.
४. प्रकाशन संस्था, जाहिरात संस्था, छापखाने, वृत्तपत्र कार्यालये, वितरण संस्था, ग्रंथ विक्री दुकाने, फ्लेक्स निर्मिती केंद्र, वार्ताहर यांना भेटी देऊन प्रशिक्षण घेणे.

घटक		तपशील	श्रेयांक	तासिका
१	१	प्रकाशन संस्था : स्वरूप, कार्यप्रणाली, कॉपीराईट कायद्याची तोंडओळख, ग्रंथविक्री, वितरण, जाहिरात, वाचकसंवाद.	१	१५
	२	ग्रंथनिर्मिती प्रक्रिया, ग्रंथ प्रकार : ललित, माहितीपर, शास्त्रीय, संदर्भग्रंथ इ.; ग्रंथनिर्मिती : संहिता संपादन, संपादकीय संस्कार, लेखक संवाद, मुखपृष्ठ, मुद्रणप्रत, छपाई, ग्रंथ बांधणी.		
२	१	मुद्रितशोधन : लेखनविषयक नियम, मुद्रितशोधन खुणा, विरामचिन्हे, अवतरणे, संक्षेप, मजकुराची मांडणी, चित्र रेखाटन योजना, सूची, संदर्भग्रंथसूची, परिशिष्टे, दर्शनीय स्वरूप, आकार.	१	१५

संदर्भ ग्रंथ :

१ पॉप्युलर रीतिपुस्तक, रामदास भटकळ, मृदुला जोशी
२ सुगम मराठी व्याकरण व लेखन - मो.रा. वाळंबे
३ मराठीचे व्याकरण, डॉ. लीला गोविलकर
४ मराठी लेखन मार्गदर्शिका, यास्मिन शेख
५ मुद्रित-शोधन, य. ए. धायगुडे
६ शुद्ध शब्दकोश, डॉ. स्नेहल तावरे
७ मराठी शुद्धलेखन नियमावली, डॉ. स्नेहल तावरे
८ मराठी लेखन कोश, अरुण फडके
९ शुद्धलेखन मार्गप्रदीप, अरुण फडके
१० उपयोजित मराठी, संपादक डॉ. केतकी मोडक, संतोष शेणई, सुजाता शेणई

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विषयाचे नाव

उपयोजित लेखनकौशल्ये [SEC 2 B (2)]

अभ्यासक्रमाची उद्दिष्टे :

१. जाहिरात, मुलाखतलेखन आणि संपादन यासाठी आवश्यक कौशल्ये प्राप्त करणे.
२. जाहिरात, मुलाखतलेखन आणि संपादन यासाठी आवश्यक प्रशिक्षण घेणे.
३. जाहिरात, मुलाखतलेखन आणि संपादन यासाठी प्रात्यक्षिकासह उपयोजनाची कौशल्ये प्राप्त करणे.

घटक		तपशील	श्रेयांक	तासिका
१	१	जाहिरातलेखन : प्रयोजन, स्वरूप, प्रकार, विविध माध्यमांतील जाहिरातींचे स्थान, जाहिरात कल्पना आणि संहितालेखन, इंटरनेट (माहिती महाजाल) जाहिरात आणि संहितालेखन	१	१५
	२	मुलाखतलेखन : वृतपत्रे, नियतकालिके, दृकश्राव्य माध्यमांसाठी मुलाखतलेखन		
२	१	माहितीपर नोंदी : शास्त्रीय ज्ञानकोश, विविध प्रकारचे ज्ञानकोश (विकिपीडिया, विश्वकोश इ. साठी) नोंदलेखन, विविध माध्यमांसाठी नोंद लेखन, प्रात्यक्षिके इ.	१	१५

संदर्भ ग्रंथ :

१. संगणक, अच्युत गोडबोले, मौज प्रकाशन, मुंबई.
२. इंटरनेट, डॉ. प्रबोध चोबे, मनोरमा प्रकाशन, मुंबई.
३. व्यावहारिक मराठी, डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
४. आधुनिक माहिती तंत्रज्ञानाच्या विश्वात, शिक्रापूरकर दीपक, मराठे उज्ज्वल, उत्कर्ष प्रकाशन, पुणे.
५. भाषांतरमीमांसा, कल्याण काळे, अंजली सोमण.
६. व्यावहारिक मराठी, पुणे विद्यापीठ प्रकाशन, पुणे.
७. व्यावहारिक मराठी, डॉ. कल्याण काळे, डॉ. दत्तात्रेय पुंडे, निराली प्रकाशन, पुणे.
८. व्यावहारिक मराठी, डॉ. लीला गोविलकर, डॉ. जयश्री पाटणकर, स्नेहवर्धन प्रकाशन, पुणे.
९. व्यावहारिक मराठी, डॉ. सयाजीराजे मोकाशी, डॉ. रंजना नेमाडे
१०. व्यावहारिक मराठी, डॉ. ल. रा. नसिराबादकर, फडके प्रकाशन, कोल्हापूर.
११. प्रसारमाध्यमांसाठी लेखन कौशल्ये, यशवंतराव चव्हाण महाराष्ट्र मुक्त विद्यापीठ, नाशिक.
१२. प्रसार माध्यमे आणि मराठी भाषा, संपादक, डॉ.भास्कर शेळके
१३. व्यावहारिक व उपयोजित मराठी आणि प्रसारमाध्यमांची कार्यशैली, संपादक, डॉ. संदीप सांगळे
१४. व्यावहारिक आणि उपयोजित मराठी, डॉ. मनोहर रोकडे
१५. मराठी भाषा उपयोजन आणि सर्जन, प्रा. सुहासकुमार बोबडे

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भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्यप्रकार : प्रवासवर्णन [CC – 1 E (3)]

अभ्यासक्रमाची उद्दिष्टे :

१ मुद्रित माध्यमांसाठी लेखन कौशल्ये आत्मसात करणे.
२ प्रवासवर्णन या साहित्यप्रकाराचे स्वरूप, प्रेरणा, प्रयोजने, वैशिष्ट्ये आणि वाटचाल समजून घेणे.
३ नेमलेल्या प्रवासवर्णनाचे आकलन,आस्वाद आणि विश्लेषण करणे.

घटक		तपशील	श्रेयांक	तासिका
१	अ	मुद्रित माध्यमांसाठी लेखन कौशल्ये : १ वृत्तलेख : स्वरूप व वैशिष्ट्ये २ अग्रलेख : स्वरूप व वैशिष्ट्ये ३ सदर लेखन : स्वरूप व वैशिष्ट्ये ४ परीक्षण : स्वरूप व वैशिष्ट्ये	१	१५
	ब	प्रवासवर्णन साहित्यप्रकार : स्वरूप, प्रेरणा, प्रयोजने, वाटचाल आणि वैशिष्ट्ये		
२		अभ्यासपुस्तक तीन मुलांचे चार दिवस आदर्श पाटील, विकास वाळके, श्रीकृष्ण शेळके साधना प्रकाशन, पुणे	२	३०

संदर्भ ग्रंथ :

१. साहित्य अध्यापन आणि प्रकार, संपादक श्री. पु. भागवत आणि इतर
२. मराठी प्रवासवर्णनांची वाटचाल, डॉ.नीला पांढरे
३. मराठी वाङ्मय इतिहास, खंड ४, महाराष्ट्र साहित्य परिषद, पुणे
४. मराठी वाङ्मय इतिहास, खंड ७, भाग १, महाराष्ट्र साहित्य परिषद, पुणे
५. आधुनिक मराठी वाङ्मयाचा इतिहास, खंड १ आणि २, अ. ना. देशपांडे
६. प्रवासवर्णन एक वाङ्मयप्रकार, वसंत सावंत
७. प्रदक्षिणा खंड २ , वि . ह. कुलकर्णी
८. अग्रलेख, गोविंद तळवलकर, प्रेस्टीज प्रकाशन, पुणे.
९. मुद्रित माध्यमांसाठी लेखन कौशल्ये : पुस्तक पहिले व दुसरे, य. च . म. मु. वि. नाशिक
१०. आधुनिक मराठी वाङ्मय : स्वरूप, आकलन आणि आस्वाद, सांगळे संदीप
११. https://shabdakosh.marathi.gov.in/ananya-glossary
१२. https://shabdakosh.marathi.gov.in/

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विषयाचे नाव

भाषिक कौशल्यविकास आणि आधुनिक मराठी साहित्यप्रकार : कविता [CC – 1 F (3)]

अभ्यासक्रमाची उद्दिष्टे :

१. मराठी साहित्य, भाषिक कौशल्यविकास आणि शासनव्यवहार यांची माहिती घेणे.
२. कविता या साहित्यप्रकाराचे स्वरूप, वाटचाल, प्रेरणा, प्रवृत्ती आणि वैशिष्ट्ये,समजून घेणे.
३. नेमलेल्या अभ्यासपुस्तकातील निवडक कवितांचे आकलन, आस्वाद आणि विश्लेषण करणे.
४. कविता या साहित्यप्रकारातील विविध आविष्कार व भाषा रूपांची अभ्यासपुस्तकातील कवितांच्या आधारे ओळख करून घेणे.

घटक		तपशील	श्रेयांक	तासिका
१	अ	मराठी साहित्य, भाषिक कौशल्यविकास आणि शासनव्यवहार १ राज्यघटनेतील भाषाविषयक तरतुदी २ मराठी राजभाषा अधिनियम ३ मराठीविषयक कार्य करणाऱ्या शासकीय संस्थांचा परिचय	१	१५
	ब	कविता : स्वरूप, वाटचाल, प्रेरणा आणि वैशिष्ट्ये		
२		संपादित अभ्यासपुस्तक **रूप : कवितेचे** संस्कृती प्रकाशन, पुणे	२	३०

संदर्भ ग्रंथ :

१. साहित्य अध्यापन आणि प्रकार, संपादक श्री. पु. भागवत आणि इतर
२. कवितेचा रूपशोध, म.सु. पाटील, शब्दालय प्रकाशन, पुणे.
३. कविता आणि प्रतिमा, सुधीर रसाळ,मौज प्रकाशन, मुंबई.
४. परंपरा आणि नवता, गो.वि.करंदीकर, पॉप्युलर प्रकाशन, मुंबई.
५. सुहृदगाथा, प्रस्तावना, गंगाधर पाटील
६. विद्रोही कविता, संपादक,केशव मेश्राम, कॉन्टिनेन्टल प्रकाशन, पुणे.
७. निळी पहाट, रा.ग.जाधव
८. साहित्य आणि अस्तित्वभान, दि.पु.चित्रे, शब्दालय प्रकाशन, श्रीरामपूर.
९. टीकास्वयंवर, भालचंद्र नेमाडे, साकेत प्रकाशन, औरंगाबाद.
१०. दलित कविता व दलित साहित्याचे सौंदर्यशास्त्र, म.सु.पाटील, पद्मगंधा प्रकाशन,पुणे
११. काव्यार्थ चिंतन, जी.एस.शिवरुद्रप्पा, साहित्य अकादमी
१२. कवितेचा शोध, वसंत पाटणकर, मौज प्रकाशन,मुंबई
१३. सौंदर्य आणि साहित्य, बा.सी.मर्ढेकर
१४. वाङ्मयप्रकार संकल्पना व स्वरूप, संपादक, आनंद वास्कर

तृतीय वर्ष कला (T. Y. B. A.)

नियमित अभ्यासक्रम

पहिले सत्र

विषयाचे नाव

मध्ययुगीन मराठी वाङ्मयाचा स्थूल इतिहास : प्रारंभ ते इ.स. १६०० [DSE 1 C (3+1)]

अभ्यासक्रमाची उद्दिष्टे :

१ वाङ्मयेतिहास संकल्पना, स्वरूप, प्रेरणा, प्रवृत्ती समजून घेणे.
२ मध्ययुगीन कालखंडाची सामाजिक, सांस्कृतिक पार्श्वभूमी समजून घेणे.
३ मराठी भाषा, साहित्याची कालखंडानुरूप इतिहास समजून घेणे.

घटक	तपशील	श्रेयांक	तासिका
१	**वाङ्मयेतिहास संकल्पना आणि मराठी भाषा, वाङ्मयाचा उगम** १. वाङ्मयेतिहास : संकल्पना आणि स्वरूप २. मराठी वाङ्मयेतिहासाचे कालखंड : स्वरूपचर्चा मराठी भाषा व वाङ्मयाचा उगम (कोरीव लेख आणि ग्रंथ या साधनांच्या आधारे) **यादव काळ आणि बहामनी काळातील वाङ्मयनिर्मिती** १ या कालखंडांची सामाजिक आणि सांस्कृतिक पार्श्वभूमी २ महानुभाव वाङ्मय : प्रेरणा, प्रवृत्ती व स्वरूप	१	१५
२	३ महानुभाव वाङ्मय : गद्य ग्रंथ - लीळाचरित्र, स्मृतिस्थळ, दृष्टान्तपाठ. पद्य ग्रंथ - महदंबेचे धवळे, साती ग्रंथ. १. वारकरी वाङ्मय : प्रेरणा, प्रवृत्ती व स्वरूप (संत ज्ञानेश्वर, संत नामदेव, संतमेळा, संत एकनाथ, शेख महंमद)	१	१५
३	१. मुकुंदराज, नृसिंहसरस्वती, दासोपंत, फादर स्टीफन्स, ब्रह्मगुणदास : वाङ्मयनिर्मितीचे स्वरूप	१	१५
४	संशोधनपर प्रकल्प / क्षेत्र कार्य (घटक १, २ आणि ३)	१	१५

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विषयाचे नाव

मध्ययुगीन मराठी वाङ्मयाचा स्थूल इतिहास - इ.स. १६०० ते इ.स. १८१७ [DSE1 D (3+1)]

घटक	तपशील	श्रेयांक	तासिका
१	**शिवकाल आणि पेशवेकाळातील वाङ्मयनिर्मिती** १. या कालखंडांची सामाजिक आणि सांस्कृतिक पार्श्वभूमी २. संत तुकाराम : वाङ्मयनिर्मितीचे स्वरूप ३. संत रामदास : वाङ्मयनिर्मितीचे स्वरूप	१	१५
२	**पंडित आणि शाहिरांची वाङ्मयनिर्मिती** १. पंडिती वाङ्मय : स्वरूप, प्रेरणा, प्रवृत्ती, आणि वैशिष्ट्ये मुक्तेश्वर, वामनपंडित, रघुनाथपंडित, मोरोपंत २. शाहिरी वाङ्मय : स्वरूप, प्रेरणा, प्रवृत्ती आणि वैशिष्ट्ये अनंत फंदी, परशराम, राम जोशी, प्रभाकर, होनाजी बाळा	१	१५
३	**बखर आणि गद्य वाङ्मयनिर्मिती** १. बखर वाङ्मय : स्वरूप, प्रेरणा, प्रवृत्ती आणि वैशिष्ट्ये सभासदाची बखर, शिवछत्रपतींचे सप्तप्रकरणात्मक चरित्र, शिवदिग्विजय, पानिपतची बखर, भाऊसाहेबांची बखर. २. आज्ञापत्र	१	१५
४	संशोधनपर प्रकल्प / क्षेत्र कार्य (घटक १, २ आणि ३)	१	१५

संदर्भ ग्रंथ :

१. महाराष्ट्र सारस्वत, वि. ल. भावे
२. मराठी भाषेचा व वाङ्मयाचा इतिहास, बा. अ. भिडे
३. मराठी वाङ्मयाचा इतिहास, खंड पहिला, ल. रा. पांगारकर
४. प्राचीन मराठी वाङ्मयाचा इतिहास, भाग १, पूर्वार्ध आणि उत्तरार्ध, अ. ना. देशपांडे
५. महाराष्ट्रीयांचे काव्यपरीक्षण, श्री. व्यं. केतकर
६. मराठी वाङ्मयाभिरुचीचे विहंगमावलोकन, जोग रा. श्री.
७. पाच भक्तीसंप्रदाय, र. रा. गोसावी
८. महाराष्ट्रातील पाच संप्रदाय, पं. रा. मोकाशी
९. नाथ संप्रदाय : उदय व विकास, प्र. न.जोशी
१०. मराठी साहित्याचे आदिबंध, उषा मा. देशमुख
११. यादवकालीन महाराष्ट्र, मु. गो. पानसे
१२. यादवकालीन मराठी, शं. गो. तुळपुळे
१३. महानुभवीय मराठी वाङ्मय, य. खु. देशपांडे
१४. महानुभाव पंथ आणि त्यांचे वाङ्मय, शं. गो. तुळपुळे
१५. श्रीचक्रधर : चरित्र, वि. भि. कोलते

तृतीय वर्ष कला (T. Y. B. A.)

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वर्णनात्मक भाषाविज्ञान : भाग १ [DSE 2 C (3)+1]

अभ्यासक्रमाची उद्दिष्टे :

१ भाषा स्वरूप, वैशिष्ट्ये व कार्ये समजावून घेणे.
२ भाषा अभ्यासाची आवश्यकता स्पष्ट करणे.
३ भाषा अभ्यासाच्या शाखा आणि विविध पद्धतींचा थोडक्यात परिचय करून घेणे.
४ वागिन्द्रियाची रचना, कार्य आणि स्वननिर्मितीची प्रक्रिया समजावून घेणे.
५ स्वनविज्ञान, स्वनिमविचार आणि मराठीची स्वनिमव्यवस्था समजावून घेणे.

घटक	तपशील	श्रेयांक	तासिका
१	**भाषा : स्वरूप व संकल्पना** १ भाषा : स्वरूप, वैशिष्ट्ये व कार्ये २ संदेशन : मानव व मानवेतर संदेशन ३ भाषाभ्यासाच्या शाखा (ध्वनिविचार – व्याकरणविचार – अर्थविचार – शब्दसंग्रह - स्थूल परिचय) ४ भाषेच्या अभ्यासाचे महत्त्व व भाषाभ्यासाच्या पद्धती (ऐतिहासिक,वर्णनात्मक, सामाजिक, तुलनात्मक – स्थूल परिचय)	१	१५
२	**स्वनविचार** १ स्वनविज्ञान : स्वरूप व संकल्पना (उच्चारणकेंद्री - संचारणकेंद्री – श्रवणकेंद्री) २ वागिन्द्रीय : रचना व कार्य स्वनांची निर्मितिप्रक्रिया ३ स्वनांचे वर्गीकरण व वर्गीकरणाची तत्त्वे (उच्चारण स्थान, उच्चारण अवयव, प्रयत्न)	१	१५
३	**स्वनिमविचार** १ स्वन -स्वनिम-स्वनांतर (परस्पर संबंध व प्रकार) २ स्वनिमनिश्चितीची तत्त्वे ३ विनियोग संकल्पना (व्यवच्छेदक विनियोग- पूरक विनियोग - मुक्त परिवर्तन) मराठीची स्वनिमव्यवस्था (स्वरस्वनिम - अर्धस्वरस्वनिम - व्यंजन स्वनिम – खंडित व खंडाधिष्ठीत स्वनिम -बलाघात, सुरावली – नासिक्यरंजन - सीमासंधी)	१	१५
४	संशोधनपर प्रकल्प / क्षेत्रकार्य (घटक १, २ आणि ३)	१	१५

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वर्णनात्मक भाषाविज्ञान : भाग २ - ४ [DSE 2 D (3)+1]

अभ्यासक्रमाची उद्दिष्टे :

१. रूपविन्यास आणि मराठीची रूपव्यवस्था समजावून घेणे
२. वाक्यविन्यास आणि वाक्यव्यवस्थेचा मराठी भाषेच्यासंदर्भात परिचय करून देणे
३. अर्थविन्यास या संकल्पनेचा भाषावैज्ञानिक अंगाने परिचय करून देणे

घटक	तपशील	श्रेयांक	तासिका
१	**रुपिमविचार** १ रूपविन्यास (संकल्पना) २ रूपिका - रुपिम – रुपिकांतर : स्वरूप व प्रकार ३ रूपिम निश्चितीची तत्त्वे ४ विनियोग संकल्पना ५ प्रकृती आणि प्रत्यय यांचे वर्गीकरण	१	१५
२	**वाक्यविचार** १ वाक्यविन्यास (संकल्पना परिचय) २ घटक आणि रचना : परस्पर संबंध ३ वाक्याचे घटक (उद्देश्य, विधेय) ४ प्रथमोपस्थित संघटक संकल्पना व वाक्यविश्लेषण (शब्द – शब्दबंध – उपवाक्य – वाक्य) ५ वाक्यांचे प्रकार	१	१५
३	**अर्थविचार** १ अर्थ : स्वरूप व संकल्पना २ अर्थविन्यास (संकल्पना परिचय) ३ अर्थाचे वर्गीकरण (प्रकार: सांकल्पनिक अर्थ - साहचर्यपर अर्थ- शैलीगत अर्थ- भावपर अर्थ- परावर्तीत अर्थ - विषय अर्थ) ४ अर्थविन्यासाची व्यापकता (समानार्थी शब्द, अनेकार्थी शब्द – सरूपता – अर्थसमावेश – अर्थविरोध)	१	१५
४	संशोधनपर प्रकल्प / क्षेत्रकार्य (घटक १, २ आणि ३)	१	१५

तृतीय वर्ष कला (T. Y. B. A.)

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कार्यक्रम संयोजनातील भाषिक कौशल्ये : भाग -१ [SEC 2 C (2)]

अभ्यासक्रमाची उद्दिष्टे :

१ कार्यक्रमांचे स्वरूप आणि प्रकार समजून घेणे.
२ कार्यक्रम संयोजनातील भाषिक कौशल्ये प्राप्त करणे.

घटक	तपशील	श्रेयांक	तासिका
१	**कार्यक्रमांचे स्वरूप आणि प्रकार** १. कार्यक्रमांचे स्वरूप आणि प्रकार : भाषणे, चर्चासत्रे, परिषदा, गटचर्चा, बैठक, मेळावे, कला – सांस्कृतिक कार्यक्रम, जाहिरात, विपणनविषयक, आभासी २. कार्यक्रम संयोजनातील विविध घटक (आयोजक, प्रायोजक, जाहिरात, निवेदक) आणि त्यांचे कार्य	१	१५
२	**कार्यक्रम संयोजनातील भाषिक कौशल्ये** १ पूर्वतयारी २ कार्यक्रम संयोजनातील भाषेचे महत्त्व ३ कार्यक्रमाची योजना, आखणी आणि रूपरेषा १. कार्यक्रमपूर्व नियोजन २. कार्यक्रमातील विविध घटक ३. भाषेचा वापर : निवेदन, प्रास्ताविक, परिचय, स्वागत,मनोगत,आभार, सूत्रसंचालन. ४. कार्यक्रमपश्चात कामे	१	१५

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कार्यक्रम संयोजनातील भाषिक कौशल्ये : भाग २ [SEC 2 D (2)]

अभ्यासक्रमाची उद्दिष्टे :

१ कार्यक्रम संयोजनातील लेखन कौशल्ये संपादन करणे.
२ कार्यक्रम संयोजनातील भाषिक कौशल्ये प्राप्त करणे.
३ आभासी कार्यक्रमांचे भाषिक कौशल्ये संयोजन करणे.

घटक	तपशील	श्रेयांक	तासिका
१	**कार्यक्रम संयोजनातील लेखन कौशल्ये** १ निमंत्रणपत्र व निमंत्रणपत्रिका लेखन २ कार्यक्रमपत्रिका लेखन ३ मानपत्र लेखन ४ बातमी लेखन ५ कार्यक्रम अहवाल लेखन	१	१५
२	**कार्यक्रम संयोजन** १ कविसंमेलन २ वाचन प्रेरणा दिन ३ मराठी भाषा पंधरवाडा ४ मराठी भाषा दिन ५ व्याख्यानमाला ६ पुस्तक प्रदर्शन **आभासी कार्यक्रम संयोजन** १ झूम / गुगल मिट वरील व्याख्यान २ फेसबुक व यूट्यूब वरील कार्यक्रम live करणे वा अपलोड करणे.	१	१५

संदर्भग्रंथ :

१ व्यावहारिक मराठी, पुणे विद्यापीठ प्रकाशन.
२ मराठी भाषेची संवाद कौशल्ये, य. च. म. मुक्त विद्यापीठ, नाशिक.
३ व्यक्तिमत्त्व विकासासाठी संभाषण व लेखन कौशल्ये, संपा. डॉ. पृथ्वीराज तौर, डॉ. शैलेन्द्र लेंडे, डॉ. वंदना महाजन.
४ व्यावहारिक व उपयोजित मराठी, संपादक संदीप सांगळे, डायमंड प्रकाशन.
५ कार्यक्रमाचे प्रभावी संयोजन आणि सूत्रसंचालन, जयप्रकाश बगदे, साकेत प्रकाशन
६ व्यावहारिक मराठी, ल रा. नासिराबादकर, फडके प्रकाशन

पहिले सत्र

विषयाचे नाव – भाषा, साहित्य आणि कौशल्यविकास [११७]

(Ability Enhancement Course)

अभ्यासक्रमाची उद्दिष्टे -

१. विविध क्षेत्रातील भाषा व्यवहाराचे स्वरूप व गरज समजावून देणे.
२. या व्यवहार क्षेत्रातील मराठी भाषेचे स्थान स्पष्ट करणे व त्यातील मराठीच्या प्रत्यक्ष वापराचा अभ्यास करणे.
३. विविध क्षेत्रीय मराठी भाषेच्या वापराची कौशल्ये विकसित करणे.
४. विविध लेखनप्रकारांचा अभ्यास व प्रत्यक्ष लेखनाची कौशल्ये वापरण्यास सक्षम करणे.
५. विविध क्षेत्रातील कर्तृत्ववान व्यक्तींच्या कार्याची व विचारांची ओळख करून देणे.
६. विद्यार्थ्यांमध्ये नैतिक, व्यावसायिक व वैचारिक मूल्यांची जोपासना करणे.

घटक	तपशील	श्रेयांक	तासिका
१	निबंध लेखन- वैचारिक, ललित आणि वाणिज्य विषयक	१	१५
२	अभ्यासपुस्तक : **उत्कर्षवाटा** शब्दालय प्रकाशन, श्रीरामपूर संपादक : प्रा. डॉ. शिरीष लांडगे, प्रा. डॉ. तुकाराम रोंगटे, प्रा. डॉ. राजेंद्र सांगळे	२	३०

विषयाचे नाव

उपयोजित मराठी (AECC – 2 A)

पहिले सत्र

अभ्यासक्रमाची उद्दिष्टे :

१ मराठी भाषा आणि साहित्य यांच्या परस्परसंबंधाची जाणीव करून देणे.
२ मराठी भाषेचा परिभाषासापेक्ष आणि शैलीसापेक्ष विकास विद्यार्थ्यांच्या लक्षात आणून देणे.
३ मराठी भाषेची उपयोजनात्मक कौशल्ये विकसित करणे.

घटक	तपशील	श्रेयांक	तासिका
१	१ भाषा आणि जीवनव्यवहार : भाषा म्हणजे काय? शास्त्रीय – व्यवहार – साहित्य - कार्यालयीन भाषा, प्रसारमाध्यमे आणि समाजमाध्यमे भाषा. २ अर्जलेखन : विनंती अर्ज, नोकरीसाठी अर्ज ३ संगणकीय अर्जलेखन : युनिकोडमधून मायक्रोसॉफ्ट वर्डमध्ये अर्ज. ४ स्व- परिचय	१	१५
२	१ प्रसारमाध्यमांसाठी लेखन : (कृषि, विज्ञान, तंत्रज्ञान, क्रीडाविषयक) १.१ वृत्तपत्रे : लेख लेखन १.२ नभोवाणी : भाषण लेखन १.३ चित्रवाणी : माहितीपटासाठी संहिता लेखन १.४ महाजाल : ब्लॉग लेखन १.५ नवसमाजमाध्यमांसाठी लेखन : फेसबुक, ट्विटर.	१	१५

संदर्भ ग्रंथ :

१ व्यावहारिक मराठी पाठ्यपुस्तक, पुणे विद्यापीठ प्रकाशन, पुणे.
२ व्यावहारिक मराठी- डॉ. कल्याण काळे व डॉ. द.दि.पुंडे.
३ व्यावहारिक मराठी- ल.रा.नसिराबादकर, फडके प्रकाशन, कोल्हापूर.

दुसरे सत्र

विषयाचे नाव – भाषा आणि कौशल्यविकास [११७]

(Ability Enhancement Course)

घटक	तपशील	श्रेयांक	तासिका
१	**अर्जलेखन व पत्रलेखन :** १. अर्जलेखन : अर्जाचे विविध नमुने - विनंती अर्ज, नोकरीसाठी अर्ज, माहितीच्या अधिकारातील अर्ज, संगणकीय अर्जलेखन– युनिकोडमधून मायक्रोसॉफ्ट वर्डमध्ये अर्ज. २. पत्रलेखन : खासगी पत्रव्यवहार, प्रशासनिक पत्रव्यवहार, व्यावसायिक पत्रव्यवहार, इ-मेल.	१	१५
२	**प्रशासनिक मराठी :** १. इतिवृत्त लेखन २. माहितीपत्रक ३. जाहीर निवेदन ४. वाणिज्य व माहिती तंत्रज्ञानविषयक पारिभाषिक संज्ञा	१	१५
३	**प्रगत भाषिक कौशल्ये :** १. सारांशलेखन २. भाषांतर- (इंग्लिश - मराठी) **जाहिरातलेखन :** १. आकाशवाणी २. वृत्तपत्र ३. दूरचित्रवाणी	१	१५

S. Y. B. Sc. (द्वितीय वर्ष विज्ञान)

विषयाचे नाव

मराठी साहित्य (AECC – 2 B)

दुसरे सत्र

अभ्यासक्रमाची उद्दिष्टे :

१. साहित्यविषयक अभिरूची विकसित करणे.
२. मराठी भाषा, साहित्य आणि यांच्या परस्परसंबंधाची जाणीव करून देणे.
३. साहित्यविषयक अभ्यासातून जीवनविषयक समज विकसित करणे.
४. विज्ञानसाहित्यविषयक आकलनक्षमता वाढविणे.

घटक	तपशील	श्रेयांक	तासिका
१	१ निबंध लेखन (वैचारिक, सामाजिक, विज्ञानविषयक) २ अभ्यासपुस्तक : **मराठी कथा दर्शन** संपादक प्रा. डॉ. शिरीष लांडगे, सुनिताराजे पवार, प्रा. डॉ. शांताराम चौधरी रुद्र प्रकाशन, पुणे	२	३०

संदर्भ ग्रंथ :

१ साहित्य अध्यापन आणि प्रकार, वा. ल. कुलकर्णी गौरव ग्रंथ, संपादक श्री. पु. भागवत, डॉ. सुधीर रसाळ.
२ कथा : संकल्पना आणि समीक्षा, सुधा जोशी, मौज प्रकाशन.
३ मराठी कथा : विसावे शतक, संपादक के. ज. पुरोहित, सुधा जोशी.
४ निबंध : शास्त्र व कला - डॉ. प्र. न. जोशी
५ निबंधलेखन - निर्मला किराणे.

Kopargaon Taluka Education Society's
K.J. Somaiya College of Arts, Commerce & Science,
Kopargaon, Dist. Ahmednagar.
B.C.A (Science) Department.

List of Courses addresses crosscutting issues as per Syllabus (2019 Pattern)

Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	BCA(SCI)	BCA 111	Fundamentals of Computer	Professional Ethics
2	BCA(SCI)	BCA 112	Problem Solving and C Programming	Professional Ethics
3	BCA(SCI)	BCA 113	Applied Mathematics	Professional Ethics
4	BCA(SCI)	BCA 114	Business Communication	Professional Ethics
5	BCA(SCI)	BCA 115	Fundamentals of Computer Laboratory	Professional Ethics
6	BCA(SCI)	BCA 116	C Programming Laboratory	Professional Ethics
7	BCA(SCI)	BCA 117	Applied Mathematics Laboratory	Professional Ethics
8	BCA(SCI)	BCA118	Business Communication Laboratory	Professional Ethics
9	BCA(SCI)	BCA121	Computer Organization	Professional Ethics
10	BCA(SCI)	BCA122	Advanced C Programming	Professional Ethics
11	BCA(SCI)	BCA123	Operating Systems Concepts	Professional Ethics
12	BCA(SCI)	BCA124	Database Management Systems – I	Professional Ethics
13	BCA(SCI)	BCA125	Computer Organization Laboratory	Professional Ethics
14	BCA(SCI)	BCA126	Advanced C Programming Laboratory	Professional Ethics
15	BCA(SCI)	BCA127	Operating Systems Laboratory	Professional Ethics
16	BCA(SCI)	BCA128	Database Management Systems -I Laboratory	Professional Ethics
17	BCA(SCI)	BCA231	Data Structures	Professional Ethics
18	BCA(SCI)	BCA232	Database Management Systems – II	Professional Ethics
19	BCA(SCI)	BCA233	Computer Networks	Professional Ethics
20	BCA(SCI)	BCA234	Data Structures Laboratory	Professional Ethics
21	BCA(SCI)	BCA235	Database Management Systems - II Laboratory	Professional Ethics
22	BCA(SCI)	BCA236	Computer Networks and Web Programming Laboratory	
23	BCA(SCI)	307	AECC-I Environmental Sciencel	Professional Ethics
24	BCA(SCI)	308	AECC-II Language Communication - I	Professional Ethics
25	BCA(SCI)	BCA241	Object Oriented Programming and C++	Professional Ethics
26	BCA(SCI)	BCA242	Web Technology	Professional Ethics
27	BCA(SCI)	BCA243	Software Engineering	Professional Ethics
28	BCA(SCI)	BCA244	C++ Programming Laboratory	Professional Ethics
29	BCA(SCI)	BCA245	Web Technology Laboratory	Professional Ethics
30	BCA(SCI)	BCA246	Python Programming Laboratory	Professional Ethics
31	BCA(SCI)	407	AECC-III Environmental Science-II	Professional Ethics
32	BCA(SCI)	408	AECC-IV Language Communication – II	Professional Ethics
33	BCA(SCI)	BCA351	DSE I (Programming in Java)	Professional Ethics

34	BCA(SCI)	BCA352	DSE II (Data Mining and Data Science)	Professional Ethics
35	BCA(SCI)	BCA353	DSE III (Principles of Operating Systems)	Professional Ethics
36	BCA(SCI)	BCA354	SEC I (Artificial Intelligence)	Professional Ethics
37	BCA(SCI)	BCA355	SEC II (Cloud Computing)	Professional Ethics
38	BCA(SCI)	BCA356	DSE I Lab (Programming in Java)	Professional Ethics
39	BCA(SCI)	BCA357	DSE II Lab (Data Mining)	Professional Ethics
40	BCA(SCI)	BCA358	DSE III Lab (Operating Systems and AI)	Professional Ethics
41	BCA(SCI)	BCA361	DSE IV Android Programming	Professional Ethics
42	BCA(SCI)	BCA362	DSE V Programming in GO	Professional Ethics
43	BCA(SCI)	BCA363	DSE VI Software Project Management	Professional Ethics
44	BCA(SCI)	BCA364	SEC III Management Information Systems	Professional Ethics
45	BCA(SCI)	BCA365	SEC IV Internet of Things (IoT)	Professional Ethics
46	BCA(SCI)	BCA366	DSE IV Lab (Android Programming)	Professional Ethics
47	BCA(SCI)	BCA367	DSE V Lab (Programming in GO and IoT)	Professional Ethics
48	BCA(SCI)	BCA368	DSE VI Project Lab	Professional Ethics

List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue(Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	BCA(SCI)	Web Programming	CC.004	2019-20	Professional Ethics

Head of Dept.
HOD
Dept.of BCA(Science)
K.J.Somaiya College,Kopargaon

IQAC coordinator
Co ordinator
IQAC, K. J. Somaiya College
Kopargaon, Dist. A.Nagar

Principal
Principal
K. J. Somaiya College of Arts
Commerce & Science, Kopargaon

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA111: Fundamentals of Computer

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: None

Companion Course: BCA115: Fundamentals of Computer Laboratory

Course Objectives:

- To study the basics of Computer System
- To learn how to configure computer devices
- To Learn Basic Commands of Operating system and application software
- To understand Open Source Software

Course Outcomes:

At the end of the course, students will be able to

- Define working of computers and peripherals, types of software and languages
- Troubleshoot the computer systems and use utility software
- Choose commands and features of operating systems and application software
- Use open source software

Course Contents

Unit I **Introduction to Computer System** **08 Hrs**

Introduction– Characteristics of Computers, Basic structure and operation of a computer, functional units and their interaction, Types of computers and features- Mini Computers, Micro Computers, Mainframe Computers, Super Computers, Laptops and Tablets,
Types of Programming Languages- Machine Languages, Assembly Languages, High Level Languages
Translators- Assembler, Compiler, Interpreter
Data Organization- Drives, Directories and Files
Number Systems - Introduction to Binary, Octal, Hexadecimal system, Conversion, Addition, Subtraction, Multiplication, Division

Unit II **Computer Peripherals** **08 Hrs**

Primary storage devices – RAM, ROM, PROM, EPROM

Secondary Storage Devices – HDD, CD, DVD, Pen drive

I/O Devices- Keyboards, Scanners, Digitizers, Plotters, LCD, Plasma Display,

Pointing Devices –Mouse, Joystick, Touch Screens

Introduction to Network devices – Hubs, Switches, Routers, NAS, MODEM, Access Points

Unit III **Computer Software** **08 Hrs**

Types of software: System Software, Application Software.

System Software: Operating System. Types of O.S., Basic Commands in Linux – ls, pwd

Introduction to GUI: Desktop Icons, File and Directory structure, Menu Items, Control Panel, File and Directory Search
Utility programs: Anti-plagiarism software, Anti-virus, Disk Cleaning, Defragmentation, Compression/Decompression of files.
Application software: Examples of commercial software with brief introduction

Unit IV **Editors, Word Processors, Spreadsheets & Presentation Tools** **08 Hrs**

Editors and Word Processors: Features and functionalities, examples of basic and advanced editors like notepad, vi and Emacs, Introduction to desktop publishing – Features and functionalities
Spreadsheets: Features and functionalities, Spreadsheet Applications
Introduction to Google Apps: Google Docs, Sheets and Forms and its applications
Presentation Tools: Design Slides (using Text, images, charts, clipart), Slide Animation, Template and theme creation

Unit V **Open Source Software** **08 Hrs**

Introduction: Open Source, Free Software, Free Software vs. Open Source software, Public Domain Software, Problems with traditional commercial software, Open Source Development Model and Licenses, History, Initiatives, Principles, methodologies and Philosophy
Open Source Operating Systems: GNU/Linux, Android, Free BSD, Open Solaris. Technologies, Development tools, IDEs, LAMP
Example Open Source Projects: Apache web server, GNU/Linux, Android, Mozilla (Firefox), Wikipedia, Drupal, Wordpress, GCC, github, Open Office.

Unit VI **PC Hardware & Trouble Shooting** **08 Hrs**

Introduction to Computer Hardware - Motherboard, CPU, Basic Input and Output Setting (BIOS), Network Interface Card (NIC), Graphics card
Logical Fault Isolation – ADJUST method, Common Networking Problems, Tools for gathering information, Troubleshooting PC hardware

Reference Books:

1. P.K. Sinha &Priti Sinha, "Computer Fundamentals", 3rd edition, BPB pub.
2. Sumitabha Das, "Unix Concepts and Applications", Tata McGraw Hill Education
3. Join Josh, "PC/HARDWARE" O'Reilly Publication.
4. Open Source Initiative: https://opensource.org/
5. Wikipedia: https://en.wikipedia.org/
6. Github: https://help.github.com/

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA112: Problem Solving and C Programming

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: None

Companion Course: BCA116 C Programming Laboratory

Course Objectives:

- To provide a broad overview of problem solving techniques
- To learn C programming to solve problems

Course Outcomes:

At the end of the course, students will be able to

- Define algorithms and explain their characteristics
- Formulate algorithm and draw flow chart to solve a given problem
- Explain use of appropriate data types, control statements
- Demonstrate ability to use top-down program design

Course Contents

Unit I	Problem solving, algorithms and flowcharts	08 Hrs

Types of Problems, Problem solving using computer, Difficulties with problem solving, Problem solving aspects.
Definition & Characteristics of algorithm, Examples of algorithms, Flow charts with examples, Top-down design
Problem solving using Arithmetic Statements, Conditional Statement & Iterative Statements such as Addition/Multiplication, check number is positive/negative, Maximum of 2 numbers & 3 numbers, sum of first n numbers, sum of given n numbers, reverse digits of a number, check whether the number is palindrome, check number is prime, factorial of number, factors of number, GCD, LCM of numbers etc.

Unit II	C Fundamentals	08 Hrs

Introduction to C, Features of C, Structure of C Program, C Character Set, Identifiers and Keywords, Variables and constants
Data types- Basic data types, Enumerated types, Type casting, Declarations,
Operators and Expressions Unary and Binary arithmetic operators, Increment Decrement operators
Relational and logical operators, Bit wise operators, Assignment operators, Comma operator, size of operator, Ternary conditional operator, Precedence and associativity

Unit III	Input Output Statements	08 Hrs

printf, scanf functions, getchar, putchar, getch functions, gets, puts functions, Escape sequence characters, Format specifiers

Unit IV	Control & Iterative Structures	08 Hrs

If, If- Else Statements, Nested If Statements, Conditional Branching – switch statement, Loop (while, do…while, for), break, continue, goto statements

Unit V	Functions	08 Hrs

Introduction to Functions, Function Arguments, Library & User defined functions, Methods for parameter passing, Recursion, Storage Classes – Auto, Static, Global and Register

Unit VI	Arrays	08 Hrs

Introduction, Array Declarations, Bounds Checking, Single dimension Arrays, Two dimension Arrays, Arrays & Function

Reference Books:

1. Cormen, Leiserson, Rivest, Stein, "Introduction to algorithms"
2. Brian W. Kernighan, Dennis M. Ritchie , "The C Programming Language", ISBN:9788120305960, PHI Learning
3. R.G. Dromey, "How to Solve it by Computer", ISBN: 9788131705629, Pearson Education
4. Behrouz A. Forouzan, RichardF. Gilberg, "A Structured Programming Approach Using C", ISBN:9788131500941, Cengage Learning India
5. E. Balaguruswamy, "Programming in ANSI C", ISBN: 9781259004612, Tata Mc-Graw Hill Publishing Co Ltd.-New Delhi
6. Maureen Spankle, "Problem Solving and Programming Concepts", ISBN: 81-317-0711-3
7. Y S Kanetkar, "Let Us C", BPB Publications

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA113: Applied Mathematics

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: Basic Mathematics

Companion Course: BCA117 Applied Mathematics Laboratory

Course Objectives:

- Learn basic terminology formal logic, proofs, sets, relations, functions and perform the operations associated with same
- Use formal logic proof and logical reasoning to solve problems
- To understand significance of statistical measures
- To study Correlation, Probability and sampling theory

Course Outcomes:

On completion of the course, students will be able to–

- Relate and apply techniques for constructing mathematical proofs and make use of appropriate set operations, propositional logic to solve problems
- Use function or relation models to interpret associated relationships
- Apply basic counting techniques and use principles of probability
- Given a data, compute various statistical measures of central tendency
- Use appropriate Sampling techniques

Course Contents

Unit I **Set Theory and Logic** **08 Hrs**

Sets– Set Theory, Need for Sets, Representation of Sets, Set Operations, cardinality of set, **Types of Sets** – Bounded and Unbounded Sets, Countable and Uncountable Sets, Finite and Infinite Sets, Countably Infinite and Uncountably Infinite Sets, power set, **Propositional Logic-** logic, Propositional Equivalences, Application of Propositional Logic-Translating English Sentences, Proof by Mathematical Induction and Strong Mathematical Induction.

Unit II **Relations and Functions** **08 Hrs**

Relations: Properties, n-ary Relations and Applications, Representing Relations , Closures of Relations, Equivalence Relations, Partial Orderings, partitions, Hasse Diagram, Lattices, Chains and Anti-Chains, Transitive Closure and Warshall's Algorithm

Functions- Surjective, Injective and Bijective functions, Inverse Functions and Compositions of Functions.

Unit III **Counting** **08 Hrs**

The Basics of Counting, rule of Sum and Product, Permutations and Combinations, Binomial Coefficients and Identities, Generalized Permutations and Combinations, The Pigeonhole Principle.

Unit IV **Data Presentation and Aggregation** **08 Hrs**

Data Types: attribute, variable, discrete and continuous variable, **Data presentation:** frequency distribution, histogram, ogive, box-plot, bar plots

Mean, Median, Mode, and Other Measures of Central Tendency: Arithmetic Mean (AM), Weighted Arithmetic Mean, Arithmetic Mean Computed from Grouped Data, Concept of Median, Mode, Geometric Mean (GM), Harmonic Mean (HM), Quartiles, Deciles, and Percentiles

Standard Deviation and Other Measures of Dispersion: Standard Deviation, Root Mean Square, Variance, Absolute and Relative Dispersion

Unit V **Correlation Theory and Sampling** **08 Hrs**

Moments, Skewness and Kurtosis: Moments, Computation of Moments for Grouped Data, Skewness, Kurtosis, Computation of Skewness and Kurtosis.

Correlation: Bivariate data, scatter plots, Linear Correlation, Correlation of Attributes, Coefficient of correlation

Linear regression: Concept, The Least-Squares Method, Regression Lines

Elementary Sampling Theory : Sampling Theory, Random Samples and Random Numbers, Sampling With and Without Replacement, Stratified Sampling

Unit VI **Probability & Hypothesis Testing** **08 Hrs**

Probability : Random experiment, sample space, events types and operations of events, Probability definition, Axioms (The four Elementary Theorems) of probability (without proof), Conditional probability, 'Bayes' theorem (without proof), Examples, Mathematical Expectations

Standard Distributions: Continuous and discrete, PDF/PMF, Introduction and properties (without proof) for binomial, normal, Standard Normal, chi-square, t, F distributions.

Introduction to Hypothesis testing

Reference Books:

1. Kenneth H. Rosen, Discrete Mathematics And Its Applications, Tata Mcgraw-Hill, Isbn 978-0-07-288008-3, 7th Edition.
2. Trivedi, K.S., " Probability, Statistics, Design Of Experiments And Queuing Theory, With Applications Of Computer Science", Prentice Hall Of India, New Delhi
3. C L Liu, "Elements Of Discrete Mathematics", Tata Mcgraw-Hill, Isbn 10:0-07-066913-9.
4. Kulkarni, M.B., Ghatpande, S.B. And Gore, S.D., "Common Statistical Tests" Satyajeet Prakashan, Pune
5. J.N. Kapur And H.C. Saxena, "Mathematical Statistics", S. Chand Publications, 20th Ed.
6. John P. D'angelo & Douglas B. West, "Mathematical Thinking–Problem Solving And Proofs" Prentice Hall, 2nd Ed.

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA114: Business Communication

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: Basic writing Skills including grammar

Companion Course: BCA118 Business Communication Laboratory

Course Objectives:

- To understand the concept, process and importance of communication.
- To develop an integrative approach where reading, writing, presentation skills are used together to enhance ability to communicate and write effectively.
- To create awareness about Methods and Media of communication.
- To improve job seeking skills.

Course Outcomes:

On completion of the course, students will be able to–

- Apply business communication strategies and principles to prepare effective communication for domestic and international business situations
- Identify ethical, legal, cultural, and global issues affecting business communication.
- Participate in team activities using collaborative work skills.
- Communicate via electronic mail, Internet, and other technologies.
- Deliver an effective oral business presentation

Course Contents

Unit I	Introduction to Communication	08 Hrs

Introduction to Communication, Meaning and Definition, Process of communication and importance, Principles of effective communication, Types of Communication, Scope of Business communication - Internal & External, Barriers to Communication, Linguistic Barriers, Psychological Barriers, Interpersonal Barriers, Cultural Barriers, Physical Barriers, Organizational Barriers , Overcoming the barriers

Verbal Communication - Written Communication-Advantages & Limitations (writing a Cover Letter, Memo, Agenda, Notice & Minutes), Oral Communication - Principles of effective oral communication - Techniques of effective speech, Media of oral communication (Face-to-face conversation - Teleconferences - Press Conference - Demonstration - Radio Recording - Dictaphone - Meetings - Demonstration and Dramatization - Public address system - Grapevine - Group Discussion - Oral report – Advantages and Limitations

Non-Verbal Communication - Body Language (Positive & Negative Gestures)handshakes, gazes, smiles, hand movements, styles of working, voice modulations, body sport for interviews; business etiquettes; business dining, business manners of people of different cultures, managing customer care

Unit II	Listening Skills	08 Hrs

Importance, Types of Listening, Barriers to Effective listening, Difference between listening and hearing – active listening, academic listening, listening for details - listening and note-taking, listening for sound contents of videos, listening to talks and descriptions, listening for meaning - listening to announcements (railway/ bus stations/ airport / stadium announcement etc.) ,Listening to Radio and Television, listening to news programmes, Tips for effective listening, 10 Commandments of listening

Unit III	Speaking and Presentation Skills	08 Hrs

Interactive nature of communication, importance of context ,formal and informal –set Expressions in different situations ,greeting – introducing - making requests - asking for /giving permission - giving instructions and directions – agreeing / disagreeing - seeking and giving advice - inviting and apologizing telephonic skills - conversational manners

Presentation as a skill - prerequisites of effective presentation, format of presentation; Assertiveness – indicators of assertive behaviour, strategies of assertive behavior; elements of presentation strategies – audience – objectives medium- key ideas - structuring the material - organizing content - audio-visual aids - hand-outs - use of power point - clarity of presentation - non-verbal communication -seminar paper presentation and discussion

Communication skills for group discussion and interviews

Unit IV	Business Correspondence	08 Hrs

Need of Business Correspondence , Components and layout of Business letter, Drafting of letters: Enquiry, Quotation, order , Complaints and follow up , Recovery , Email etiquette, notices, circulars, memos

Preparing agenda and writing minutes of meetings, Making notes on Business conversations

Effective use of SMS and Case writing and Documentation, Persuasive letter, Proposal, Report Writing

Preparing Press Release and Press Notes, Job application letter , Essentials of an impressive Resume

Unit V	Creativity and Capacity Building	08 Hrs

Creativity at Workplace: Introduction, Current Workplaces, Creativity, Motivation, Nurturing Hobbies at Work, The Six Thinking Hat Method Ethical Values: Ethics and Society, Theories of Ethics, Correlation between Values and Behavior, Nurturing Ethics, Importance of Work Ethics, Problems in the Absence of Work Ethics

Capacity Building: Learn, Unlearn and Relearn: Capacity Building, Elements of Capacity Building, Zones of Learning, Ideas for Learning, Strategies for Capacity Building

Unit VI	Soft Skills	08 Hrs

Leadership and Team Building: Leader and Leadership, Leadership Traits, Culture and Leadership, Leadership Styles and Trends, Team Building, Types of Teams,

Decision Making and Negotiation: Introduction to Decision Making, Steps for Decision Making, Decision Making Techniques, Negotiation Fundamentals, Negotiation Styles, Major Negotiation Concepts

Stress and Time Management: Stress, Sources of Stress, Ways to Cope with Stress

Reference Books:

1. McGrath, E.H., "Basic Managerial Skills for All", PHI, New Delhi
2. Gajendra S. Chauhan, Sangeeta Sharma, "Soft Skills: an Integrated Approach to Maximise Personality", Wiley India
3. Hamp-Lyons and etal, "Study Writing", 2nd Edition, Cambridge University Press, 2008.
4. Barun K. Mitra , "Personality Development and Soft Skills", Oxford Press
5. S.A. Sherlekar , "Modern Business Organization", Himalaya Publishing"

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA115: Fundamentals of Computers Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks End-Semester :35 Marks

Companion Course: BCA111: Fundamentals of Computers

Course Objectives:

- To understand installation process to install operating system and applications
- To learn various features of application software

Course Outcomes:

On completion of the course, students will be able to–

- Install operating system and execute various commands
- Effectively use various features of application software
- Create and use spreadsheets effectively
- Prepare effective Presentation

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign
Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Topics for Laboratory Assignments

Sr. No.	Assignment
1	Operating System Commands
2	Spreadsheet
3	Presentation Tool
4	Utility programs, anti-plagiarism software etc
5	Word Processing using Open Office
6	Google Apps, Wordpress, Drupal, Wiki, Github etc

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA116: C Programming Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks
		End-Semester :35 Marks

Companion Course: BCA112 Problem Solving & C Programming

Course Objectives:

- To learn formulation of algorithm for a given problem
- To study various data types, arrays and functions in C
- To understand input-output and, control and iterative statements in C

Course Outcomes:

On completion of the course, students will be able to–

- Formulate an algorithm and draw flowchart for the given problem
- Implement the given algorithm in C
- Write programs using appropriate data types and control structures in C

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign
Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints.

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Sr. No.	Assignment
1	Assignment on use of data types, simple operators (expressions)
2	Assignment on decision making statements (if and if-else, nested structures)
3	Assignment on decision making statements (switch case)
4	Assignment on use of while loops
5	Assignment on use of for loops
6	Assignment on nested loops
7	Assignment on exit, goto, continue, break
8	Assignment on menu driven programs.
9	Assignment on writing C programs in modular way (use of user defined functions)
10	Assignment on call by value
11	Assignment on call by reference
12	Assignment on recursive functions
13	Assignment on use of arrays (1-D array) and functions
14	Assignment on use of multidimensional array (2-D arrays) and functions
15	Assignment on Standard Library Function

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA117: Applied Mathematics Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks
		End-Semester: 35 Marks

Companion Course: BCA113 Applied Mathematics

Course Objectives:

- To provide knowledge about applying theoretical concepts of applied mathematics and statistics to solve problems
- To provide hands-on experience on statistical package

Course Outcomes:

On completion of the course, student will be able to

- Apply mathematical and statistical concepts to solve problems
- Use R to perform statistical operations and data visualization

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Suggested List of Laboratory Assignments

Applied Mathematics: 2 Assignments each based on following topics

1	Set Theory
2	Logic, Mathematical Induction
3	Relations
4	Functions
5	Counting

Statistics (Assignments may be performed using R)

1	Download and Install R, understand IDE
2	Using R execute the basic commands, array, list and frames.
3	Create a Matrix using R and Perform the operations addition, inverse, transpose and multiplication operations.
4	Using R Execute the statistical functions: mean, median, mode, quartiles, range, inter quartile range histogram
5	Using R, drawing scatter Plots, Line Plots, Bar Plots etc
6	Using R import the data from Excel / .CSV file and Perform operations
7	Using R import the data from Excel / .CSV file and Calculate the standard deviation,
8	Using R import the data from Excel / .CSV file and draw the skewness
9	Import the data from Excel / .CSV and perform the Chi-squared Test.

References:

- Richard Cotton, "Learning R", SPD O'Reilly Publications

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA118: Business Communication Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks
		End-Semester: 35 Marks

Companion Course: BCA114 Business Communications

Course Objectives:

- To study different ways for effective listening, writing, reading and presentation
- To learn tools used in business communication

Course Outcomes:

On completion of the course, student will be able to

- Effectively listen to lectures, public announcements and news on TV and radio.
- Engage in telephonic conversation.
- Communicate effectively and accurately in English
- Use spoken language for various purposes
- Demonstrate ability to prepare documents used in business correspondence

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Suggested List of Laboratory Assignments

1	Listening Comprehension Exercise
2	Reading Comprehension & Vocabulary Exercise
3	Role Play I
4	Telephone Conversation
5	Face to Face Conversation
6	Introducing Yourself
7	Thumbnail Portrait
8	Writing Skills - Covering Letter, Resume , Application letter, Report Writing, Proposal Writing ,Email Communication
9	Presentation Skills
10	Group Discussions
11	Mock Interviews
12	Public Speaking activity
13	Leadership Skills and Team Building Activity

References:

- D. Sudha Rani , "Business Communication and Soft Skills Laboratory Manual"

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA121: Computer Organization

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA111 Fundamentals Of Computer

Companion Course: BCA125: Computer Organization Laboratory

Course Objectives:

- To study number system, logic gates
- To understand combinational and sequential circuits
- To provide a broad overview of architecture and functioning of computer systems
- To learn the basic concepts behind the architecture and organization of computers.

Course Outcomes:

On completion of the course, student will be able to–

- Design of combinational circuits
- Design of sequential circuits
- Explain block diagram of CPU, Memory and types of I/O transfers

Course Contents

Unit I	Data representation and Computers Arithmetic	08 Hrs

Review of Decimal, Binary, Octal, Hexadecimal Number system and their inter-conversion, BCD code, Gray code, Excess-3 code, ASCII , EBCDIC, Unicode, Concept of parity code. Signed and Unsigned numbers, 1's and 2's complement of binary numbers, Binary arithmetic (Addition, subtraction and subtraction using1's complement and 2's complement).

Unit II	Boolean Algebra & Logic Gates	08 Hrs

Introduction, Logic (AND OR NOT), Boolean theorems, Boolean Laws, De Morgan's Theorem, Reduction of Logic expression using Boolean Algebra, Deriving Boolean expression from given circuit, exclusive OR and Exclusive NOR gates, Universal Logic gates, Implementation of other gates using universal gates

Minterm, Maxterm and Karnaugh Maps:

Introduction, minterms and sum of minterm form, maxterm and Product of maxterm form, Reduction technique using Karnaugh maps – 2/3/4 variable K-maps, Grouping of variables in K-maps, K-maps for product of sum form, minimize Boolean expression using K-map and obtain K-map from Boolean expression

Unit III	Combinational Circuits	08 Hrs

Introduction - Multi-input, multi-output Combinational circuits, Code converters design and implementations

Arithmetic Circuits: Introduction, Adder, BCD Adder, Excess – 3 Adder, Binary Subtractors, BCD Subtractor, Multiplier, Comparator

Multiplexer, Demultiplexer, ALU, Encoder and Decoder: Introduction, Multiplexer, De-multiplexer, Decoder, ALU, Encoders

Unit IV	Sequential circuits	08 Hrs

Introduction, Terminologies used, S-R flip-flop, D flip-flop, JK flip-flop, Race-around condition, Master – slave JK flip-flop, T flip-flop, conversion from one type of flip-flop to another, Application of flip-flops.

Counters:

Introduction, Asynchronous counter, Terms related to counters, IC7493 (4-bit binary counter), Synchronous counter, Bushing, Type T Design, Type JK Design, Pre-settable counter, IC 7490, IC 7492,

Synchronous counter ICs, Analysis of counter circuits.

Shift Register:

Introduction, parallel and shift registers, Ring counter, Johnson counter

Unit V	CPU, Memory and I/O Organization	08 Hrs

Block diagram of CPU, functions of CPU, general register organization, flags, Concept of RISC and CISC, Introduction to hardwired and micro-programmed CPU.

Memory System hierarchy, Cache Memory, Internal Memory, External Memory, Concept of Virtual Memory.

Input/ Output: types of I/O data transfers - CPU initiated, Interrupt initiated and DMA, Need of I/O interfaces, Parallel and serial communication (asynchronous and synchronous data transfer).

Unit VI	Introduction to Microprocessors and Microcontrollers	10 Hours

Block diagram of Pentium, Functional units, Concept of pipeline and parallelism, Programmers model

Introduction to Microcontroller Intel 8051 – Functional block diagram, Introduction to multi-core processors.

Reference Books:

1. R.P. Jain, "Modern Digital Electronics", McGraw-Hill Publications
2. Flod and Jain, "Digital Fundamentals", Pearson Publication.
3. Morris Mano, "Computer System Architecture" Prentice-Hall.

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA122: Advanced C Programming

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA112: Problem Solving and C Programming

Companion Course: BCA126: Advanced C Programming Laboratory

Course Objectives:

- To learn advanced features in C Programming
- To study advanced data types
- To understand built-in library functions

Course Outcomes:

On completion of the course, student will be able to–

- Write programs using pointers, structures and unions
- Use Pre-processor directives
- Manipulate strings using library functions
- Write programs to perform operations on Files

Course Contents

Unit I	Preprocessor	08 Hrs

Concept, Format of preprocessor directives, File inclusion directives (#include), Macro substitution directives (#define), nested macros, parameterized macros,

Macros versus functions, #error / #pragma directives, Conditional compilation (#if/#ifdef/#else/#elif/#endif), Predefined macros (_DATE_ / _TIME_ /_FILE_ /_LINE_ /_STDC_)

Unit II	Pointers	08 Hrs

Concept – reference & dereference, Declaration, definition, initialization & use, Types of pointers,

Pointer Arithmetic, Multiple indirection,

parameter passing – call by value and call by reference

Arrays & Pointers - Pointer to array, Array of pointers,

Functions & pointers - Passing pointer to function, Returning pointer from function, Function pointer, Pointers &const

Dynamic memory management, Allocation, Resizing, Releasing, Memory leak / dangling pointers

Unit III	Strings	08 Hrs

Concept, Declaration, definition, initialization, format specifiers, String literals/ constants & variables – reading & writing from & to console, Importance of terminating NULL character, Strings & pointers

Array of strings & array of character pointers, User defined functions, predefined functions in string.h - strlen , strcpy , strcat , strcmp , strcmpi , strrev , strlwr , strupr , strset , strchr , strrchr , strstr , strncpy , strncat , strncmp , strncmpi , strnset , strtok, Command line arguments – argc and argv

Unit IV	Structures	08 Hrs

Concept, Declaration, definition, initialization, accessing structure members (. operator), Array of structures, Pointers to structures, Declaring pointer to structure
Accessing structure members via pointer to structure, Structures & functions,
Passing each member of structure as a separate argument, Passing structure by value / address
Nested structures, typedef & structures,

Unit V	Advanced Features	08 Hrs

Unions - Concept, Declaration, definition, accessing union members, Difference between Structures & unions, structures within union, union within structures, pointers and unions, nested unions, enumerated data types, Bit fields, Concept, need, use, multi-file programs

Unit VI	File Handling	08 Hrs

Concept of streams, need, Types of files, Operations on text & binary files, Random access file, library functions for file handling – fopen, fclose, fgetc, fseek, fgets, fputc etc

Reference Books:

1. The C Programming Language (Second Edition) – By B. W. Kerninghan& D. M. Ritchie
2. Programming in C – A Practical Approach – By Ajay Mittal (Pearson Publications)
3. Programming with C – By Byron S Gottfried (Schaum's Outlines)
4. A structural Programming Approach using C – By BehrouzForouzan& Richard Gilberg
5. Y S Kanetkar, "Let Us C", BPB Publications

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA123: Operating Systems Concepts

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA111 Fundamentals of Computers

Companion Course: BCA127 Operating Systems Laboratory

Course Objectives:

- To Understand the basic concepts of operating system
- To study Architecture, File systems and basic operating system commands
- To Use of editors and Networking commands.
- To learn Shell Programming and shell scripts.

Course Outcomes:

On completion of the course, student will be able to–

- explain basic concepts of operating system
- use basic Linux commands and Linux documentation
- write shell scripts

Course Contents

Unit I	Introduction	08 Hrs

Introduction to Operating Systems, Different services provided by Operating System to Users.

Introduce the concept of Process, Process States, Process Control Block, User Interface, System Calls.

Introduction to Linux Operating System - Features of Linux, Architecture of the Linux, Introduction to File System and Process Environment.

Working with Linux - The login prompt, General features of commands/ command structure, Command arguments and options.

Understanding of some basic commands such as echo, printf, ls, who, date, passwd, cal, Combining commands

Unit II	Commands & Processes	08 Hrs

What is a Command?, Meaning of Internal and external commands, The type command: knowing the type of a command and locating it, The man command knowing more about commands and using Linux online manual pages. The man with keyword option and whatis

Operating system Processes - Concept, Mechanism of process creation, Parent and child process, The ps command with its options, Executing a command at a specified point of time: at command.

The nice command, Background processes. The bg and fg commands, The kill command, The find command with illustrative example.

Unit III	File System	08 Hrs

Linux files - Naming files. Basic file types, Organization of files. Standard directories, Parent child relationship, The home directory and the HOME variable.

The PATH variable, manipulating the PATH, Relative and absolute pathnames, Directory commands – pwd, cd, mkdir, rmdir commands, The dot (.) and double dots (..) notations to represent present and parent directories and their usage in relative path names

File related commands – cat, mv, rm, cp, wc and od commands, File attributes and permissions and knowing them, The ls command with options, Changing file permissions: the relative and absolute permissions changing methods

Unit IV	Using Shells and Vi Editor	08 Hrs

What is Shell? Different types of shells, The shells interpretive cycle, Wild cards and file name generation, Removing the special meanings of wild cards, Three standard files and redirection,

Connecting commands: Pipe, The grep, egrep commands. .

Vi Editor - Introduction to the Vi editor, Different ways of invoking and quitting vi, Different modes of vi, Input mode commands, Command mode commands, The ex mode commands, Illustrative examples Navigation commands

Unit V	Security & Networking	08 Hrs

Security Understanding Linux Security, Uses of root, pseudo command, working with passwords, Bypassing user authentication, Understanding ssh

Networking Basic introduction to Networking, Network protocols: http, ftp etc., IP address, DNS

Unit VI	Shell Scripts	08 Hrs

Shell programming - Ordinary and environment variables, The .profile. Read and read only commands, Command line arguments, exit and exit status of a command, Logical operators for conditional execution, The test command and its shortcut.

The if, while, for and case control statements, The set and shift commands and handling positional parameters, The here (<<) document and trap command, Simple shell program examples.

File inodes and the inode structure, File links – hard and soft links. Filters, Head and tail commands.

Cut and paste commands, The sort command and its usage with different options

Reference Books:

1. Unix Concepts and Applications by Sumitabha Das.
2. Operating System Concepts - Siberchatz, Galvin, Gagne (8th Edition)
3. UNIX and Shell Programming, Behrouz A. Forouzan, Richard F. Gilberg : Cengage Learning – India Edition. 2009.
4. Linux Command Line and Shell Scripting Bible, Richard Blum , Christine Bresnahan, 2ndEdition , Wiley,2011

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA124: Database Management Systems – I

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hours/Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA113 Applied Mathematics

Companion Course: BCA128: Database Management Systems – I Laboratory

Course Objectives:

- To understand the fundamental concepts of database management such as database design, database languages, and database-system implementation
- To study and understand systematic database design approaches
- To learn SQL – the database Query language

Course Outcomes:

On completion of the course, student will be able to–

- Design E-R Model for given requirements and convert the same into database tables.
- Formulate database queries using SQL
- Design a database in appropriate normal form

Course Contents

Unit I	File Organization	08 Hrs

Introduction, Physical / logical files, Record organization (fixed, variable length) Types of file organization(heap, sorted, indexed, hashed)

Unit II	Introduction of DBMS	08 Hrs

Overview, File system Vs. DBMS, Describing & storing data (Data models - relational, hierarchical, network), Levels of abstraction, Data independence, Structure of DBMS, Users of DBMS, Advantages of DBMS

Unit III	Conceptual Design (E-R model)	08 Hrs

Overview of DB design
ER data model (entities, attributes, entity sets, relations, relationship sets)
Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization), Case studies

Unit IV	Structure of Relational Databases	08 Hrs

Concepts of a table, a row, a relation, a tuple and a key in a relational database
Conversion of ER to Relational model
Integrity constraints (primary key, referential integrity, Null constraint, unique constraint, check constraint)

Unit V	SQL	08 Hrs

Introduction, DDL commands (create, drop, alter) with examples, Basic structure of SQL query, Set operations, Aggregate functions, Null values, Nested Sub-queries, Modifications to Database (insert, delete, update),
SQL mechanisms for joining relations (inner joins, outer joins and their types)
Examples on SQL (case studies)

Unit VI	Relational Database Design	08 Hrs

Pitfalls in Relational-Database Design (undesirable properties of a RDB design like repetition, inability to represent certain information)
Functional dependencies (Basic concepts, Closure of set of functional dependencies, Closure of an Attribute set)
Concept of a Super Key and a primary key (Algorithm to derive a Primary Key for a relation)
Concept of Decomposition, Desirable Properties of Decomposition (Lossless join and Dependency preservation)
Concept of Normalization - Normal forms (only definitions) 1NF, 2NF, 3NF, BCNF
Examples on Normalization

Reference Books:

1. Henry F. Korth, Abraham Silberschatz, S. Sudarshan, "Database System Concepts", Tata McGraw-Hill Education
2. Raghu Ramakrishnan and Johannes Gehrke, "Database Management Systems", McGraw-Hill

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA125: Computer Organization Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks End-Semester :35 Marks

Companion Course: BCA121 Computer Organization

Course Objectives:

- To study architecture and functioning of computer systems
- To learn the basic concept behind the architecture and organization of computers

Course Outcomes:

On completion of the course, student will be able to–

- Design and implement combinational circuits
- Design and implement sequential circuits
- Translate real world problems into digital logic formulations

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign
Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Suggested Topics for Laboratory Assignments

1	Study of Logic gates and their ICs and universal gates
2	Implement code converters
3	Implement Adder and Subtractor Arithmetic circuits
4	Design and implement combinational circuit based on the problem given and minimizing using K-maps
5	Implement Encoder and Decoder and Multiplexer and De-multiplexers
6	Study of flip-flops and counters Memory Organization
7	Study of counter ICs and designing Mod-N counters

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA126: Advanced C Programming Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks End-Semester :35 Marks

Companion Course: BCA122 Advanced C Programming

Course Objectives:

- To learn advanced features in C Programming
- To study advanced data types
- To understand built-in library functions

Course Outcomes:

On completion of the course, student will be able to–

- Write programs using pointers, structures and unions
- Use Pre-processor directives
- Manipulate strings using library functions
- Write programs to perform operations on Files

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign
Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Sr. No.	Assignment
1	To demonstrate use of preprocessor directives
2	To demonstrate use of pointers
3	To demonstrate advanced use of pointers
4	To demonstrate concept of strings, array of strings
5	To demonstrate string operations using pointers
6	To demonstrate command line arguments
7	To demonstrate structures (using array and functions)
8	To demonstrate nested structures and Unions
9	To demonstrate use of bitwise operators.
10	To demonstrate file handling

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA127: Operating Systems Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks End-Semester :35 Marks

Companion Course: BCA123 Operating Systems Concepts

Course Objectives:

- To provide hands-on knowledge for
  - Installation of Linux and Packages
  - Setting environment, use documentation, commands and editors
  - Configure Security and Network environment

Course Outcomes:

On completion of the course, student will be able to–

- Install Linux and packages, configure environment
- Use commands and editors and use documentation
- Configure Security and network environment

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign
Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference one or two journals may be maintained with program prints

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Suggested List of Laboratory Assignments

1 Linux Installation:
a. Install your choice of Linux distribution e.g. Ubuntu, Fedora, Debian.
b. Try different installation media like CD/DVD, USB Drive to install.
c. Customize desktop environment by changing different default options like changing default background, themes, screensavers.

2 a. Screen Resolution: Ascertain the current screen resolution for your desktop.
b. Networking: Get the current networking configuration for your desktop. Are you on a wired or a wireless connection? What wireless networks are available, if any?
c. Time Settings Change the time zone of your system. After noting the time change, change the time zone back to your local time zone

3 Installing and Removing Software:
a. Install gcc package, run the package and remove it.

4 Documentations:
a. Finding Info Documentation: From the command line: bring up the info page for say "sed" command. Study the usage section.
b. Finding man pages From the command line: Bring up the man page for the 'ls' command. Study the EXAMPLES section.
c. Finding man pages by the given Topic, by the given Section
d. From the command line, bring up the man page for the given library function
e. Study of Command-Line Help

5 Command line operations:
a. Find the passwd file in / using find command
b. Create a symbolic link to the file you found
e. Create a file say, xyz.txt and move it in /tmp directory using relative pathname.
f. Delete the file moved to /tmp in previous step using absolute path.
g. Find the location of ls. ps. bash commands.

6 File Operations:
a. Explore mounted file systems on your system using different ways
b. Archive and backup your home directory using tar, gzip commands.
d. Use dd command to create files and explore different options to dd.
e. Use diff command to create diff of two files.
f. Use patch command to patch a file. Analyze the patch using diff command again.

7 User environment
a. Find in which account are you logged in?
b. Display /etc/shadow file using cat and understand the importance of shadow file. How it's different than passwd file?
c. Get you current working directory.
d. Explore different ways of getting command history, how to run previously executed command without typing it?
e. Create alias to most commonly used commands

8. Using Linux Editors: vim/emacs
a. Create, modify, search, navigate a file in editor.
b. Learn all essential commands such as search, search/replace, highlight, show line

9. Linux Security:
a. Use of sudo to change user privileges to root
b. Identify all operations that require sudo privileges
c. Create a new user and add it to sudo configuration file.
d. Set password for new user.
e. Modify the expiration date for new user using password ageing.
f. Delete newly added user.

10. Network:
    a. Get IP address of your machine using ifconfig.
    b. If IP is not set, then assign an IP address according to your network settings.
    c. Get hostname of your machine.
    d. Use ping to check the network connectivity to remote machines.
    e. Use telnet/ssh to connect to remote machines and learn the difference between the two.
11. Shell Scripting
    a. Searching with grep: Search for your username in the /etc/passwd file.
    b. Parsing files with awk: Display in a column a unique list of all the shells used for users in /etc/passwd. Which field in /etc/passwd holds the shell (user command interpreter in the manual page)? How do you make a list of unique entries, that is, no repeated entries?
    c. Searching and substituting with sed: Search all instances of the user command interpreter (shell) equal to /bin/false in /etc/passwd and substitute with /bin/bash using sed.
    d. Exit status: write a script which does ls to a non existent file. Display an exit status of the previous command. Now create the file and again display the exit status. In each task send the ls output to /dev/null
    e. Working with files: Write a shell script which will ask user for a directory, create that directory and switch to it and tell the user where you are using pwd command. Now use touch to create some new files followed by displaying the filenames.

Savitribai Phule Pune University
First Year of Computer Applications (2019 Course)
BCA128: Database Management Systems – I Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 03 Hrs/Week	1.5	Continuous Evaluation: 15 Marks End-Semester :35 Marks

Companion Course: BCA124: Database Management Systems – I

Course Objectives:

- To learn design of E-R diagrams
- To prepare and execute database queries

Course Outcomes:

On completion of the course, student will be able to–

- Prepare E-R Diagram for the given problem statement
- Formulate appropriate SQL DDL Queries
- Formulate appropriate SQL DML Queries

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

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Sr. No.	Assignment
1	Case study – ER diagram
2	Case study – ER diagram (with generalization)
3	Case study – ER diagram (with aggregation)
4	Using PostgreSQL (demo of PostgrSQL)
5	Data Definition queries (Create)
6	Data Definition querie (Alter)
7	Data Definition queries (Drop)
8	SQL DML Select queries

9	Queries using joins
10	Aggregate Functions and Group by and Having Clauses
11	Nested Queries
12	Data Manipulation queries (Insert)
13	Data Manipulation queries (Delete)
14	Data Manipulation queries (Update)

SEMESTER III

BCA231: Data Structures

Teaching Scheme:	Credits	Examination Scheme:
Theory: 05 Hrs./Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA 112 and BCA 122

Companion Course: BCA234: Data Structures Laboratory

Course Objectives:

- To understand algorithms and analysis of algorithms
- To learn static and dynamic data structures.

Course Outcomes:

After successful completion of this course, learner will be able to

- Apply appropriate data structures for the given problem.
- Design an efficient algorithm for the given problem.
- Determine the time and space complexity of a given algorithm.

Course Contents

Unit I — **Introduction to data structure** — **06Hrs.**

- **Data types and data objects**
- **Abstract Data Types (ADT)**
- **Data structure**
- **Algorithm analysis**: Frequency counts, Space and Time complexity, Asymptotic notation : BigO, Omega (Ω)
- **Algorithms and its complexity** using simple example algorithms

Unit II — **Arrays** — **06 Hrs.**

- **Introduction and definition**
- **Matrix representation using arrays:** Row and column major, operations on matrices, Sparse Matrix
- **Sorting techniques with time complexity:** Bubble sort, Insertion sort, Merge sort, Quick sort
- **Searching techniques with time Complexity**: Linear search, Binary search

Unit III — **Linked Lists** — **12Hrs.**

- **Introduction and Definition**
- **Representation**: Static &Dynamic
- **Types of linked lists**: singly, doubly, circular
- **Operations on link list:** create, display, insert, delete, reverse, search, sort, concatenation, Merge
- **Real world applications of Link list (implementation not expected)**

Unit IV — **Stacks and Queues** — **12Hrs.**

- **Representation of Stack**: Using arrays and Linked Lists
- **Operations on stack**: push, pop
- **Applications of Stack** : Recursion, Infix to postfix, postfix to infix
- **Representation of Queues :** Static & Dynamic

- **Operations on queue:** insert, delete
- **Types of queue:** Circular queue and Priority queue
- **Real world Applications of queue (Implementation not expected)**

Unit V	Trees	12 Hrs.

- **Introduction and Tree terminologies:** Definitions: Tree, root, child, leaf, level, height, depth
- **Binary trees:** Types: Rooted, full, complete and skewed.
- **Representation of Trees:** Using arrays and Linked Lists
- **Types of Traversal:** Preorder, Inorder, Postorder, Applications of Binary trees
- **Binary Search Tree (BST):** Introduction and definition

Unit VI	Graphs	12 Hrs.

- **Introduction and Graph terminologies**
- **Representation of a Graph –** Adjacency matrix, Adjacency list, Adjacency multi-list
- **Graph Traversals –** DFS, BFS
- **Applications of graphs -** Topological sort

Reference Books

1. Fundamentals of Data Structures-Horowitz Sahani (Galgotia)
2. Introduction to Data Structures using C-Ashok Kamthane
3. Data Structures using C-Bandopadhyay &Dey(Pearson)
4. Data Structures using C-By Srivastava BPB Publication

E-Books

1)Data Structure Using C – By Balagurusamy
https://books.google.co.in/books?id=nB_ZAgAAQBAJ&printsec=frontcover&dq=data+structures+ebook&hl=en&sa=X&ved=0ahUKEwjNwd_Ki6LpAhXVH7cAHfbrAgkQ6AEIJzAA#v=onepage&q&f=false
2) Data Structures and Algorithms - Gavpai
https://books.google.co.in/books?id=Vx_rKhsmEr8C&printsec=frontcover&dq=data+structures+ebook&hl=en&sa=X&ved=0ahUKEwjNwd_Ki6LpAhXVH7cAHfbrAgkQ6AEINzAC#v=onepage&q&f=false
3) Classic Data Structures – Debasis Samanta
https://books.google.co.in/books?id=law2E-LPSclC&printsec=frontcover&dq=data+structures+ebook&hl=en&sa=X&ved=0ahUKEwjNwd_Ki6LpAhXVH7cAHfbrAgkQ6AEIYTAH#v=onepage&q&f=false

SEMESTER III

BCA232 : Database Management Systems – II

Teaching Scheme:		Examination Scheme:
Theory: 05 Hrs./Week	Credits 04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Prerequisite Courses: BCA – 124

Companion Course : BCA235 Database Management Systems-II Laboratory

Course Objectives:

- To understand advanced SQL features and procedural SQL.
- To study concurrency control and crash recovery techniques.
- To understand need of database security.
- To learn different database system architectures.

Course Outcomes: After successful completion of this course, learner will be able to

- Formulate SQL queries using advanced SQL features.
- Perform Database operations using PL/PostgreSQL.
- Compare and contrast different concurrency control and recovery techniques.
- Apply mechanisms for database security.
- Analyze various database system architectures.

Course Contents

Unit I	Relational Database Design	16 Hrs

1.1. PL/Postgre SQL: Language structure
1.2. Controlling the program flow, conditional statements, loops
1.3. Views
1.4. Functions
1.5. Handling errors and exceptions
1.6. Cursors
1.7. Triggers

Unit II	Transaction Concepts	8 Hrs

2.1 Transaction, properties of transaction, states of transactions
2.2 Concurrent execution of transactions and conflicting operations
2.3 Schedules, types of schedules, concept of serializability, precedence graph for serializability

Unit III	Concurrency Control	12Hrs

3.1 Ensuring serializability by locks, different lock modes
3.2 2PLand its variations
3.3 Multiple Granularity locking protocol
3.4 Basic timestamp method for concurrency, Thomas Write Rule
3.5 Locks with multiple granularity, dynamic database concurrency (Phantom Problem)
3.6 Timestamps versus locking
3.7 Optimistic concurrency control algorithm, multi version concurrency control
3.8 Deadlock handling methods -
3.8.1 Detection and Recovery (Wait for graph).
3.8.2 Prevention algorithms (Wound-wait, Wait-die)
3.8.3 Deadlock recovery techniques(Selection of Victim, Starvation, Rollback)

Unit IV	Crash Recovery	12 Hrs

4.1 Transaction Failure classification
4.2 Recovery concepts
4.3 Checkpoints
4.4 Recovery with concurrent transactions (Rollback, checkpoints, commit)
4.5 Log base recovery techniques (Deferred and Immediate update)
4.6 Buffer Management
4.7 Database backup and recovery from catastrophic failures
4.8 Shadow paging

Unit V	Database Security	06 Hrs

5.1 Introduction to database security concepts
5.2 Methods for database security
5.3 Discretionary access control method
5.4 Mandatory access control and role based access control for multilevel security
5.5 Use of views in security enforcement
5.6 Overview of encryption technique for security
5.7 Statistical database security

Unit VI	Database System Architectures	06 Hrs

6.1 Centralized and Client – Server Architectures
6.2 Server System Architectures
6.3 Introduction to Parallel Systems
6.4 Introduction to Distributed Systems
6.5 Introduction to Object Based Databases

Books:

1. Database System Concepts – Abraham Silberschatz, Henry F. Korth, S. Sudarshan, 6th edition- McGraw-Hill
2. Fundamentals of Database Systems- Ramez Elmasri, Shamkant B. Navathe, 6th edition– Pearson.
3. Database Management Systems -Raghu Ramakrishnan, Johannes Gehrke, 3rd edition, Tata McGraw Hill
4. Introduction to Database Management System- Bipin Desai, 3rd edition, Galgotia Publication
5. An Introduction to Database Systems - C.J. Date, 7th edition, Addison-Wesley
6. Practical PostgreSQL- Joshua D. Drake, John C Worsley, O'Reilly Publications

E-Books

1) Fundamentals of Relational Database Management System – S. Sumathi S. Esakkirajan
https://books.google.co.in/books?id=RjnNA0GW0wsC&printsec=frontcover&dq=Relational+Database+Management+System+ebook&hl=en&sa=X&ved=0ahUKEwi3ubfgkKLpAhXWxzgGHY2oCv8Q6AEIKjAA#v=onepage&q=Relational%20Database%20Management%20System%20ebook&f=false
2)Introduction to Database Management System – Dr. Satinder Bal Gupta, Aditya Mittal
https://books.google.co.in/books?id=NGISs8YFs3EC&printsec=frontcover&dq=Relational+Database+Management+System+ebook&hl=en&sa=X&ved=0ahUKEwi3ubfgkKLpAhXWxzgGHY2oCv8Q6AEINDAB#v=onepage&q&f=false
3) Database Management System – P.S.Gill
https://books.google.co.in/books?id=mK4COraJvIIC&printsec=frontcover&dq=Relational+Database+Management+System+ebook&hl=en&sa=X&ved=0ahUKEwi3ubfgkKLpAhXWxzgGHY2oCv8Q6AEITjAE#v=onepage&q&f=false
4)Database Management System – Monelli Ayyavaraiah, Arapalli Gopi
https://books.google.co.in/books?id=BaZjDwAAQBAJ&printsec=frontcover&dq=Relational+Database+Management+System+ebook&hl=en&sa=X&ved=0ahUKEwi3ubfgkKLpAhXWxzgGHY2oCv8Q6AEIRTAD#v=onepage&q&f=false

SEMESTER III

BCA233:Computer Networks

Teaching Scheme: **TH: 05 Hours/Week**	**Credit 04**	**Examination Scheme:** **Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Prerequisite Courses: BCA-111 & BCA-121

Companion Course: BCA – 236 Computer Networks and Web Programming Lab

Course Objectives:

- To understand the fundamental concepts of networking standards, protocols and technologies.
- To study different techniques for framing, error control, flow control and routing.
- To learn role of protocols at various layers in the protocol stacks.
- To develop an understanding of modern network architectures from a design and performance perspective

Course Outcomes: After successful completion of this course, learner will be able to-

- Analyze the requirements for a given organization and select appropriate network architecture, topologies, transmission mediums and technologies.
- Analyze data flow between TCP/IP model using Application, Transport and Network Layer Protocols.
- Illustrate applications of Computer Network.
- Compare and contrast different routing and switching algorithms

Course Contents

Unit I — **Introduction to Data Communications Computer Networks** — **6 Hrs**

1.1 Data communications, Characteristics of Data Communication
1.2 Components of Data communication
1.3 Data Representation – Text, Numbers, Images, Audio, Video
1.4 Types of Data flow – Simplex, Half Duplex, Full Duplex
1.5 Computer Networks applications –Business Application, Home Application, Mobile User
1.6 Broadcast and point-to-point networks
1.7 Network Topologies - Bus, Star, Ring, Mesh
1.8 Network Types- LAN, MAN, WAN, PAN, Wireless Networks, Home Networks, internetworks
1.9 Protocols and standards – Definition of a Protocol, Protocol standards: De facto and De jure

Unit II — **Network Models** — **6 Hrs**

2.1. OSI Model – layered architecture, peer-to-peer processes, encapsulation
2.2 TCP/IP Model – layers and Protocol Suite
2.3 Addressing-Physical, Logical, Port addresses, Specific addresses

Unit III — **Physical Layer** — **12 Hrs**

3.1Analog and Digital data, Analog and Digital signals, Digital Signals-Bit rate, Bit length
3.2 Baseband Transmission, Broadband Transmission
3.3 Transmission Impairments– Attenuation, Distortion and Noise
3.4 Data Rate Limits– Noiseless channel: Nyquist's bit rate, noisy channel : Shannon'slaw
3.4 Performance of the Network Bandwidth, Throughput, Latency (Delay), Bandwidth – Delay Product, Jitters
3.4Line Coding Characteristics, Line Coding Schemes–Unipolar -NRZ, Polar-NRZ-I, NRZ-L, RZ, Manchester and Differential Manchester, Problems
3.5 Transmission Modes, Parallel Transmission and Serial Transmission– Asynchronous and Synchronous and Isochronous
3.6 Multiplexing FDM and TDM
3.7 Switching-Circuit Switching, Message Switching and Packet Switching.

Unit IV — **Data Link Layer** — **12 Hrs**

4.1Framing – Concept, Methods – Character Count, Flag bytes with Byte Stuffing,Starting & ending Flags with Bit Stuffing
4.2 Error detection code – Hamming Distance, CRC
4.3 Elementary data link protocols - Simplex stop & wait protocol, Simplex protocol for noisy channel, PPP, HDLC
4.4 Sliding Window Protocols – 1-bit sliding window protocols, Pipelining – Go-Back N and Selective Repeat
4.5 Random Access Protocols - ALOHA– pure and slotted, CSMA-1- persistent, p-persistent and non-persistent CSMA/CD,CSMA/CA
4.6 Controlled Access - Reservation, Polling and Token Passing
4.7 Channelization – Definitions – FDMA, TDMA and CDMA

Unit V — **Network Layer** — **12 Hrs**

5.1 IPv4 addresses: Address space, Notation, Classful addressing, Classless addressing, NAT,
Sub netting, Super netting
5.2 IPv4: Datagram, Fragmentation, checksum, options
5.3 IPv6 addresses: Structure, address space
5.4 IPv6:packet format, Extension headers

Unit VI — **Transport and Application Layer** — **12 Hrs**

6.1. Process-to-Process Delivery, Multiplexing and De-multiplexing
6.2. User Datagram Protocol (UDP) - Datagram Format, Checksum, UDP operations, Use of UDP 6.3. Transmission Control Protocol (TCP) - TCP Services – Process to-Process Communication, Stream Delivery Service, Sending and Receiving Buffers, Segments, Full – Duplex Communication, Connection oriented service, Reliable service
6.4. TCP Features – Numbering System, Byte Number, Sequence Number, Acknowledgement Number, Flow Control, Error Control, Congestion Control
6.5 TCP Segment Format
6.6 TCP Vs UDP
6.6 Domain Name System (DNS) - Distribution of Name Space, DNS in the Internet
6.7 E-MAIL - Architecture, User Agent, Message Transfer Agent - SMTP, Web Based Mail
6.8 WWW – Architecture
6.9 HTTP - HTTP Transaction

Reference Books:

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

E-Books

1)Computer Networks – Andrew S.Tenenbaum
https://books.google.co.in/books?id=b2HyGSu46lQC&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWIH7cAHR6_BKAQ6AEILjAB#v=onepage&q=Computer%20Networks%20ebook&f=false
2) Computer Networks – Behrouz A. ForouZan and Firouz Mosharraf
https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWIH7cAHR6_BKAQ6AEINzAC#v=onepage&q&f=false
3)Computer Networks – V.S.Bagad and I.A. Dhotre
https://books.google.co.in/books?id=KpOb37EHETcC&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWIH7cAHR6_BKAQ6AEIWjAG#v=onepage&q&f=false

SEMESTER III

BCA234: Data Structures Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./Week/Batch	02	Continuous Evaluation: 15Marks End-Semester: 35Marks

Prerequisite Courses: BCA – 116 and BCA – 126

Companion Course: BCA- 231: Data Structures

Course Objectives:

- To understand algorithms and analysis of algorithms
- To learn static and dynamic data structures.

Course Outcomes:

After successful completion of this course, learner will be able to

- Apply appropriate data structures for the given problem.
- Design an efficient algorithm for the given problem and implement it using C Programming.
- Determine the time and space complexity of a given algorithm.

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Assignment No	Topics for the Assignments	Number of sessions
1	Non-Recursive Sorting Techniques 1. Bubble Sort 2. Insertion Sort	1
2	Recursive Sorting Techniques 1. Quick Sort 2. Merge Sort	2
3	Searching Techniques 1. Linear search 2. Binary Search	2
4	Linked List 1. Linked List 2. Singly Circular Linked List 3. Doubly Linked List 4. Doubly Circular Linked List	2

1. Data Communications and Networking by Behrouz Forouzan, Fifth Edition, ISBN 978-0-07-337622-6 McGraw Hill.
2. Computer Networks, ANDREW S. Tanenbaum, Fifth Edition, ISBN-13: 978-0-13-212695-3, Pearson

E-Books

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2) Computer Networks – Behrouz A. ForouZan and Firouz Mosharraf
https://books.google.co.in/books?id=o8CjAgAAQBAJ&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWIH7cAHR6_BKAQ6AEINzAC#v=onepage&q&f=false
3)Computer Networks – V.S.Bagad and I.A. Dhotre
https://books.google.co.in/books?id=KpOb37EHETcC&printsec=frontcover&dq=Computer+Networks+ebook&hl=en&sa=X&ved=0ahUKEwj9woKylKLpAhWIH7cAHR6_BKAQ6AEIWjAG#v=onepage&q&f=false

SEMESTER III

BCA234: Data Structures Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./Week/Batch	02	Continuous Evaluation: 15Marks End-Semester: 35Marks

Prerequisite Courses: BCA – 116 and BCA – 126

Companion Course: BCA- 231: Data Structures

Course Objectives:

- To understand algorithms and analysis of algorithms
- To learn static and dynamic data structures.

Course Outcomes:

After successful completion of this course, learner will be able to

- Apply appropriate data structures for the given problem.
- Design an efficient algorithm for the given problem and implement it using C Programming.
- Determine the time and space complexity of a given algorithm.

Guidelines for Instructor's Manual

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Assignment No	Topics for the Assignments	Number of sessions
1	Non-Recursive Sorting Techniques 1. Bubble Sort 2. Insertion Sort	1
2	Recursive Sorting Techniques 1. Quick Sort 2. Merge Sort	2
3	Searching Techniques 1. Linear search 2. Binary Search	2
4	Linked List 1. Linked List 2. Singly Circular Linked List 3. Doubly Linked List 4. Doubly Circular Linked List	2

5	Stack 1. Static Stack Implementation 2. Dynamic Stack Implementation	2
6	Queue 1. Static Queue Implementation 2. Dynamic Queue Implementation	2
7	Binary Search Tree (Dynamic)	1
8	Graph 1. Adjacency Matrix Representation 2. Adjacency List Representation 3. In-degree and Out-degree calculation	2
	Total Number of sessions per batch	**14**

SEMESTER III

BCA235:Database Management Systems-II Laboratory

Teaching Scheme: **Practical: 04 Hrs./Week/Batch**	**Credits2**	**Examination Scheme:** **Continuous Evaluation: 15Marks** **End-Semester :35Marks**

Prerequisite Courses: BCA – 128

Companion Course: BCA232: Database Management Systems-II

Course Objectives:

- To learn advanced features in SQL such as Nested queries and Views
- To become familiar with PL/Postgre SQL

Course Outcomes: After successful completion of this course, learner will be able to

- Formulate SQL queries using advanced features
- Write stored procedures, cursors and triggers using PL/Postgre SQL.
- Design a database using database normalization technique

Lab Course Contents

Assignment No	Topics for the Assignments	No. Of Sessions
1	Simple and Nested Queries	02
2	Views Creation	02
3	Stored Functions	02
4	Cursors 1)Simple Cursor 2) Parameterize Cursor	02
5	Designing a Database using normalization theory for the given application/database design	02
6	Error and Exception handling 1) Raise Notice 2) Raise Exception	02
7	Triggers 1) Before (Insert, Update, Delete) 2) After (Insert, Update, Delete)	02
	Total Number of Sessions per batch	**14**

BCA 236: Computer Network and Web Programming Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Theory: 02 Hrs/Week	02	Continuous Evaluation: 15 Marks
Practical: 04 HRs/Week		End-Semester : 35 Marks
Pre-requisite Course: BCA 111		

Companion Course: BCA 233 Computer Network

Course Objectives:

- To understand the principles and methodologies of web based applications development process
- To learn HTML, CSS, Java Scripts, Cookies and XML

Course Outcomes:

After successful completion of this course, learner will be able to -

- Use HTML and CSS to design a website.
- Write java scripts
- Interpret and formulate XML queries

Course Contents (For Theory Sessions)

Unit I Introduction to Web Technologies **04Hrs**

1.1 Introduction to Web Technologies
1.2 Website – Working principal
1.3 Software to create websites
1.4 Qualities of a good website
1.5 Client-Server and its Communication
1.6 Client and Server Scripting Languages
1.7 Basic working of the Internet, Internet Protocols (HTTP, FTP, IP)
1.8 World Wide Web (WWW).
1.9 HTTP request message, HTTP response message
1.10 Types of Websites (Static and Dynamic Websites)

Unit II Introduction to HTML **02Hrs**

2.1 Introduction to HTML
2.2 HTML tags and attributes
2.3 Working with Elements.
2.4 Inserting Images
2.5 Client Server image mapping
2.6 Lists
2.7 Tables
2.8 Text and Image links
2.9 Frames
2.10 Forms and controls
2.11 Text boxes, buttons – radio & checkbox, List boxes

Unit III Introduction to CSS **04Hrs**

3.1 Introduction to Style Sheets
3.2 Introduction to Responsive Website
3.3 Types of CSS
3.4 CSS Border, margin, Positioning, color, text, link, background, list, table, padding, image, display properties
3.5 Use of Id & classes in CSS
3.6 Use of &
3.7 Introduction of CSS3 : Gradients, Transitions, Animations, multiple columns
3.8 Introduction of Bootstrap

Unit IV Introduction to JavaScript **06Hrs**

4.1 Concept of script, Types of Scripts, Introduction to javascript
4.2 Variables, identifier & operator, control structure.
4.3.Examples on javascript operators
4.4 Functions
4.5 Event Handling in Java Scripts
4.6 Concept of array, Arrays in javascript , types of arrays with examples
4.7 Event handling in javascript with examples
4.8 Math and date objects with examples.
4.9 String objects with examples, and related functions
4. 10 DOM in javascript, DOM objects
4.11 Validations in javascript with examples.

Unit V Working with cookies **04Hrs**

5.1 Basics of cookies
5.2 Reading a cookie value, writing a cookie value
5.3 Creating cookies, deleting cookies
5.4 Setting expiry date of cookies.
5.5 Examples on cookies.

Unit VI Introduction to XML **04Hrs**

6.1 Introduction to XML
5.2 Uses of XML
5.3 Simple XML examples,
5.4 XML key components
5.5.DTD and Schemas,
5.6 Using XML in web applications.
5.7.Introduction to XSL, XSL elements, transforming with XSLT

Course Contents (For Lab Sessions)

Assignment No	Topics for the Assignments	No. of Sessions
1	Using Networking commands – ping, hostname, traceroute, netstat, ifconfig, who, nmap, nslookup etc	01
2	Study of network devices – cables, switches, Modem etc	01
3	Study of LAN Environment – IP, MAC addresses, DHCP Server, Drawing network topology	01
4	Basic HTML Tags - headings, paragraphs, line break, colors etc fonts, links, Images etc	01
5	Creating List using HTML Tags	01
6	Creating List and Tables using HTML Tags	01
7	Creating Frames and Forms by using HTML Tags	01
8	Styling HTML pages using CSS	01
9	Basics of JavaScript	01
10	Functions in JavaScript	01
11	Validation using JavaScript	01
12	Designing Input screens using HTML & CSS.	01
13	Field and Form validation.	01
14	Testing a developed client application	01
	Total Number of Sessions per Batch	**14**

Theory lectures will be conducted for the whole class at a time
Lab Sessions will be conducted for each batch of 12 students separately
End sem practical exam will be conducted based on assignments carried out during lab sessions only
Continuous assessment will be carried out based on performance in both lab and theory sessions

Reference Books

1. Steven Holzner, IIHTML Black BookII, Dremtech press.
2. Web Technologies, Black Book, Dreamtech Press
3. Web Applications : Concepts and Real World Design, Knuckles, Wiley-India
4. Internet and World Wide Web How to program, P.J. Deitel & H.M. Deitel Pearson Education
5. Programming PHP By Rasmus Lerdorf and Kevin Tatroe, O'Reilly publication
6. Programming the World Wide Web , Robert W Sebesta (3rd Edition)
7. Thinking in HTML eBook by Aravind Shenoy
8. Learn HTML and CSS faster by Mark Myers

E-books

1. https://www.w3schools.com
2. https://wwwtutorialspoint.com
3. https://www.php.net

Environmental Studies (AECC)

Unit 1 : Introduction to environmental studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; Concept of sustainability and sustainable development.

Unit 2 : Ecosystems

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: food chains, food webs and ecological succession. Case studies of the following ecosystems :
  a) Forest ecosystem
  b) Grassland ecosystem
  c) Desert ecosystem
  d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit 3 : Natural Resources : Renewable and Non---renewable Resources

- Land resources and landuse change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter---state).
- Energy resources : Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies.

Unit 4 : Biodiversity and Conservation

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega---biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man---wildlife conflicts, biological invasions; Conservation of biodiversity : In---situ and Ex---situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

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Sem-IV

Unit 5 : Environmental Pollution

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management : Control measures of urban and industrial waste.
- Pollution case studies.

Unit 6 : Environmental Policies & Practices

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture

- Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human wildlife conflicts in Indian context.

Unit 7 : Human Communities and the Environment

- Human population growth: Impacts on environment, human health and welfare.
- Resettlement and rehabilitation of project affected persons; case studies.
- Disaster management : floods, earthquake, cyclones and landslides.
- Environmental movements : Chipko, Silent valley, Bishnois of Rajasthan.
- Environmental ethics: Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

Unit 8 : Field work

- Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
- Visit to a local polluted site---Urban/Rural/Industrial/Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystems---pond, river, Delhi Ridge, etc.

SYBSC & SYBSC (Computer Science)

ENGLISH

(Ability Enhancement Compulsory Course-AECC)

(Choice Based Credit System-35:15-Pattern)
(w. e. f- 2020- 2021)

(02-Credit Course)

Text: ***Horizons: English in Multivalent Contexts*** (Board of Editors- Orient BlackSwan)

Preamble:

This is an ABILITY ENHANCEMENT COURSE. Considering the needs of students and the requirements of professional sectors, the syllabus of this paper is designed to enhance linguistic and professional skills of the students. In the age of technology, it's high time for the students to acquire and exercise the skill and sub-skills of using English in multivalent contexts.

The paper aims at a balanced up-gradation of the students, focussing on their ability enhancement. Hence, to avoid a lopsided professional development, the humane values are also taken care of by accommodating literature section in the syllabus. The other units cater to the needs of enhancing speaking ability, writing ability, the ability to face an interview, the ability of using soft skills effectively while planning one's work and working on the plans. By and large, the present syllabus is an attempt to galvanise the existing competencies of the students and enhancing their abilities for a better performance and better results.

Objectives:

1. To introduce the use of English in multimedia
2. To acquaint the students with the language skills in multivalent contexts
3. To acquaint and enlighten students regarding the speaking skill in various contexts
4. To acquaint and familiarize the students with advanced writing skills in different contexts
5. To acquaint and familiarize the students with soft skills
6. To minimize the gap between the existing communicative skills of the students and the skills they require at professional level
7. To develop competence among the students to appreciate and analyze short stories and poetry

Sem-III

Semester-III

Text: ***Horizons: English in Multivalent Contexts*** (Board of Editors- Orient BlackSwan)

Content-

UNIT-I- LITERATURE **10 Clock Hours**

1. **Short Story:**
   i) 'A Shadow': R. K. Narayan
2. **Poetry:**
   i) La Belle Dame sans Merci: John Keats
   ii) Where the Mind is without Fear: Rabindranath Tagore

UNIT-II-CONVERSATIONAL SKILL **10 Clock Hours**

(Sample Dialogues, Useful Expressions and Exercises)

1. Introducing Yourself and Others
2. Asking, Giving and Refusing Permission
3. Describing Daily Routine
4. Complaining and Apologizing
5.

UNIT-III-INTERVIEW TECHNIQUES **10 Clock Hours**

1. Job Application Letter
2. Resume Writing
3. GDPI
4. Presentations

Course Code 408

Sem-IV

Semester-IV

Text: ***Horizons: English in Multivalent Context*** (Board of Editors- Orient BlackSwan)

10 Clock Hours

UNIT-I-LITERATURE

1. **Short Story:**
   i) My Lost Dollar: Stephen Leacock
2. **Poetry:**
   i) The Bird Sanctuary: Sarojini Naidu
   ii) Stopping by Woods on a Snowy Evening: Robert Frost

10 Clock Hours

UNIT-II-WRITING SKILLS

(Sample Passages, Useful Techniques and Exercises)

1. Notices
2. Agenda
3. Minutes
4. Content Writing

UNIT-III-SOFT SKILLS AND PERSONALITY DEVELOPMENT

(Sample Situations, Useful Techniques and Exercises) **10 Clock Hours**

1. An Introduction to Soft Skills
2. SWOC Analysis
3. Goal Setting
4. Project Management

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SEMESTER IV

BCA241:Object Oriented Programming and C++

Teaching Scheme:	Credits	Examination Scheme:
Theory: 05 Hrs./Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course: BCA - 112 & BCA – 122

Companion Course: BCA244: C++ Programming Laboratory

Course Objectives:

- To learn principles of Object Oriented Programming (OOP).
- To understand object-oriented concepts such as data abstraction, encapsulation, inheritance, dynamic binding, and polymorphism.
- To use the object-oriented paradigm in program design.

Course Outcomes:

After successful completion of this course, learner will be able to–

- Compare and contrast procedural and object oriented programming
- Apply principles of OOP
- Design and develop applications using object oriented programming language C++

Course Contents

Unit I	Introduction to C++	06Hrs.

- How C++ evolved from C?
- Features of C++
- Procedure-oriented programming Vs Object-oriented programming
- The basic anatomy of a C++ program, Simple "Hello World" program
- Compiling, linking and running a C++ program.

Unit II	Object Oriented Programming Concepts	08Hrs.

- Classes and objects
- Abstraction
- Inheritance
- Polymorphism
- Data Binding
- Encapsulation
- Message Passing

Unit III	Programming in C++	08Hrs

- Data Types,
- New operators and keywords,
- Type casting in C++,
- reference variables,
- Classes and Access Specifiers
- Defining data members and member functions
- Arrays and Array of objects
- Usage of namespace, Managing Console I/O, Usage of Manipulators

Unit IV	Constructors, Destructors, Function and Operator overloading	14Hrs.

- Static Members Call by reference, return by reference
- Inline Function

- Friend Function
- Function overloading
- Constructer & Destructor and their types
- Overloading unary and binary operators (with member function and with friend function)
- Usage of this pointer
- Overloading using friend functions Overloading "<<>>" operator Type Conversion, Function overloading

Unit V	Inheritance	14Hrs.

- Introduction
- Types of Inheritance
- Base class and derived class examples
- Virtual base class
- Abstract class
- Polymorphism
- Virtual functions and pure virtual functions, Overriding

Unit VI	Files and Exception Handling	10Hrs.

- Classes for file stream operations
- Opening and closing a file
- Random access files
- Introduction to Exception handling mechanism

Reference Books

1. Object Oriented Programming (C++) Balaguruswamy, McGraw Hill Education; Seventh edition
2. Deitel, —C++ How to Programll, 4th Edition, Pearson Education
3. The Complete Reference C++ by Herbert Schildt, McGraw Hill Education; 4 edition
4. Mastering C++ by Venugopal, T Ravishankar, McGraw Hill Education; 2 edition

E-Books

1) Head First C++ Programming – Harry. H. Chaudhary
https://books.google.co.in/books?id=-xzlAwAAQBAJ&printsec=frontcover&dq=C%2B%2B+ebook&hl=en&sa=X&ved=0ahUKEwj7yKfmnaLpAhXhX3wKHX31Bn4Q6AEIJzAA#v=onepage&q&f=false
2) A Complete Guide to Programming C++ - Jones and Bartett Computer Science
https://books.google.co.in/books?id=-yhuY0Wg_QcC&printsec=frontcover&dq=C%2B%2B+ebook&hl=en&sa=X&ved=0ahUKEwj7yKfmnaLpAhXhX3wKHX31Bn4Q6AEINzAC#v=onepage&q&f=false
3)Programming with C++ - D Ravichandran
https://books.google.co.in/books?id=Zw0jgoug61gC&printsec=frontcover&dq=C%2B%2B+ebook&hl=en&sa=X&ved=0ahUKEwj7yKfmnaLpAhXhX3wKHX31Bn4Q6AEILzAB#v=onepage&q=C%2B%2B%20ebook&f=false
4) C++ Programming – D.S.Malik
https://books.google.co.in/books?id=NxIeCgAAQBAJ&printsec=frontcover&dq=C%2B%2B+ebook&hl=en&sa=X&ved=0ahUKEwj7yKfmnaLpAhXhX3wKHX31Bn4Q6AEIajAI#v=onepage&q=C%2B%2B%20ebook&f=false

SEMESTER IV

BCA242: Web Technology

Teaching Scheme:	Credits	Examination Scheme:
Theory: 05 Hrs./Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Prerequisite Courses: BCA – 233

Companion Course : BCA245 Web Technology Laboratory

Course Objectives:

- To learn PHP programming and database connectivity
- To understand and learn AJAX and XMK

Course Outcomes: After completion of this course, learner will be able to

- Develop web based application using suitable client side and server side web technologies.
- Build Dynamic web site using server side PHP Programming and Database connectivity.
- Build applications using AJAX and XML

Course Contents

Unit I — **Introduction to PHP** — **6 Hrs**

- HTTP basics, Introduction to web server and web browser
- Introduction to PHP
- PHP - Lexical structure, Language basics.

Unit II — **Functions and Arrays** — **8 Hrs**

- Defining and calling a function
- Default parameters
- Variable parameters, Missing parameters
- Variable function, Anonymous function
- Indexed Vs Associative arrays
- Identifying elements of an array
- Storing data in arrays
- Multidimensional arrays
- Extracting multiple values
- Traversing arrays
- Sorting Using arrays

Unit III — **Object Oriented Programming** — **10 Hrs**

- Classes
- Objects
- Introspection
- Serialization
- Inheritance
- Interfaces
- Encapsulation

Unit IV — **Web Techniques** — **12 Hrs**

- Variables
- Server information
- Processing forms
- Setting response headers
- Maintaining state
- SSL

Unit V — **Databases** — **12 Hrs**

- Using PHP to access a database
- Relational databases and SQL
- PEAR DB basics
- Advanced database techniques

Unit VI — **Ajax and XML** — **12 Hrs**

- Understanding java scripts for AJAX
- AJAX web application model
- AJAX –PHP framework
- Performing AJAX validation
- Handling XML data using php and AJAX
- What is XML?
- XML document Structure
- PHP and XML
- XML parser
- The document object model
- The simple XML extension

Changing a value with simple XML

Reference Books

1. Programming PHP By Rasmus Lerdorfand Kevin Tatroe, O'Reilly publication
2. Beginning PHP5, Wrox publication
3. PHP for Beginners, SPD publication

E-Books

1)The Complete Reference – Steven Holzner
https://books.google.co.in/books?id=bGS4CmJY0I8C&printsec=frontcover&dq=PHP+ebook&hl=en&sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIVTAF#v=onepage&q&f=false

2) Programming PHP – Rasmus Lerdorf , Kevin Tatroe and Peter Macintyre
https://books.google.co.in/books?id=h-E1IVko-skC&printsec=frontcover&dq=PHP+ebook&hl=en&sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIcDAI#v=onepage&q=PHP%20ebook&f=false

3) Beginner to Intermediate PHP5 – Mario Lurig
https://books.google.co.in/books?id=noi76uKOJ5wC&printsec=frontcover&dq=PHP+ebook&hl=en&sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIMDAB#v=onepage&q&f=false

4) PHP MySQL, JavaScript & HTML5 – A iley Brand
https://books.google.co.in/books?id=p9BuBgAAQBAJ&printsec=frontcover&dq=PHP+ebook&hl=en&sa=X&ved=0ahUKEwjl4PuNoKLpAhURwTgGHXadDbYQ6AEIQTAD#v=onepage&q&f=false

SEMESTER III

BCA-233: Software Engineering

Teaching Scheme:	Credits	Examination Scheme:
Theory: 05 Hrs/Week	02	Continuous Evaluation: 15 Marks
Pre-requisite Course: BCA – 232		End-Semester : 35 Marks

Companion Course: BCA 236 Python Programming Laboratory

Course Objectives:

- To learn and understand the principles of System and Software Engineering
- To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
- To learn design processes and software quality parameters

Course Outcomes: After successful completion of this course, learner will be able to

- Compare and contrast various Software Engineering models
- Decide on appropriate process model for a developing a software project
- Classify software applications and Identify unique features of various domains
- Prepare System Requirement Specification (SRS) for the given problem
- Design and analyze Data Flow diagrams

Course Contents

Unit I Introduction to System Engineering — 06 Hrs

1.1 Definition
1.2 Basic Components
1.3 Elements of the system
1.4 System Components
1.5 Types of System

Unit II Introduction to Software Engineering — 10Hrs

2.1 Definition of Software
2.2 Characteristics of Software
2.3 Software Application Domain
2.4 Definition of Software Engineering
2.5 Need for software Engineering
2.6 Mc Call's Quality factors
2.7 The Software Process
2.8 Software Engineering Practice

Unit III Software Development Life Cycle (SDLC) and Methodologies — 10 Hrs

3.1 Introduction
3.2 Activities of SDLC
3.3 A Generic Process Model
3.4 Prescriptive Process models
3.4.4.1 Waterfall Model
3.4.2 Incremental Process Models
3.4.3 Evolutionary process Models (Prototyping and Spiral Model)
3.5 Concurrent Models, Types

Unit IV Requirement Engineering — 10 Hrs

4.1 Introduction

4.2 Requirement Engineering Tasks
4.3 Establishing Groundwork for understanding of Software Requirement
4.4 Requirement Gathering
4.5 Feasibility study
4.6 Fact Finding Techniques

Unit V Analysis and Design Engineering — 10 Hrs

5.1 Decision Tree and Decision Table
5.2 Data Flow Diagrams (DFD)
5.3 Data Dictionary
5.3.1 Elements of DD
5.3.2 Advantages of DD
5.4 Input and Output Design
5.5 PseudoCode
5.6 Case Studies on above topics

Unit VI Agile Development — 10 Hrs

6.1 Agility
6.2 Agile Process
6.2.1 Principles
6.2.2 The Politics Of Agile Development
6.2.3 Human Factors
6.3 Extreme Programming(XP)
6.4 Adaptive Software Development(ASD)
6.5 Scrum
6.6 Dynamic System Development Model (DSDM)

Reference Books

1. Software Engineering : A Practitioner's Approach- Roger S. Pressman, McGraw hill International Editions 2010(Seventh Edition)
2. System Analysis, Design and Introduction to Software Engineering (SADSE) - S. Parthsarthy, B.W. Khalkar
3. Analysis and Design of Information Systems(Second Edition) - James A. Senn, McGraw Hill
4. System Analysis and Design- Elias Awad, Galgotia Publication, Second Edition
5. Fundamentals of Software Engineering- Rajib Mall, PHI Publication, Fourth Edition

E-Books

1)Software Engineering and Quality Assurance – Mrs Anuradha A. Puntambekar https://books.google.co.in/books?id=r203sZeGhhcC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEINDAB#v=onepage&q&f=false
2)Software Engineering – Bharat Bhushan Agarawal and Sumit Prakash Tayal https://books.google.co.in/books?id=CDWRq0B9e5kC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEIVzAF#v=onepage&q&f=false
3) Software Engineering – Jibitesh Mishtre and Ashok Mohanty https://books.google.co.in/books?id=YnGz2ghKF-gC&printsec=frontcover&dq=Software+Engineering+ebook&hl=en&sa=X&ved=0ahUKEwi9wJr-l6LpAhU46nMBHeWQCQwQ6AEIaTAH#v=onepage&q&f=false

SEMESTER IV

BCA244 : C++ Programming Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Theory: 04 Hrs./Week/Batch	02	Continuous Evaluation: 15 Marks End-Semester : 35 Marks

Prerequisite Courses: BCA 112 and BCA 122

Companion Course: BCA 241 Object oriented Programming and C++

Course Objectives:

- To learn principles of Object Oriented Programming (OOP).
- To understand object-oriented concepts such as data abstraction, encapsulation, inheritance, dynamic binding, and polymorphism.
- To use the object-oriented paradigm in program design.

Course Outcomes: After successful completion of this course, learners will be able to

- Compare and contrast procedural and object oriented programming
- Apply principles of OOP
- Design and develop applications using object oriented programming language C++

Lab Course Contents

Assignment No	Topics for the Assignments	No. Of Sessions
1	Class , Object and methods implementation	02
2	Constructor: Copy Constructor, Default Constructor, Parameterized Constructor	02
3	Memory Allocation: new and delete operators , dynamic constructor	02
4	Inline function, friend function, default argument, Function Overloading, Operator overloading	03
5	Inheritance: Single, multiple, multilevel, hierarchy, Constructor and destructor in derived class	03
6	File Handling: Read, Write, Updating of files using random access	02
	Total Number of Sessions per batch	**14**

SEMESTER IV

BCA245 : Web Technology Laboratory

Teaching Scheme:	Credits	Examination Scheme:
Practical: 04 Hrs./Week/Batch	02	Continuous Evaluation: 15Marks End-Semester: 35Marks

Prerequisite Courses: BCA – 236

Companion Course: BCA242: Web Technology

Course Objectives:

- To get familiar with basics of the Internet Programming.
- To acquire knowledge and skills for creation of web site using client and server side programming
- To understand process of developing responsive web applications
- To explore different web extensions and web services standards
- To explore different web extensions and web services standards

Course Outcomes: After successful completion of this course, learners will be able to

- Design and implement static and dynamic websites using appropriate client side and server side technologies.
- Build Dynamic web site using PHP Programming and Database connectivity.
- Build applications using AJAX and XML and web services.

Lab Course Contents

Assignment No	Topics for the Assignments	No. Of Sessions
1	PHP Programming	02
2	Use Functions	02
3	Use Arrays	02
4	Use Inheritance and Interfaces	02
5	Accessing Databases (PostgreSQL)	04
6	Use XML and AJAX	02
	Total Number of Sessions per Batch	**14**

SEMESTER IV

BCA246: Python Programming Laboratory

Teaching Scheme: **Theory: 02Hrs/Week** **Practical: 04 Hrs/Week**	**Credits 04**	**Examination Scheme:** **Continuous Evaluation: 30 Marks** **End-Semester: 70 Marks**
Prerequisite Course:	**BCA – 126, BCA – 234**	
Companion Course	**BCA – 243 Software Engineering**	

Course Objectives:

- To understand programming constructs in Python.
- To learn problems solving using Python

Course Outcomes: After successful completion of this course, learner will be able to-

- Write programs using Python programming constructs.
- Develop applications using Python programming.

Course Contents (Theory Sessions)

Unit I Introduction to Python Scripting **04 Hrs**

1.1 Why Scripting is Useful in Computational Science
- Classification of Programming Languages
- Productive Pairs of Programming Languages
- Gluing Existing Applications
- Scripting Yields Shorter Code, Efficiency
- Type-Specification (Declaration) of Variables
- Flexible Function Interfaces
- Interactive Computing
- Creating Code at Run Time
- Nested Heterogeneous Data Structures
- GUI Programming
- Mixed Language Programming

1.2 When to Choose a Dynamically Typed Language
1.3 Why Python? Script or Program?
1.4 Application of Python

Unit II Basic Python **08 Hrs**

2.1 Python identifiers and reserved words
2.2 Lines and indentation, multi-line statements
Comments
2.3 Input/output with print and input functions,
2.4 Command line arguments and processing command line arguments
2.5 Standard data types - basic, none, Boolean (true & False), numbers
2.6 Python strings
2.7 Data type conversion
2.8 Python basic operators (Arithmetic, comparison, assignment, bitwise logical)
2.9 Python membership operators (in & not in)
2.10 Python identity operators (is & is not)
2.11 Operator precedence

2.12 Control Statements, Python loops, Iterating by subsequence index, loop control statements (break, continue,pass)
2.13 Mathematical functions and constants (import math), Random number functions

Unit III Python String **06 Hrs**

3.1 Concept, escape characters
3.2 String special operations, String formatting operator ,Single quotes, Double quotes, Triple quotes ,Raw String, Unicode strings, Built-in String methods.
3.3 Python Lists - concept, creating and accessing elements, updating & deleting lists, basic list operations, reverse
3.4 Indexing, slicing and Matrices

Unit IV Python List **06 Hrs**

4.1 built-in List functions
4.2 Functional programming tools - filter(), map(), and reduce()
4.3 Using Lists as stacks and Queues, List comprehensions.

Unit V Python tuples and Sets **06 Hrs**

5.1 Creating & deleting tuples
- Accessing values in a tuple
- Updating tuples, delete tuple elements

5.2 Basic tuple operations
- Indexing, slicing and Matrices, built- in tuple functions.

5.3 Sets - Concept, operations

Unit VI Python Dictionary **06 Hrs**

6.1 Creating and accessing values in a dictionary
6.2 Updating dictionary, delete dictionary elements
6.3 Properties of dictionary keys
6.4 Built-in dictionary functions and methods
6.5 Defining a function (def)
6.6 Function arguments - Pass by value, Keyword Arguments, default arguments
6.7 Documentation Strings
6.8 Variable Number of Arguments
6.9 Call by Reference
6.10 Order of arguments (positional, extra & keyword)

Reference Books:

1. Introducing Python- Modern Computing in Simple Packages – Bill Lubanovic, O„Reilly Publication
2. Beginning Python: From Novice to Professional, Magnus Lie Hetland, Apress
3. Practical Programming: An Introduction to Computer Science Using Python 3, Paul Gries, et al., Pragmatic Bookshelf, 2/E 2014
4. Introduction to Computer Science Using Python- Charles Dierbach, Wiley Publication
Learning with Python ", Green Tea Press, 2002
5. E-Books : python_tutorial. pdf, python_book_01.pdf
6. Beginning Programming with Python for Dummies Paperback – 2015 by John PaulMueller
7 A Beginner"s Python Tutorial: http://en.wikibooks.org/wiki/A Beginner%27s Python

E-Books

1)Python Programming – John Zelle
https://books.google.co.in/books?id=aJQILlLxRmAC&printsec=frontcover&dq=Python+programming+e
book&hl=en&sa=X&ved=0ahUKEwjwntzPp6LpAhWQXCsKHb8aACkQ6AEIJzAA#v=onepage&q&f=fals
e
2) Learning Python – Mark Lutz
https://books.google.co.in/books?id=4pqQfXQvekcC&printsec=frontcover&dq=Python+programming+e
book&hl=en&sa=X&ved=0ahUKEwjwntzPp6LpAhWQXCsKHb8aACkQ6AEIMDAB#v=onepage&q=Pyth
on%20programming%20ebook&f=false
3) Programming with Python – Vaibhav Gondaliya
https://books.google.co.in/books?id=LPOrDwAAQBAJ&printsec=frontcover&dq=Python+programming+
ebook&hl=en&sa=X&ved=0ahUKEwjBiaDfqKLpAhVHILcAHUJBC204ChDoAQg_MAM#v=onepage&q&
f=false
4) A Primer on Scientific Programming with Python – Hans Petter Langtangen
https://books.google.co.in/books?id=nUzADAAAQBAJ&printsec=frontcover&dq=Python+programming+
ebook&hl=en&sa=X&ved=0ahUKEwjBiaDfqKLpAhVHILcAHUJBC204ChDoAQh0MAk#v=onepage&q=

Course Contents (Laboratory Sessions)

Guidelines for Instructor's Manual

The instructor's manual is to be developed as a hands-on resource and reference. The instructor's manual need to include University syllabus, conduction & Assessment guidelines.

Guidelines for Student Journal

The laboratory assignments are to be submitted by student in the form of journal. Journal consists of Certificate, table of contents, and **handwritten write-up** of each assignment (Title, Objectives, Problem Statement, Outcomes, software & Hardware requirements, Date of Completion, Assessment grade/marks and assessor's sign

Program codes with sample output of all performed assignments are to be submitted as softcopy. Use of DVD containing students programs maintained by lab In-charge is highly encouraged. For reference, one or two journals may be maintained with program prints.

Guidelines for Assessment

Continuous assessment of laboratory work is to be done based on overall performance of student. For each lab assignment, the instructor will assign grade/marks based on parameters with appropriate weightage. Suggested parameters include- timely completion, performance, innovation, efficient codes, punctuality and neatness.

Assignment No.	Topics for the Assignments	Number of sessions
1	Basic Python	2
2	Python Strings	2
3	Python tuple	1
4	Python Set	2
5	Python Dictionary	2
6	Functions	2
7	Problem definition and the scope of the problem	1
8	Prepare SRS for a given problem	1
9	Design Data Flow Diagrams for the problem	1
	Total Number of Sessions per Batch	**14**

Theory lectures will be conducted for the whole class at a time
Lab Sessions will be conducted for each batch of 12 students separately
End sem practical exam will be conducted based on assignments carried out during lab sessions only
Continuous assessment will be carried out based on performance in both lab and theory sessions

SYBSC & SYBSC (Computer Science)

ENGLISH

(Ability Enhancement Compulsory Course-AECC)

(Choice Based Credit System-35:15-Pattern)
(w. e. f- 2020- 2021)

(02-Credit Course)

Text: *Horizons: English in Multivalent Contexts* (Board of Editors- Orient BlackSwan)

Preamble:

This is an ABILITY ENHANCEMENT COURSE. Considering the needs of students and the requirements of professional sectors, the syllabus of this paper is designed to enhance linguistic and professional skills of the students. In the age of technology, it's high time for the students to acquire and exercise the skill and sub-skills of using English in multivalent contexts.

The paper aims at a balanced up-gradation of the students, focussing on their ability enhancement. Hence, to avoid a lopsided professional development, the humane values are also taken care of by accommodating literature section in the syllabus. The other units cater to the needs of enhancing speaking ability, writing ability, the ability to face an interview, the ability of using soft skills effectively while planning one's work and working on the plans. By and large, the present syllabus is an attempt to galvanise the existing competencies of the students and enhancing their abilities for a better performance and better results.

Objectives:

1. To introduce the use of English in multimedia
2. To acquaint the students with the language skills in multivalent contexts
3. To acquaint and enlighten students regarding the speaking skill in various contexts
4. To acquaint and familiarize the students with advanced writing skills in different contexts
5. To acquaint and familiarize the students with soft skills
6. To minimize the gap between the existing communicative skills of the students and the skills they require at professional level
7. To develop competence among the students to appreciate and analyze short stories and poetry

Semester-III

Text: ***Horizons: English in Multivalent Contexts*** (Board of Editors- Orient BlackSwan)

Content-

UNIT-I- LITERATURE

1. **Short Story:** **10 Clock Hours**
   i) 'A Shadow': R. K. Narayan
2. **Poetry:**
   i) La Belle Dame sans Merci: John Keats
   ii) Where the Mind is without Fear: Rabindranath Tagore

UNIT-II-CONVERSATIONAL SKILL

(Sample Dialogues, Useful Expressions and Exercises) **10 Clock Hours**

1. Introducing Yourself and Others
2. Asking, Giving and Refusing Permission
3. Describing Daily Routine
4. Complaining and Apologizing
5.

UNIT-III-INTERVIEW TECHNIQUES

1. Job Application Letter
2. Resume Writing
3. GDPI **10 Clock Hours**
4. Presentations

Semester-IV

Text: ***Horizons: English in Multivalent Context*** (Board of Editors- Orient BlackSwan)

UNIT-I-LITERATURE

1. **Short Story:**
   i) My Lost Dollar: Stephen Leacock **10 Clock Hours**
2. **Poetry:**
   i) The Bird Sanctuary: Sarojini Naidu
   ii) Stopping by Woods on a Snowy Evening: Robert Frost

UNIT-II-WRITING SKILLS

(Sample Passages, Useful Techniques and Exercises) **10 Clock Hours**

1. Notices
2. Agenda
3. Minutes
4. Content Writing

UNIT-III-SOFT SKILLS AND PERSONALITY DEVELOPMENT

(Sample Situations, Useful Techniques and Exercises) **10 Clock Hours**

1. An Introduction to Soft Skills
2. SWOC Analysis
3. Goal Setting
4. Project Management

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BIBLIOGRAPHY:

1. Adair, John. Effective Communication, London: Pan Macmillan Ltd. 2003.

2. Amos, Julie-Ann. Handling Tough Job Interviews. Mumbai: Jaico Publishing, 2004.

3. Baron, N.S., (2008).Always On: Language in an Online and Mobile World. Oxford University

Press. Oxford.

4. Borg, James.(2010). Body Language: 7 Easy Lessons to Master the Silent Language. FT Press.

5. Collins, Patrick. Speak with Power and Confidence. New York: Sterling, 2009.

6. Kroehnert, Gary. Basic Presentation Skills. Sidney: McGraw Hill, 2010.

7. Linda B., Iris V. (2001). Intercultural Communication in the Global Workplace. 2nd Edition. Tata McGraw

8. Mitra, B. (2011). Personality Development & Soft Skills.1st edition. Oxfor.

9. Moore, Ninja-Jo, et al. Nonverbal Communication: Studies and Applications. New York: Oxford University Press, 2010.

10. Nelson, Paul E. & Judy C. Pearson, Confidence in Public Speaking.

11. Prasad, H. M. How to Prepare for Group Discussion and Interview. New Delhi: Tata McGraw-Hill Publishing Company Limited, 2001.

12. Pease, Allan. Body Language. Delhi: Sudha Publications, 1998.

13. Raman, Meenakshi & Sangeeta Sharma. Technical Communication: Principles and Practice. Second Edition. New Delhi: Oxford University Press, 2011.

14. Rutherford, Andrea J. Basic Communication Skills for Technology: Second Edition. Delhi: Pearson Education, 2007.

15. Sharma, R. C. & Krishna Mohan. Business Correspondence and Report Writing: Third Edition. New Delhi: Tata McGraw-Hill Publishing company Limited, 2007.

WEB LINKS:

http://networketiquette.net/

https://public.wsu.edu/~brians/errors/

http://users3.ev1.net/~pamthompson/body_language.htm

http://www.albion.com/netiquette/corerules.html

http://www.bbc.co.uk/worldservice/learningenglish/radio/specials/1535_questionanswer/page15.shtml

http://www.colostate.edu/Depts/Speech/rccs/theory44.html

http://www.dailywritingtips.com/

EVALUATION PATTERN

Considering the choice-based credit system (CBCS) and the semester pattern, both Semesters-III & IV will have a uniform evaluation pattern of **50 marks** each. There will be an **'Internal Examination'** for **15 marks** and **Semester-end Examination** for **35 marks**.

The Internal Examination for **15 marks** will be conducted in two parts.

1) Practical Examination for 05 marks:

(The choices like Group Discussion, Mock Interviews, Seminar, Project Presentation, Role Play, Home Assignment, Library Work, Lecture Notes etc. can be considered.)

2) A Mid-semester Written Test for 10 marks:

The Mid-semester Written Test will be based on the book prescribed for the syllabus. The test aims at assessing students' writing competence in general. Hence, descriptive and essay type questions can be considered while setting the question paper.

Semester-end Examination:

The Semester-end Examination will have a uniform question paper pattern for both semesters. The pattern of the question paper is given below.

Semester-V

SEMESTER V		
BCA 351: DSE I (Programming in Java)		
Teaching Scheme: **Theory: 05 Hrs./Week**	**Credits** **04**	**Examination Scheme:** **Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Pre-requisite Course:

- BCA 241 Object Oriented Programming and C++

Companion Course:

- BCA 356 DSE I Laboratory (Programming in Java)

Course Objectives:

- To learn implementation of object-oriented conceptswith Java.
- To understand collection classes and interfaces.
- To know the process of application development using Graphical User Interface (GUI).
- To know the process of application development using Graphical User Interface (GUI).
- To acquire knowledge about handling databases using Java.
- To study web components for developing web applications.

Course Outcomes:

After successful completion of this course, learner will be able to:

- Identify classes, objects, class members and relationships for a given problem.
- Design end to end applications using object oriented constructs.
- Apply collection classes for storing java objects.
- Use Java APIs for program development.
- Handle abnormal termination of a program using exception handling.

	Course Contents	**10 Hrs**
Unit I	**Introducing Java, Classes and Objects** **Introducing Java** 1.1 A Short History of Java 1.2 Features of Java 1.3 Java Environment – Compiler, Interpreter, JVM 1.4 Simple java program 1.5 Types of Comments 1.6 Declaring single and multi-dimensional arrays 1.7 Accepting input using Command line arguments 1.8 Accepting input from console (Using BufferedReader and Scanner class) **Classes and Objects** 1.9 Defining Your Own Classes 1.10 Access Specifiers (public, protected, private, default) 1.11 Array of Objects 1.12 Constructor, Overloading Constructors and use of „this" Keyword 1.13 static blocks, static Fields and static methods 1.14 Predefined classes – Object class methods (equals(), toString(),	

	hashcode()) 1.15 Garbage Collection (finalize() Method)	
Unit II	**Inheritance and Interface**	**10 Hrs**
	Inheritance 2.1 Inheritance Basics (extends Keyword) and Types of Inheritance 2.2 Superclass, Subclass and use of Super Keyword 2.3 Method Overriding and runtime polymorphism 2.4 Use of final keyword related to variable, method and class 2.5 Use of abstract class and abstract methods **Interface** 2.6 Defining and Implementing Interfaces 2.7 Runtime polymorphism using interface **Packages** 2.8 Creating, Accessing and using Packages	
Unit III	**Collections, Exception Handling and I/O**	**10 Hrs**
	Collections 3.1 Wrapper Classes 3.2 Introduction to the Collection framework 3.3 List – ArrayList, LinkedList and Vector 3.4 Set - HashSet, TreeSet, and LinkedHashSet 3.5 Map – HashMap, LinkedHashMap, Hashtable and TreeMap 3.6 Interfaces such as Iterators, ListIterators, Enumerations **Exception Handling** 3.7 Exception class, Checked and Unchecked exception 3.8 Catching exception and exception handling – try, catch, finally, throw and throws, multiple catch block 3.9 Creating user defined exception **I/O** 3.10String class(basic methods) , String Buffer class 3.11 File class 3.12 DataInputStream and DataOutputStream class	
Unit IV	**Swing**	**10 Hrs**
	4.1 What is Swing? 4.2 The MVC Architecture and Swing 4.3 Layout Manager and Layouts, The JComponent class 4.4 Components – JLabel, JButton, JText, JTextArea, JCheckBox, JRadioButton, JList, JComboBox, JMenu and JPopupMenu Class, JMenuItem 4.5 Dialogs (Message, confirmation, input), JFileChooser 4.6 Event Handling: Event sources, Listeners – ActionListener, ItemListener 4.7 Mouse and Keyboard Event Handling 4.8 Adapters – MouseAdapter, KeyAdapter 4.9 Anonymous inner class	
Unit V	**Database Programming**	**10 Hrs**

	5.1 The role of jdbc, jdbc configuration 5.2 Types of drivers 5.3 Connectivity with database 5.4 JDBC Statements – Statement, PreparedStatement, CallableStatement 5.5 Scrollable and updatable result sets - TYPE_FORWARD_ONLY, TYPE_SCROLL_INSENSITIVE, TYPE_SCROLL_SENSITIVE - CONCUR_READ_ONLY, CONCUR_UPDATABLE 5.6 Metadata – DatabaseMetadata, ResultSetMetadata (Database : PostgreSQL)	
Unit VI	**Servlets & JSP**	**10 Hrs**
	Servlets 6.1 Introduction to Servlets and Hierarchy of Servlets 6.2 Life cycle of a servlet 6.3 Tomcat configuration (Note: Only for Lab Demonstration) 6.4 Handing get and post request (HTTP) 6.5 Handling a data from HTML to a servlet 6.6 Session tracking – Cookies and Http Session **JSP** 6.7 Simple JSP program 6.8 Life cycle of a JSP 6.9 Implicit Objects 6.10 Scripting elements – Declarations, Expressions, Scriplets, Comments 6.11 JSP Directives – Page Directive, include directive 6.12 Mixing Scriplets and HTML	

Reference Books:

1) Core Java Volume I - Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-0-13-516630-7
2) The Complete Reference By Herbert Shildt, 11th Edition, McGraw Hill Education, ISBN 978-260-44023-2
3) Java Beginners Guide By Herbert Shildt, 8th Edition, McGraw-Hill Education ISBN 978-1-260-44021-8
4) Core Java Volume II – Fundamentals By Cay S. Horstmann, 11th Edition, Prentice Hall, ISBN 978-013-516631-4
5) Java 2 Programming Black Book By Steven Holzner, DreamTech Press, ISBN 978-93-5119-953-4

E-Books:

1) The Complete Reference By Herbert Shildt
https://bbooks.info/viewmore/java-the-complete-reference-eleventh-edition
2) Java 2 Programming Black Book By Steven Holzner
https://idoc.pub/documents/java-2-black-book-steven-holzner-vyly2rmq9v4m

Online Courses:

https://nptel.ac.in/courses/106/105/106105191/

SEMESTER V		
BCA 352: DSE II - Data Mining and Data Science		
Teaching Scheme: **Theory: 05 Hrs./Week**	**Credits** **04**	**Examination Scheme:** **Continuous Evaluation: 30 Marks** **End-Semester : 70 Marks**

Pre-requisite Course:

- BCA 117 Applied Mathematics Laboratory
- BCA 232 Database Management Systems-II

Companion Course:

- BCA 357 DSE- II Laboratory (Data Mining)

Course Objectives:

- To introduce students to the basic concepts and techniques of Data Mining and Data Science
- To study data mining algorithms for solving practical problems.
- To understand data visualization and exploratory analysis.

Course Outcomes:

After successful completion of this course, learner will be able to:

- Identify the key processes of data mining, data warehousing and knowledge discovery
- Design data warehouse with dimensional modeling and apply OLAP operations.
- Identify appropriate data mining algorithms to solve real world problems
- Compare and evaluate different data mining techniques like classification, prediction, clustering and association rule mining
- Choose an appropriate method to perform exploratory analysis.
- Interpret results by carrying out data visualization and formal inference procedures

	Course Contents	
Unit I	**Introduction to Data Mining**	**10 Hrs**
	1.1 Definition Data mining 1.2 Data Mining issues 1.3 Stages of the Data Mining Process (KDD) 1.4 Data Mining Techniques/Tasks 1.5 Knowledge Representation Methods 1.6 Applications of Data mining 1.7 Data Pre-processing 1.7.1 Data Cleaning 1.7.2 Data Transformation 1.7.3 Data Reduction 1.7.4 Data Discretization	
Unit II	**Data Warehousing**	**08 Hrs**
	2.1 Introduction to Data Warehouse 2.2 Data Warehouse Architecture and its components 2.3 Data Modeling with OLAP 2.3.1 Introduction 2.3.2 Difference between OLTP and OLAP	

	2.3.3 Data Mart 2.3.4 Fact Table, Dimension Table, OLAP cube 2.3.5 Different OLAP Operations 2.4 Schema Design 2.4.1 Introduction 2.4.2 Star and snow-Flake Schema 2.5 Introduction to Machine Learning 2.6 Introduction to Pattern Matching 2.7 Case study based on Schema Design	
Unit III	**Classification**	**12 Hrs**
	3.1 Introduction, Definition 3.2 Decision Tree 3.2.1 Introduction 3.2.2 Construction Principle 3.2.3 Attribute Selection Measures 3.2.4 Tree Pruning 3.3 Rule-Based Classification 3.3.1 Using IF-THEN Rules for Classification 3.3.2 Rule Extraction from a Decision Tree 3.4 Bayes Classification Methods 3.4.1 Bayes' Theorem 3.4.2 Naive Bayesian Classification 3.5 Bayesian Networks 3.6 Parameter and structure learning 3.7 Linear classifier 3.8 Perceptron 3.9 k-Nearest-Neighbor Classifiers 3.10 SVM classifiers 3.10.1 Introduction 3.10.2 Types of SVM 3.10.3 Working of SVM 3.11 Regression 3.11.1 Linear Regression 3.11.2 Non linear Regression 3.12 Introduction to Prediction	
Unit IV	**Clustering and Association Rule Mining**	**10 Hrs**
	4.1 Cluster Analysis 4.1.1 Introduction 4.1.2 Requirements for Cluster Analysis 4.2 Hierarchical Methods 4.2.1 Agglomerative Hierarchical Clustering 4.2.2. Divisive Hierarchical Clustering 4.3 Partitioning Methods 4.3.1 k-Means: A Centroid-Based Technique 4.3.2 k-Medoids: A Representative Object-Based Technique	

	4.4 Introduction to Association Rule Mining Market Basket Analysis, Items, Itemsets and Large Itemsets 4.5 Apriori Algorithm 4.6 Kinds of Association Rules Mining Multilevel association rules Constraint Based Association rules mining	
Unit V	**Introduction to Data Science**	**10 Hrs**
	5.1. Basics of Data 5.2 What is Data Science? 5.3. Data science process 5.4. Stages in a Data Science project 5.5 Applications of Data Science in various fields 5.6. Basics of Data Analytics 5.7 Types of Analytics – Descriptive, Predictive, Prescriptive 5.8 Statistical Inference - Populations and samples - Statistical modeling - probability distributions	
Unit VI	**EDA and Data Visualization**	**10 Hrs**
	6.1 What is Exploratory Data Analysis ? 6.2 Steps in EDA 6.3 Basic tools (plots, graphs and summary statistics) of EDA 6.4 Types of exploratory data analysis 6.5 Basic principles of data visualization 6.6 Benefits of Data Visualization 6.7 Data visualization techniques 6.8 Tools for data visualization	

Reference Books:

1) Data Mining : Introductory and Advanced Topics by Margaret Dunham, S. Sridhar, Pearson Publication

2) Data Mining concepts and Techniques by Jiawei Han and Micheline Kamber, ELSEVIER, Third Edition,

3) R and Data Mining, By Yanchang Zhao, Elsevier Inc., ISBN-10: 0123969638

4) Data Science from Scratch: First Principles with Python By O''Reilly Media, 20153.

5) Making sense of Data: A practical Guide to Exploratory Data Analysis and Data Mining by Glenn J. Myatt John Wiley Publishers, 2007

E-Books:

1. http://myweb.sabanciuniv.edu/rdehkharghani/files/2016/02/The-Morgan-Kaufmann-Series-in-Data-Management-Systems-Jiawei-Han-Micheline-Kamber-Jian-Pei-Data-Mining.-Concepts-and-Techniques-3rd-Edition-Morgan-Kaufmann-2011.pdf
2. https://data-flair.training/blogs/data-mining-tutorial/
3. http://infolab.stanford.edu/~ullman/mmds/book.pdf
4. https://archive.org/details/IntroductionToDataMining
5. https://www.academia.edu/6489220/Data_Mining_ebook
6. https://en.wikibooks.org/wiki/Data_Mining_Algorithms_In_R
7. https://www.cs.umd.edu/~samir/498/10Algorithms-08.pdf
8. http://www.elfhs.ssru.ac.th/morakot_wo/file.php/1/9781788290678-

SEMESTER V

BCA 353: DSE III (Principles of Operating Systems)

Teaching Scheme:	Credits	Examination Scheme:
Theory: 05 Hrs./Week	04	Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course:

- BCA123 Operating System Concepts

Companion Course:-

- BCA 358 DSE III Laboratory (Operating Systems & AI)

Course Objectives:

- To study algorithms for CPU-scheduling, process creation and termination.
- To understand the notion of a Multithreading and Inter-process communication.
- To learn critical-section problems and classical process-synchronization problems.
- To know the concept of deadlock, different methods for preventing or avoiding deadlocks and techniques for memory management.
- To learn and understand file system, directory structure, file allocation methods and disk scheduling algorithms.

Course Outcomes:

After successful completion of this course, learner will be able to:

- Describe algorithms for process, memory and disk scheduling
- Apply technique for inter-process communication and Multithreading.
- Implement concept of critical-section
- Compare and contrast deadlock avoidance and prevention.
- Use functions for file system management

	Course Contents	
Unit I	**Process Scheduling and Multithreaded Programming**	**14 Hrs**
	1.1 Process Scheduling – Scheduling queues, Schedulers, context switch 1.2 Operations on Process – Process creation with program using fork(), Process termination 1.3 Interprocess Communication – Shared memory system, Message passing systems 1.4 Multithreaded Programming – Overview, Multithreading Models 1.5 Basic Concept – CPU-I/O burst cycle, CPU Scheduler, Pre-emptive Scheduling, Dispatcher 1.6 Scheduling Criteria 1.7 Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round-robin scheduling, Multiple queue scheduling, Multilevel feedback queue scheduling 1.8 Thread Scheduling	
Unit II	**Process Synchronization**	**8 Hrs**

	2.1 Background 2.2 Critical Section Problem 2.3 Semaphores: Usage, Implementation 2.4 Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem, The dining philosopher problem	
Unit III	**Deadlocks**	**10 Hrs**
	3.1 System Model 3.2 Deadlock Characterization – Necessary Conditions, Resource Allocation Graph 3.3 Deadlock Prevention 3.4 Deadlock Avoidance - Safe state, Resource-Allocation-Graph Algorithm, Banker"s Algorithm 3.5 Deadlock Detection 3.6 Recovery from Deadlock – Process Termination, Resource Pre-emption	
Unit IV	**Memory Management**	**12 Hrs**
	4.1 Background – Basic Hardware, Address Binding, Logical Versus Physical Address Space, Dynamic Loading, Dynamic Linking and Shared Libraries, Overlays 4.2 Swapping 4.3 Contiguous Memory Allocation – Memory mapping and protection, Memory allocation, Fragmentation 4.4 Paging – Basic Method, Hardware support, Protection, Shared Pages 4.5 Segmentation – Basic concept, Hardware 4.6 Virtual Memory Management – Demand paging, Performance of demand paging, Page replacement – FIFO, Optimal, LRU, Second Chance Algorithm 4.7 Thrashing – Cause of thrashing, Working-Set Model	
Unit V	**File System**	**10 Hrs**
	5.1 File Concept, File Attribute, File Operations, File Types, File Structure 5.2 Access Methods - Sequential Access Method, Direct Access Method, Other Access Methods 5.3 Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic graph directory, General graph directory 5.4 File System Structure and Implementation - Partitions and Mounting, Virtual File Systems 5.5 Allocation Methods - Contiguous allocation, Linked allocation, Indexed allocation 5.6 Free Space Management – Bit vector, Linked list, Grouping, Counting, Space maps	
Unit VI	**Disk Scheduling**	**6 Hrs**
	6.1 Overview 6.2 Disk Structure 6.3 Disk Scheduling, FCFS Scheduling, SSTF Scheduling, SCAN Scheduling, C-SCAN Scheduling, LOOK Scheduling 6.4 Disk Management	

Reference Books:

1) Operating System Concepts, Avi Silberschatz, Peter Galvin, Greg Gagne, 8th Edition, Wiley Asia
2) Operating Systems: Internals and Design Principles, William Stallings, Prentice Hall of India.
3) The Design of the UNIX Operating System By Maurice J. Bach., PHI publication

E-Books:

1) http://www.uobabylon.edu.iq/download/M.S%202013-2014/Operating_System_Concepts,_8th_Edition%5BA4%5D.pdf

SEMESTER V		
BCA354: Artificial Intelligence		
Teaching Scheme: **Theory: 3 Hrs./Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation: 15 Marks** **End-Semester :35 Marks**

Pre-requisite Course:

- BCA112 Problem Solving and C Programming
- BCA231 Data Structures.

Companion Course:

- BCA358 Laboratory (Operating Systems and AI)

Course Objectives:

- To learn various types of algorithms useful in Artificial Intelligence (AI).
- To convey the ideas in AI research related to emerging technology.
- To introduce ideas and techniques underlying the design of intelligent computer systems

Course Outcomes:

After successful completion of this course, learner will be able to:

- Apply the suitable algorithms to solve AI problems
- Identify and apply suitable Intelligent agents for various AI applications
- Build smart system using different informed search / uninformed search or heuristic approaches
- Represent complex problems with expressive language of representation

	Course Contents	
Unit I	**Introduction to Artificial Intelligence** 1.1 Introduction to AI 1.2 Comparison of AI, Machine Learning, Deep Learning 1.3 Applications of AI 1.4 AI Techniques 1.5 Intelligent Agents, Agents and Environments, Structure of Agents	4 Hrs
Unit II	**Problems, Problem Spaces and search** 2.1 Defining problem as a State Space Search 2.2 Production System 2.3 Problem Characteristics 2.4 Search & Control Strategies 2.5 Problems – Water Jug problem, Missionary Cannibal Problem, Block words Problem, Monkey & Banana problem	5 Hrs
Unit III	**Searching Algorithms** 3.1 Uninformed Search Algorithms/Blind Search Techniques 3.1.1 Breadth-first Search 3.1.2 Depth-first Search 3.2 Informed (Heuristic) search Techniques 3.2.1 Generate-and-test 3.2.2 Simple Hill Climbing	6 Hrs

	3.2.3 Best First Search 3.2.4 Constraint Satisfaction 3.2.5 Means End Analysis 3.2.6 A* and AO*	
Unit IV	**Knowledge Representation**	**7 Hrs**
	4.1 Definition of Knowledge 4.2 Types of knowledge (Procedural and Declarative knowledge) 4.3 Approaches to Knowledge Representation 4.4 Knowledge representation using Propositional and Predicate logic 4.5 Conversion to clause form 4.6 Resolution in Propositional logic 4.7 Resolution in Predicate logic	
Unit V	**Slot and Filler Structures**	**4 Hrs**
	5.1 Weak structures (Semantic networks and Frame) 5.2 Strong structures (Conceptual dependencies and Script)	
Unit VI	**Recent Trends in AI and Applications**	**4 Hrs**
	6.1 Introduction to Machine Learning, 6.2 Types of Learning, (Supervised, Unsupervised and Reinforcement Learning), 6.3 Predictive Analytics (Weather Forecasting) 6.4 AI-Powered Chatbots (SBI card chatbot (ILA))	

Reference Books:

1) Artificial Intelligence, Tata McGraw Hill, Elaine Rich and Kevin Knight
2) Computational Intelligence, Eberhart, Elsevier, ISBN 9788131217832
3) Artificial Intelligence: A New Synthesis, Nilsson, Elsevier, ISBN 9788181471901
4) Introduction to Artificial Intelligence and Expert System, Dan Patterson, Prentice Hall of India Pvt. Ltd., New Delhi, 1997
5) Artificial Intelligence: A Modern Approach, Russel &Norvig, Pearson Education
6) Introduction to Machine Learning, Ethem Alpaydin, PHI

E-References:

1) https://www.oracle.com/in/chatbots/what-is-a-chatbot/
2)https://www.dataversity.net/case-study-predictive-analytics-and-data-science-keep-an-eye-on-the-weather/
3) https://www.senseforth.ai/conversational-ai-case-studies/SBI-Cards/

SEMESTER V

BCA 355: SEC II (Cloud Computing)

Teaching Scheme: Theory: 3 Hrs./Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks

Pre-requisite Course:

- BCA233 Computer Network

Companion Course: NIL

Course Objectives:

- To study cloud computing concepts, technologies, architecture and applications.
- To understand issues in application deployment and implementations in cloud environment.
- To learn recent trends in cloud computing.

Course Outcomes:

After successful completion of this course, learner will be able to:

- Explain the core issues in cloud computing such as security, privacy, and interoperability.
- Choose the appropriate technologies, algorithms, and approaches for the given application.
- Compare and contrast various cloud services

	Course Contents	
Unit I	**Introduction to Cloud Computing** 1.1 Overview, Layers and Types of Cloud 1.2 Desired Features of a Cloud 1.3 Benefits and Disadvantages of Cloud Computing 1.4 Cloud Infrastructure Management 1.5 Infrastructure as a Service	3 Hrs
Unit II	**Abstraction and Virtualization** 2.1 Using Virtualization Technology 2.2 Load Balancing and Virtualization – The Google Cloud 2.3 Understating Hypervisors – Virtual Machine types 2.4 Exploring SaaS – salesforce.com 2.5 Exploring PaaS- force.com, Exploring IaaS – Amazon EC2	6 Hrs
Unit III	**Programming Environment** 3.1 Features of Cloud and Grid Platforms, 3.2 Programming Support of Google App Engine 3.3 Programming on Amazon AWS 3.4 Microsoft Azure 3.5 Emerging Cloud Software Environments.	6 Hrs

Unit IV	**Deploying Applications and cloud services** 4.1 Moving application to cloud 4.2 Microsoft Cloud Services 4.3 Google Cloud Applications 4.4 Amazon Cloud Services 4.5 Cloud Applications.	5 Hrs
Unit V	**Emerging trends in cloud computing** 5.1 Multi-Cloud Vs Omni-Cloud 5.2 Integrated Blockchain technology 5.3 Kubernetes 5.4 Cloud AI 5.5 Intelligent SaaS 5.6 Kubernetes Supremacy 5.7 Containerization by Industry Giants	5 Hrs
Unit VI	**Security In The Cloud** 6.1 Security Overview 6.2 Cloud Security Challenges and Risks 6.3 Software-as-a-Service Security 6.4 Security Governance 6.5 Risk Management – Security Monitoring 6.6 Security Architecture Design.	5 Hrs

Reference Books:

1) Cloud Computing: Principles and Paradigms, Editors, RajkumarBuyya, James Broberg, Andrzej M. Goscinski, Wiley,2011.
2) Enterprise Cloud Computing - Technology, Architecture, Applications, Gautam Shroff, Cambridge University Press, 2010.
3) Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010.
4) Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Ronald L. Krutz, Russell Dean Vines, Wiley- India,2010.
5) Cloud Computing: Technologies and Strategies of the Ubiquitous Data Center, Brian J. S. Chee and Curtis Franklin.
5) AWS, The ultimate guide from beginners to advanced, Maveric Koston.
6) Microsoft Azure: Planning, Deploying, and Managing Your Data Center in the Cloud, Anthony Puca, Mike Manning, Marshal Copeland, Julian Soh, David Gollob.

E-Books:

1) https://openlibrary.org/
2) https://nlist.inflibnet.ac.in/
3) https://archive.org/
4) https://books.google.co.in/
5)https://en.wikibooks.org/wiki/Main_Page

SEMESTER V

BCA356: DSE I Laboratory (Programming in JAVA)

Teaching Scheme: PR: 4* Hours/Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester Exam : 35 Marks

Prerequisite Courses:

- BCA 241 Object Oriented Programming and C++

Companion Courses:

- BCA 351 DSE I (Programming in Java)

Course Objectives:

- To learn implementation of object-oriented concepts with Java.
- To understand collection classes and interfaces.
- To know the process of application development using Graphical User Interface (GUI).
- To acquire knowledge about handling databases using Java.
- To study web components for developing web applications.

Course Outcomes:

After Completion of this course, students will able to

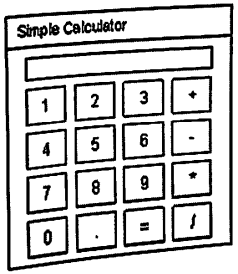
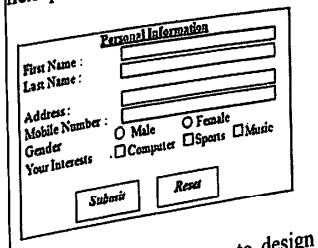
- Identify classes, objects, class members and relationships for a given problem.
- Design end to end applications using object oriented constructs.
- Apply collection classes for storing java objects.
- Use Java APIs for program development.
- Handle abnormal termination of a program using exception handling.

Lab Course Contents

Assignment No	Assignment Name	No.Of Sessions
1	**Basics of Java, Classes and Objects** Classes and objects, Array of objects, Static keyword, Constructor 1. Write a Java program to accept a number from command prompt and generate multiplication table of a number. 2. Write a Java program to print the factors of a number. 3. Write a Java program to display Fibonacci series using recursion. 4. Write a Java program to accept a number from user and print all prime numbers upto that number(Use Buffered Reader class) 5. Write a Java program to print the sum of elements of the array. 6. Write a Java Program which define class Product with data member as id, name and price Store the information of 5	04

	products and Display the name of product having minimum price(Use array of object). 7. Write a Java Program which define class Employee with data member as id, name and salary Store the information of n employees and Display the name of employee having maximum salary (Use array of object). 8. Define a class student having rollno, name and percentage. Define Default and parameterized constructor. Overload the constructor. Accept the 5 student details and display it.(use this keyword). 9. Define a class MyNumber having one private integer data member. Write a default constructor initialize it to 0 and another constructor to initialize it to a value. Write methods isNegative, isPositive, isOdd, iseven. Use command line argument to pass a value to the object and perform the above tests. 10. Define a class CricketPlayer(name, no_of_innings, no_of_times_notout, total_runs, bat_avg). Create an array of "n" player objects. Calculate the batting average for each player using a static method avg (). Handle appropriate exception while calculating average. Define static method "sortPlayer" which sort the array on the basis of average. Display the player details in sorted order.	
2	**Inheritance and Interface** Types of Inheritance, Method Overriding, Super keyword, Abstract classes, Interfaces, Package 1. Write a Java program to create a super class Vehicle having members Company and Price. Derive two different classes LightMotorVehicle (mileage) and HeavyMotorVehicle (capacity_in_tons). Accept the information for "n" vehicles and display the information in appropriate form. While taking data, ask user about the type of vehicle first. 2. Define a class Employee having members – id, name, department, salary. Define default and parameterized constructors. Create a subclass called Worker with private member bonus. Define methods accept and display in both the classes. Create "n" objects of the Worker class and display the details of the worker having the maximum total salary (salary + bonus). 3. Define a class Student with attributes rollno and name. Define default and parameterized constructor. Override the toString () method. Keep the count of Objects created. Create objects using parameterized constructor and Display the object count after each object is created. 4.Create an interface "CreditCardInterface" with methods: viewCreditAmount(), useCard(), payCard(), and increaseLimit(). Create a class "SolverCardCustomer" (name,	04

	cardnumber (16digit), creditamount-initialized to 0, creditLimit-set to 50,000) which implements above interface. Inherit class GoldCardCustomer from SilverCardCustomer having same methods but creditLimit of 1,00,000. Create an object of each class and perform operations. Display appropriate messages for success or failure of transaction. (Use method overloading) a) useCard() method increase the creditAmount by a specific amount uptocreaditLimit. b) payCreadit() reduces the creditAmount by a specific amount. c) increaseLimit() increases the creaditLimit for GoldCardCustomers (only 3 times, not more than 5000 rupees each time.) 5. Create an abstract class Shape with methods area & volume. Derive two classes Sphere (radius), Cylinder(radius, height) from it. Calculate area and volume of both. (Use Method Overriding) 6. Define an Interface Shape with abstract method area(). Write a java program to calculate an area of Circle and Sphere.(use final keyword) 7. Create a package named Series having three different classes to print series: a. Fibonacci series b. Cube of numbers c. Square of numbers Write a java program to generate „n" terms of the above series. 8. Write a package game which will have 2 classes Indoor & Outdoor. Use a function display() to generate the list of player for the specific game. Use default & parameterized constructor.	
3	**Collection, Exception handling and I/O** List, Set, Map interface related classes, Exception handling-try and catch, User defined Exception, File class 1.Accept N integers from the user and store them in a collection. Display them in the sortedorder. The collection should not accept duplicate elements. (Use a suitable collection). 2. Construct a Linked List having names of Fruits: Apple, Banana, Guava and Orange and Display i. the contents of the List using an Iterator; ii. the contents of the List in reverse order using a ListIterator; 3.Create a Hash table containing Student Name and Percentage. Display the contents of the hash table. Also	04

	search for a specific Student and display his percentage. 4.Write a java program to accept a number from the user, if number is zero then throw user defined exception —Number is 0, otherwise check whether no is prime or not 5. Write a java program to accept Doctor Name from the user and check whether it is valid or not. (It should not contain digits and special symbol) If it is not valid then throw user defined Exception —Name is Invalid -- otherwise display it. 6. Write a class Driver with attributeslicense_no, name, address and age. Initialize values through the parameterized constructor. If age of Driver is less than 18 then user-defined exception should be generated —Age is below 18 years -. 7. Write a java program that displays the number of characters, lines and words of a file. 8. Write a java program to accept details of n customers (c_id, cname, address, mobile_no) from user and store it in a file (Use DataOutputStream class). Display the details of customers by reading it from file.(use DataInputStream class)	
4	**Swing** GUI designing, Event handling on GUI 1.Write a java program to design the following GUI using Swing components.  2. Write a java program to design a following GUI using Swing. After submission, display the accepted details on the next page. (Use Event Handling)  3. Write a java program to design the following GUI using Swing components.	04

	Customer account Details Name of Customer: _____ Name of Bank . . _____ Account No. : _____ Pan Number: _____ Submit 4.Write a program to create following GUI using Swing and check whether username and password is correct or not. (Use Event Handling) **User Login** User Name: _____ Password . _____ Submit	
5	**Database Programming :** Use DriverManager class, Statement, PreparedStatement interface, ResultSet interface, ResultsetMetaData Interface to Execute DML commands 1. Create a table Country (Name, continent, Capital, Region).Insert values in the table. Write a program to display all the countries located in West Region. 2. Write a program to display information about the ResultSet like number of columns available in ResultSet and SQL type of the column. (Consider the table mentioned in 1.) 3. Write a menu driven program to perform the following operations on the table District(ID, Name, Population, State, Area). a. Insert b. Modify c. Delete d. Search e. Display f. Exit 4. Create a table Course (Code,name, department, number_of_students). Insert values in the table. Write a program to update number_of_studentsof "BCA Science" to 1000. 5. Write a program to insert the records into the table Employee (ID,name,salary) using PreparedStatement interface	04

6	**Servlets and JSP :** Servlet lifecycle: Init(), Service(), doGet(), doPost(), destroy(), Form data parsing: getParameter(), getParameterValues(), JSP implicit objects, JSP tags: Directives, Declarations, Scriptlets, Expressions 1. Write a program to display Servlet Life Cycle. 2. Write a SERVLET program to display number of times user has visited the page. (use cookies) 3. Write a JSP program to check whether given number is Prime or not. (Use Include directive). 4. Write a JSP program to display the details of Player (ID, Name, TeamName) from a database on a browser using JSP. 5. Write a JSP Program to validate username and password 6. Write a JSP program to calculate factorial value for an integer number. Take the input in a HTML form.	04
	Total Number of Sessions	24

SEMESTER V		
BCA357: DSE II Laboratory (Data mining)		
Teaching Scheme: **PR:4* Hours/Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation : 15 Marks** **End-Semester Exam : 35 Marks**
Prerequisite Courses: • **BCA 246 Python Programming Laboratory**		
Companion Courses: • **BCA 352 DSE II (Data Mining and Data Science)**		
Course Objectives: • To understand the basics of R programming • To study facilities for performing data mining with R packages • To learn python functionalities and features used for data mining • To explore Data analysis and Data Visualization using Python		
Course Outcomes: After completion of this course, students will able to • Implement data mining tasks using R • Use the python packages to carry out data mining tasks. • Perform data analysis and data visualization using python packages.		
Lab Course Contents		
Assignment No	**Assignment Name**	**No. Of Sessions**
1	**R Programming Basics, Programs using List, Matrix, String and Factors, Program using data frame and visualization** 1. Write a R program to add, multiply and divide two vectors of integer type. (vector length should be minimum 4) 2. Write a R program to calculate the multiplication table using a function. 3. Write a script in R to create a list of employees and perform the following: Display names of employees in the list. Add an employee at the end of the list. Remove the third element of the list. 4. Write a R program to sort a list of strings in ascending and descending order. 5. Write a R program to reverse a number and also calculate the sum of digits of that number. 6. Write a R program to calculate the sum of two matrices of given size. 7. Write a R program to concatenate two given factors. 8. Write a R program to create a data frame using two given vectors and display the duplicate elements. 9. Write a R program to perform the following:	10

	Display all rows of the data set having height greater than 120. Display all rows of data set in ascending order of weight. a. (Use inbuilt data set woman) 10. Write a R program to perform the following: Display all the cars having mpg more than 20. Subset the data set by mpg column for values greater than 15.0 Display all cars having four gears. (Use inbuilt data set mtcar) 11. Write a R Program to perform the following: Create a Scattered plot to compare wind speed and temperature. Create a Scattered plot to show the relationship between ozone and wind values by giving appropriate values to colour argument. Create a Bar plot to show the ozone level for all the days having temperature > 70. (Use inbuilt datasetair quality)	
2	**Classification – Decision tree** Conversion of Categorical values in numeric format for a given dataset. Perform Classification using Decision Tree algorithm	03
3	**Association Rules and Clustering (Using inbuilt Data set)** Perform ARM using Apriori Algorithm Perform Clustering using k-means clustering algorithm	04
4	**Regression Analysis and Outlier detection** Perform Regression Analysis. Perform Linear Regression	03
5	**Python programs for Clustering** Write a python program to implement k-nearest Neighbors ML algorithm to build prediction model (Use Forge Dataset) Write a python program to implement k-means algorithms on a synthetic dataset.	04
	Total Number of Sessions	24

SEMESTER V		
BCA 358: DSE III Laboratory (Operating Systems and AI)		
Teaching Scheme: **PR: 4* Hours/Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation : 15 Marks** **End-Semester Exam : 35 Marks**

Prerequisite Courses:

- BCA123 Operating System Concepts

Companion Courses:

- BCA 353 : DSE III (Principles of Operating Systems)
- BCA 354: SEC I (Artificial Intelligence)

Course Objectives:

- To study the process management and scheduling.
- To Study Memory Management
- To study and understand searching techniques

Course Outcomes:

After successful completion of this course, learner will be able to:

- Implement algorithms for Process scheduling and Memory management
- Describe process synchronization and multithreading
- Compare and contrast the algorithms for memory management and its allocation policies.
- Use searching algorithms
- Design a simple Expert system

Lab Course Contents

Assignment No	Assignment Name	No. Of Session
1	**Assignment 1: Operations on processes** 1. Create a child process using fork(), display parent and child process id. Child process will display the message "Hello World" and the parent process should display "Hi". 2. Creating a child process using the command exec(). Note down process ids of the parent and the child processes, check whether the control is given back to the parent after the child process terminates. Write a similar program using execv() and execvp() and observe the differences in behaviors of the commands 3. Creating a child process without terminating the parent process Write a program to create a child process using fork().The parent should goto sleep state and child process should begin its	2

	execution. In the child process, use execl() to execute the "ls" command. 4. Write a program to illustrate the concept of orphan process (Using fork() and sleep()) 5. Write a program that demonstrates the use of nice() system call. After a child process is started using fork(), assign higher priority to the child using nice() system call. 6. Write a program to find the execution time taken for execution of a given set of instructions (use clock() function)	
2	**Assignment 2: CPU Scheduling** FCFS, SJF, Priority Scheduling, Round-robin scheduling a. Write a program to simulate FCFS CPU-scheduling algorithm. Accept number of Processes as input. Also accept arrival time and CPU burst time for each process as input. The output should generate a Gantt chart, turnaround time and waiting time for each process. Also display the average turnaround time and average waiting time. b. Write a program to simulate Non-Pre-emptive Shortest Job First (SJF) CPU scheduling algorithm. Accept the number of Processes and arrival time and CPU burst time for each process as input. The output should generate a Gantt chart, turnaround time and waiting time for each process. Also display the average turnaround time and average waiting time. c. Write a program to simulate Non-Pre-emptive Priority and Round robin CPU scheduling algorithm. Accept the number of Processes and arrival time, CPU burst time and priority for each process as input. Priorities should be in High to Low order (Example 1 is High and 5 is Low). For Round robin, consider time slice is 2 units.	4
3	**Assignment 3: Deadlock detection and avoidance** Write a program for deadlock detection considering a single instance of each resource using wait for graph. Write a program which will traverse the graph to check for cycles. If a cycle is detected, print the list of processes that are involved in the deadlock. Deadlock avoidance using Banker"s Algorithm Write a program to implement a Banker's Algorithm. Accept the total number of processes (n) and resource types (m) as input. Also accept the number of instances for each resource type, Allocation and Max of	4

size "n x m" as input and perform the following operations:

a) Show the contents of Available array of size "m" b) Calculate and display the contents of Need matrix of size "n x m"

Using Safety and Resource-Request algorithm perform the following operations: a) Check whether the system is in safe state or not
b) If a request of size "m" arrives from process P_i , can it be granted immediately by keeping the system in safe state? Where 0 <= i<=m-1.

2. Consider the following snapshot of the system

Process	Allocation				MAX				Available			
	A	B	C	D	A	B	C	D	A	B	C	D
P0	0	0	1	2	0	0	1	2	1	5	2	0
P1	1	0	0	0	1	7	5	0				
P2	1	3	5	4	2	3	5	6				
P3	0	6	3	2	0	6	5	2				
P4	0	0	1	4	0	6	5	6				

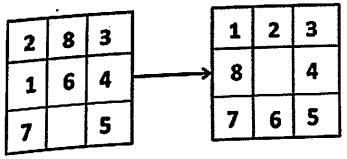
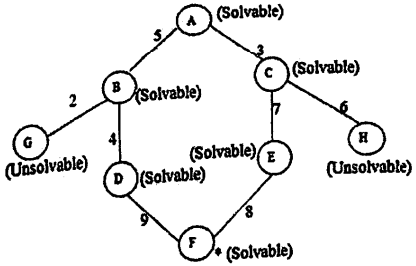
Calculate and display the contents of matrix Need

Using Safety and Resource-Request algorithm decide:

a) Whether the system is in safe state or not.

b)If the request from process P_4 arrives as (0, 0, 4, 1), can it be granted immediately by keeping system in safe state?

4	**Assignment 4: Page Replacement Algorithms:** FIFO, Optimal, LRU a. Consider the following page reference string: 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3 How many page faults would occur for the following page replacement algorithms assuming four frames? All frames are initially empty. 1. LRU 2. Optimal 3. FIFO	4

	b. Write a program to simulate demand paging using FIFO, LRU, optimal page replacement algorithms. Assume the memory of "n" frames. Show the contents of the page after every page replacement in a frame and at the end show the total number of page faults accordingly. Reference String : 3,4,5,4,3,4,7,2,4,5,6,7,2,4,6	
5	**Assignment 5: Implement A* Algorithm** **Sample Assignment** Given an initial state of a 8-puzzle problem and final state to be reached-  **Initial State** **Goal State** Find the most cost-effective path to reach the final state from initial state using A* Algorithm. Consider g(n) = Depth of node and h(n) = Number of misplaced tiles.	4
6	**Assignment 6: Implement AO* Algorithm** **Sample Assignment** Implement AO* algorithm on the following graph.  Figure	4
7	**Design of an Expert System for popular domains such as Medical Diagnosis**	2
	Total Number of Sessions	24

SEMESTER VI		
BCA 361: Android Programming		
Teaching Scheme: **Theory: 05 Hrs./Week**	**Credits** **04**	**Examination Scheme:** **Continuous Evaluation: 30 Marks** **End-Semester: 70 Marks**

Pre-requisite Course:
- BCA 351: DSE I (Programming in Java)
- BCA 356: DSE I Lab (Programming in Java)

Companion Course:
- BCA 366: DSE IV (Android Programming)

Course Objectives:
- To understand the Android Operating System
- To study Android Apps Development Cycle
- To learn to create Android Applications.

Course Outcomes:
After successful completion of this course, learner will be able to:
- Describe the process of developing mobile applications.
- Create mobile applications on the Android Platform.
- Design and implement mobile applications involving data storage in SQLite database
- Use location-based services while developing applications

	Course Contents	**06 Hrs**
Unit I	**Introduction to Android** 1.1. Overview 1.2. History 1.3. Features of Android 1.4. Architecture of Android • Overview of Stack • Linux Kernel • Native Libraries • Android Runtime • Application Framework • Applications 1.5. SDK Overview • Platforms • Tools – (JDK, SDK, Eclipse/Android Studio, ADT, AVD, Android Emulator), Versions 1.6. Creating your first Android Application	**10 Hrs**
Unit II	**Activities, Fragments and Intents** 2.1. Introduction to Activities 2.2. Activity Lifecycle 2.3. Introduction to Intents 2.4. Linking Activities using Intents 2.5. Calling built-in applications using Intents 2.6. Introduction to Fragments 2.7. Adding Fragments Dynamically 2.8. Lifecycle of Fragment 2.9. Toast	

Unit III	**Android User Interface**	**06 Hrs**
	3.1. Understanding the components of a screen • Views and View Groups • Linear Layout • Absolute Layout • Table Layout • Relative Layout • Frame Layout • Scroll Layout • Scroll View • Constraint Layout 3.2. Adapting to Display Orientation • Anchoring Views • Resizing and Repositioning 3.3. Split Screen / Multi-Screen Activities	
Unit IV	**Designing Your User Interface with Views**	**13 Hrs**
	4.1. Using Basic Views • TextView • Button, ImageButton, EditText, CheckBox • Switch, ToggleButton, RadioButton, and RadioGroup Views • ProgressBar View • AutoCompleteTextView View 4.2. Using Picker Views • TimePicker View • DatePicker View 4.3. Using List Views to Display Long Lists • ListView View • Using the Spinner View 4.4. Understanding Specialized Fragments • Using a ListFragment • Using a DialogFragment 4.5. Displaying Pictures and Menus 4.5.1. Using Image Views to Display Pictures • Gallery and ImageView views • Image Switcher • Grid View 4.5.2. Using Menus with Views • Creating the helper methods • Options Menu • Context Menu 4.6. VideoView • Play video from URL with using VideoView • VideoView Create • Optimized VideoView • Optimized VideoView in ListView	
Unit V	**Databases – SQLite, Messaging and E-mail**	**14 Hrs**
	6.1. Introduction to SQLite 6.2. SQLite Open Helper and SQLite Database 6.3. Creating , opening and closing database 6.4. Working with cursors, Insert, Update, Delete 6.5. Building and executing queries	

	6.6. SMS Messaging • Sending SMS Messages Programmatically • Getting Feedback after Sending a Message • Sending SMS Messages Using Intent • Receiving SMS Messages • Caveats and Warnings 6.7. Sending E-mail	
Unit VI	**Location-Based Services and Google Map**	**11 Hrs**
	6.1. Display Google Maps • Creating the project • Obtaining the Maps API Key • Displaying the Map • Displaying the Zoom Control • Changing Views • Navigating to a specific location • Adding Markers • Getting the location that was touched • Geocoding and Reverse Geocoding 6.2. Getting Location Data 6.3. Monitoring a Location	

Reference Books:

1) Beginning Android4 Application Development, By Wei-Meng Lee WILEY India Edition
2) Professional Android 4 Application Development, By Reto Meier WROX Publication
3) Head First Android Development: A Brain-Friendly Guide, By David Griffiths and Dawn Griffiths

E-Books:

1) https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-Programming-Cookbook.pdf
2) https://www.programming-book.com/download/?file=10988
3) http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
4) https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1) The official site for Android developers - https://developer.android.com
2) https://www.tutorialspoint.com/android/index.htm
3) https://www.javatpoint.com/android-tutorial

Unit III	**Android User Interface**	**06 Hrs**
	3.1. Understanding the components of a screen • Views and View Groups • Linear Layout • Absolute Layout • Table Layout • Relative Layout • Frame Layout • Scroll Layout • Scroll View • Constraint Layout 3.2. Adapting to Display Orientation • Anchoring Views • Resizing and Repositioning 3.3. Split Screen / Multi-Screen Activities	
Unit IV	**Designing Your User Interface with Views**	**13 Hrs**
	4.1. Using Basic Views • TextView • Button, ImageButton, EditText, CheckBox • Switch, ToggleButton, RadioButton, and RadioGroup Views • ProgressBar View • AutoCompleteTextView View 4.2. Using Picker Views • TimePicker View • DatePicker View 4.3. Using List Views to Display Long Lists • ListView View • Using the Spinner View 4.4. Understanding Specialized Fragments • Using a ListFragment • Using a DialogFragment 4.5. Displaying Pictures and Menus 4.5.1. Using Image Views to Display Pictures • Gallery and ImageView views • Image Switcher • Grid View 4.5.2. Using Menus with Views • Creating the helper methods • Options Menu • Context Menu 4.6. VideoView • Play video from URL with using VideoView • VideoView Create • Optimized VideoView • Optimized VideoView in ListView	
Unit V	**Databases – SQLite, Messaging and E-mail**	**14 Hrs**
	6.1. Introduction to SQLite 6.2. SQLite Open Helper and SQLite Database 6.3. Creating , opening and closing database 6.4. Working with cursors, Insert, Update, Delete 6.5. Building and executing queries	

	6.6. SMS Messaging • Sending SMS Messages Programmatically • Getting Feedback after Sending a Message • Sending SMS Messages Using Intent • Receiving SMS Messages • Caveats and Warnings 6.7. Sending E-mail	
Unit VI	**Location-Based Services and Google Map**	**11 Hrs**
	6.1. Display Google Maps • Creating the project • Obtaining the Maps API Key • Displaying the Map • Displaying the Zoom Control • Changing Views • Navigating to a specific location • Adding Markers • Getting the location that was touched • Geocoding and Reverse Geocoding 6.2. Getting Location Data 6.3. Monitoring a Location	

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2) Professional Android 4 Application Development, By Reto Meier WROX Publication
WROX Publication
3) Head First Android Development: A Brain-Friendly Guide, By David Griffiths and Dawn
Griffiths

E-Books:

1) https://enos.itcollege.ee/~jpoial/allalaadimised/reading/Android-Programming-Cookbook.pdf
2) https://www.programming-book.com/download/?file=10988
3) http://projanco.com/Library/Android%20App%20Development%20in%20Android%20Studio%20-%20Java%20plus%20Android%20edition%20for%20beginners.pdf
4) https://www.programmer-books.com/professional-android-4th-edition-pdf/

Websites:

1) The official site for Android developers - https://developer.android.com
2) https://www.tutorialspoint.com/android/index.htm
3) https://www.javatpoint.com/android-tutorial

SEMESTER VI

BCA 362: DSE-V Programming in Go

Teaching Scheme: Theory: 05 Hrs./Week	Credits 04	Examination Scheme: Continuous Evaluation: 30 Marks End-Semester : 70 Marks

Pre-requisite Course:

- BCA122: Advanced C Programming
- BCA241: Object Oriented Programming and C++

Companion Course:

- BCA367: DSE V Lab (Programming in GO and IoT)

Course Objectives:

- To study various programming constructs in GO
- To understand salient features in GO
- To know advance features in GO

Course Outcomes:

After successful completion of this course, learner will be able to:

- Describe the core features and concepts in Go
- Write simple Go programs using functions
- Apply defining methods and Go Interfaces
- Use Go routines and Channels
- Explore Go Packages

	Course Contents	
Unit I	**Introduction**	**10 Hrs**
	1.1 Go Runtime and Compilations 1.2 Keywords and Identifiers 1.3 Constants and Variables 1.4 Operators and Expressions 1.5 Local Assignments 1.6 Booleans, Numeric , Characters 1.7 Pointers and Addresses 1.8Strings 1.9 if-else, switch, for loop 1.10 Iterations 1.11Using break and continue	
Unit II	**Functions**	**10 Hrs**
	2.1 Parameters and Return Values 2.2 Call by Value and Reference 2.3 Named Return Variables 2.4 Blank Identifiers 2.5 Variable Argument Parameters 2.6 Using defer statements 2.7 Recursive Functions 2.8 Functions as Parameters	
Unit III	**Working with Data**	**8 Hrs**
	3.1 Array Literals 3.2 Multidimensional Arrays 3.3 Array Parameters 3.4 Slices and Slice Parameters	

	3.5 Multidimensional Slices 3.6 Structures and Structure Parameters	
Unit IV	**Methods and Interfaces**	**12 Hrs**
	4.1 Method Declarations 4.2 Functions vs. Methods 4.3 Pointer and Value Receivers 4.4 Method Values and Expressions 4.5 Interface Types and Values 4.6 Type Assertions and Type Switches 4.7 Method Sets with Interfaces 4.8 Embedded Interfaces 4.9 Empty Interfaces	
Unit V	**Goroutines and Channels**	**10 Hrs**
	5.1 Concurrency vs. Parallelism 5.2 Goroutine Functions and Lambdas 5.3 Wait Groups 5.4 Channels 5.5 Sending and Receiving 5.6 Unbuffered and Buffered Channels 5.7 Directional Channels 5.8 Multiplexing with select 5.9 Timers and Tickers	
Unit VI	**Packages and Files**	**10 Hrs**
	6.1 Packages and Workspaces 6.2 Exporting Package Names 6.3 Import Paths and Named Imports 6.4 Package Initializations 6.5 Blank Imports 6.6 Unit Testing with Test Functions 6.7 Table Tests and Random Tests 6.8 Benchmarking 6.9 Working with Files	

Reference Books:

1) Introducing Go, Caleb Doxey, Oreilly publication
2) Learning Go Programming: Build Scalable Next-Gen Web Application using Golang (English Edition), Shubhangi Agarwal, BPB publication

E-Books:

1) Introducing Go By Caleb Doxey, Released January 2016Publisher(s): O'Reilly Media, Inc. ISBN: 9781491941959https://www.oreilly.com/library/view/introducing-go/9781491941997/
2) Go Bootcamp by Matt Aimonettihttp://www.golangbootcamp.com/book

Online Courses: Golang free online course with MOOC

SEMESTER VI

BCA 363: DSE VI Software Project Management

Teaching Scheme: Theory: 05 Hrs./Week	Credits 04	Examination Scheme: Continuous Evaluation: 30 Marks End-Semester: 70 Marks

Pre-requisite Course:

- BCA243 Software Engineering

Companion Course:

- BCA 368 DSE VI Project Laboratory

Course Objectives:

- To understand the fundamentals of Software Project Management
- To introduce Software project planning and management tools
- To study software project scheduling and tracking
- To know the agile project management
- To learn managing people in software project

Course Outcomes:

On Successful completion of the course, learners should be able to

- Comprehend Software Project Management Concepts
- Use various tools for Software Project Management Schedule various activities in software projects
- Track a project and manage changes
- Apply Agile Project Management concepts
- Analyze staffing process for team building and decision making

	Course Contents	
Unit I	**Introduction to Software Project Management**	10 Hrs
	1.1 Project Definition 1.2 Project versus Flow type work 1.3 Project Lifecycle 1.4 Processes and Knowledge Areas in Project Management (PM) 1.5 Build or Buy decision, 1.6 Work Breakdown Structure (WBS) and its types 1.7 Introduction to PMBOK, 1.8 Program and Portfolio Management	
Unit II	**Project Planning and Project Management Tools**	10 Hrs
	2.1 Project Planning 2.2 Steps for Project Planning, 2.3 PERT and Gantt Charts 2.4 Introduction to Project Management using Gantt Project 2.5 Objectives of Activity planning 2.6 Project Schedules, Activities, Sequencing and Scheduling 2.7 Network Planning Models, 2.8 Formulating Network Model.	
Unit III	**Activity based Scheduling**	10 Hrs
	3.1 Introduction 3.2 Objectives of Activity Planning 3.3 Activity relationships (FS, SF, SS, FF)	

	3.4 Forward Pass technique 3.5 Backward Pass techniques 3.6 Critical Path concept and remedies	
Unit IV	**Project Tracking and Control**	10 Hrs
	4.1 Introduction 4.2 Collection of Project data 4.3 Visualizing progress 4.4 Cost monitoring 4.5 Earned Value Analysis 4.6 Project tracking 4.7 Change Control 4.8 Software Configuration Management 4.9 Managing contracts and Contract Management.	
Unit V	**Agile Project Management**	10 Hrs
	5.1 Predictive versus Empirical Management 5.2 Comparison between Non-Agile and Agile Project 5.3 Three stages of Agile Project 5.4 Estimation 5.5 Scope Management 5.6 Roles and Responsibilities 5.7 Scheduling and Tracking	
Unit VI	**Staffing in Software Projects**	10 Hrs
	6.1 Managing People Organizational behavior 6.2 Best methods of Staff Selection 6.3 Motivation 6.4 The Oldham Hackman job characteristic Model 6.5 Stress, Health and Safety 6.6 Ethical and Professional Concerns 6.7 Working in Teams, Decision Making 6.8 Organizational structures, Dispersed and Virtual Teams 6.9 Communications Genres and Communication Plans.	

Text Book:

1. Bob Hughes, Mike Cotterell and Rajib Mall, "Software Project Management", Sixth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki, "Effective Software Project Management", Wiley Publication,2011

Reference Books:

1. Ken Schwaber, "Agile Project Management", MicrosoftPress,2004
2. Walker Royce, "Software Project Management", Addison-Wesley,1998.
3. Jalote Pankaj, "Software Project Management in Practice", Addison-WesleyProfessional,2002
4. PMBOK Guide

e-books:

- https://www.kornev-online.net/ITIL/Mcgraw.Hill.Software_Project_Management_2nd_Edition.pdf

SEMESTER VI

BCA364: SEC III Management Information System

Teaching Scheme: Theory: 3 Hrs./Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks

Pre-requisite Course:

- BCA243 Software Engineering

Companion Course: None

Course Objectives:

- To know the role of information technology and decision support systems in business model.
- To learn the fundamental principles of information systems
- To understand the principles and techniques used for management and decision making
- To explore various applications of MIS

Course Outcomes:

After successful completion of this course, learners will able to

- Describe MIS, BPR, EMS
- Compare MIS with BPR, DSS and EMS
- Identify various ERP modules for a given application
- List the applications of MIS in Manufacturing and service sectors

	Course Contents	
Unit I	**Introduction to MIS**	
	1.1 Introduction to MIS 1.2 Definition 1.3 Role of MIS 1.4 Impact of MIS 1.5 MIS as a control system. 1.6 MIS: a support to the management.	3Hrs
Unit II	**Decision Making and Information**	
	2.1 Decision Making Process and models 2.2 Decision Analysis by Analytical Modeling 2.3 Behavioral Concepts in Decision-Making 2.4 Organizational Decision-Making 2.5 Information Management: Classification of Information 2.6 Methods of Data and information collection	5 Hrs
Unit III	**Business Process Re-engineering (BPR)**	
	3.1 Introduction to BPR and Business process 3.2 Process Model of the organization 3.3 Value stream Model of Organization 3.4 Relevance of Information Technology 3.5 MIS and BPR	5 Hrs
Unit IV	**Enterprise Management Systems (EMS)**	
	4.1 Introduction to EMS and ERP 4.2 ERP Model, Modules, Benefits of ERP	7Hrs

	4.3 ERP Product Evaluation and Implementation 4.4 Introduction to Supply Chain management (SCM) and Customer Relationship Management) 4.5 EMS and MIS	
Unit V	**Decision Support Systems & Knowledge Management**	6 Hrs
	5.1 Introduction to Decision Support Systems (DSS) 5.2 Group Decision Support Systems (GDSS) 5.3 Business Intelligence and Analytics 5.4 Executive Information Systems & Executive Support Systems 5.5 Introduction to Knowledge Management 5.6 Knowledge Management Systems 5.7 Knowledge Based Expert Systems (KBES)	
Unit VI	**Applications of MIS in Manufacturing and Service Sectors**	4Hrs
	6.1 MIS for Financial and marketing Management 6.2 Introduction to service and service sector 6.3 Service Process Cycle 6.4 Customer service Design and Service Management System	
	Reference Books • Jawadekar, W.S., "Management Information Systems", Tata McGraw Hill Private Limited, New Delhi, 2009. • Kenneth C. Laudon and Jane P. Laudon: "Management Information Systems" 9/e, Pearson Education, New Delhi. • Goyal, D.P.: "Management Information System", MACMILLAN India Limited, New Delhi, 2008. • Mahadco Jaiswal, Monika Mital: "Management Information System", Oxford University Press, New Delhi, 2008. • Murthy C.S.V.: "Management Information System", Himalaya Publications, New Delhi, 2008.	

SEMESTER VI

BCA365: SEC IV Internet of Things (IoT)

Teaching Scheme: Theory: 3 Hrs./Week	Credits 02	Examination Scheme: Continuous Evaluation: 15 Marks End-Semester : 35 Marks

Pre-requisite Course:

- BCA121: Computer Organization
- BCA125: Computer Organization Laboratory
- BCA233: Computer Networks
- BCA355: SEC II (Cloud Computing)

Companion Course:

- BCA367 DSE V Laboratory (Programming in GO and IoT)

Course Objectives:

- To understand fundamentals of Internet of Things (IoT) and Embedded Systems
- To know methodologies for IoT application development
- To study the IoT protocols, cloud platforms and security issues in IoT
- To learn real world application scenarios of IoT along with its societal and economic impact

Course Outcomes:

On successful completion of the course, learners should be able to

- Define Embedded Systems and the Internet of Things
- Apply enabling technologies for developing IoT systems
- Design simple IoT applications
- Analyze protocols for communication among IoT devices
- Describe cloud-based IoT systems
- Comprehend security issues in IoT applications

	Course Contents	
Unit I	**Introduction to Embedded Systems**	**5 Hrs**
	1.1 Definition, Characteristics of Embedded System, 1.2 Real time systems, Real time tasks 1.3 Processor basics: General Processors in Computer Vs Embedded Processors, Micro controllers and examples 1.4 Components of Embedded Systems, 1.5 Introduction to embedded processor.	
Unit II	**Internet of Things : Concepts**	**5 Hrs**
	2.1 Definition, Characteristics of IoT, Trends in Adoption of IoT, 2.2 IoT Devices, IoT Devices Vs Computers, 2.3 Basic Building Blocks. 2.4 Physical Design of IoT: - Things in IoT, Interoperability of IoT Devices, Sensors and Actuators, Need of Analog/Digital Conversion. 2.5 Logical Design of IoT:- IoT functional blocks, IoT Enabling technologies, IoT levels and deployment templates, Applications of	

	IoT	
Unit III	**Introduction to IoT Design Methodology**	**5 Hrs**
	3.1 Design Steps 3.2 Basics of IoT Networking, Networking Components, Internet Structure 3.3 IoT Communication Models and IoT Communication APIs, 3.4 Sensor Networks 3.5 Four pillars of IoT: M2M, SCADA,WSN, RFID	
Unit IV	**Introduction to IoT Protocols**	**5 Hrs**
	4.1 Protocol Standardization for IoT 4.2 M2M and WSN Protocols 4.3 RFID Protocol, 4.4 Modbus Protocol, Zigbee Architecture. 4.5 IP based Protocols: MQTT (Secure), 6LoWPAN, LoRa.	
Unit V	**Cloud Platforms for IoT**	**5 Hrs**
	5.1 Introduction to Cloud Storage Models, Communication API 5.2 Cloud for IoT 5.3 Introduction to Amazon Web Services for IoT and SkyNet IoT 5.4 Messaging Platform 5.5 Introduction to RESTful Web Services -GRPC,SOAP.	
Unit VI	**Security in IoT**	**5 Hrs**
	6.1 Introduction, Vulnerabilities of IoT, Security Requirements 6.2 Challengesfor Secure IoT, Threat Modeling 6.3 Key elements of IoT Security: Identity establishment, Access control, Data and message security, Non-repudiation and availability 6.4 Security model for IoT 6.5 Challenges in designing IOT applications, Introduction to Lightweight cryptography	

Reference Books:

1. Arshdeep Bahga,Vijay Madisetti, "Internet of Things– A hands- on approach", Universities Press, ISBN: 0: 0996025510, 13:978-996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition, Wiley Publication,ISBN:978-1-119-99435-0
3. Dawoud Shenouda, Peter Dawoud, "Microcontroller and Smart Home Networks", ISBN: 9788770221566, e-ISBN: 9788770221559
4. Charles Crowell, "Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT", ISBN-13 : 979-8613100194
5. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5

SEMESTER VI

BCA366: DSE IV Laboratory (Android Programming)

Teaching Scheme: PR: 4* Hours/Week	Credit 02	Examination Scheme: Continuous Evaluation : 15 Marks End-Semester Exam : 35 Marks

Prerequisite Courses:

- BCA 351: DSE I (Programming in Java)
- BCA 356: DSE I Lab (Programming in Java)

Companion Courses:

- BCA – 361 Android Programming

Course Objectives:

- To understand the Android Operating System and
- To study Android Apps Development Cycle
- To learn to create Android Applications.

Course Outcomes:

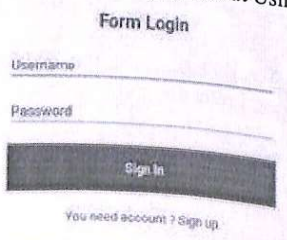
After completion of this course, students will able to

- Describe the process of developing mobile applications.
- Create mobile applications on the Android Platform.
- Design and implement mobile applications involving data storage in SQLite database
- Use location-based services while developing applications

Lab Course Contents

Assignment No	Assignment Name	No. Of Sessions
1	Introduction to Android	02
2	Activities, Fragments and Intents	04
3	Android User Interface	04
4	Designing User Interface with Views	05
5	Databases-SQLite, Messaging and E-mail	05
6	Location-Based Services and Google Map	04
	Total Number of Sessions	24

Sample Assignments Programs

Assignment 1	Introduction to Android Install Android Studio and build simple Hello World application.
Assignment 2	Activities, Fragments and Intents Create Simple application to display details of selected list item on Second Activity (use Fragmentation). Create simple application with Login Screen. On successful login, gives message go to next Activity (Without Using Database). 

	Create a Simple Application Which Send —Hellol message from one activity to another with help of Button (Use Intent).
Assignment 3	Android User Interface Design following-add a border to an Android Layout 
Assignment 4	Designing Your User Interface with Views Construct an app that toggles a light bulb on and off when the user clicks on toggle button. Create gallery application to display all images date wise (Use Grid View).
Assignment 5	Databases-SQLite, Messaging and E-mail Construct a simple notes list that lets the user add new notes but not edit them. Demonstrates the basics of ListActivity. Use a SQLite database to store the notes. Create application to send and receive messages. Create application to send email with validation.
Assignment 6	Location-Based Services and Google Map Write a program to track android device using Google Maps. Write a program to draw path along a route in Google map.

Suggested Online Courses:

Learners may study following online courses

- Advanced App Development in Android Capstone (Coursera)
- Android Basics: Multi screen Apps (Udacity)
- Android Basics: Networking (Udacity)
- Firebase in a Weekend: Android (Udacity)
- Android App Development for Beginners (edX)
- Introduction to Mobile Application Development using Android (edX)

SEMESTER VI		
BCA367: DSE V Laboratory (Programming in GO and IoT)		
Teaching Scheme: **PR: 4* Hours/Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation : 15 Marks** **End-Semester Exam : 35 Marks**

Prerequisite Courses:

- Knowledge of Programming Languages C, C++, Java, Python

Companion Courses:

- BCA362 Programming in GO
- BCA365 Internet of Things (IoT)

Course Objectives:

- To introduce essential programming features in GO
- To become familiar with programming techniques in GO
- To understand the technique of building Packages and File handling
- To learn developing simple IoT applications

Course Outcomes:

On completion of this course, students will be able to:

- Write programs using features supported in GO
- Handle errors and utilize Goroutines and Channels
- Write programs on File handling
- Compare and contrast features of GO with other object oriented languages
- Design Simple IoT application

Lab Course Contents

Assignment No	Assignment Name	No. Of Sessions
Programming in GO		
1	Introduction to Go Programming	02
2	Functions	03
3	Working with data	03
4	Methods and Interfaces	04
5	Go routines and channels	03
6	Packages and files	03
Internet of Things (IoT)		
7	Interfacing Raspberry-Pi/ Adriano with IR sensor	02
8	Interfacing Raspberry-Pi/ Beagle board with temperature sensor	02
9	Interfacing Raspberry-Pi/ Beagleboard with camera	02
		24

Sample Assignments Programs	
Assignment 1	**SET A** 1. WAP in go language to print Student name, rollno, division and college name 2. WAP in go language to print whether number is even or odd. 3. WAP in go language to swap the number without temporary variable. **SET B** 1. WAP in go to print table of given number. 2. WAP in go language to print PASCALS triangle.

	3. WAP in go language to print Fibonacci series of n terms. **SET C** 1. WAP in go language to concatenate two strings using pointers. 2. WAP in go language to accept two strings and compare them. 3. WAP in go language to accept user choice and print answer of using arithmetical operators.
Assignment 2	**SET A** 1. WAP in go language to print addition of two number using function. 2. WAP in go language to print recursive sum of digits of given number. 3. WAP in go language using function to check whether accepts number is palindrome or not. **SET B** 1. WAP in go language to swap two numbers using call by reference concept. 2. WAP in go language to demonstrate use of names returns variables. 3. WAP in go language to show the compiler throws an error if a variable is declared but not used. **SET C** 1. WAP in go language to illustrate the concept of call by value. 2. WAP in go language to create a file and write hello world in it and close the file by using defer statement. 3. WAP in go language to illustrate the concept of returning multiple values from a function
Assignment 3	**SET A** 1. WAP in go language to find the largest and smallest number in an array. 2. WAP in go language to accept the book details such as BookID, Title, Author, Price. Read and display the details of n number of books. 3. WAP in go language to Initialize a Slice using Multi-Line Syntax and display **SET B** 1. WAP in go language to create and print multidimensional Slice. 2. WAP in go language to sort array elements in ascending order. 3. WAP in go language to accept n student details like roll_no, stud_name, mark1,mark2, mark3. Calculate the total and average of marks using structure. **SET C** 1. WAP in go language to accept two matrices and display it's multiplication. 2. WAP in go language to accept n records of employee information (eno,ename,salary) and display record of employees having maximum salary. 3. WAP in go language to demonstrate working of slices (like append, remove, copy etc.)
Assignment 4	**SET A** 1. WAP in go language to create an interface shape that includes area and perimeter. Implements these methods in circle and rectangle type. 2. WAP in go language to print multiplication of two numbers using method. 3. WAP in go language to create structure author. Write a method show() whose receiver is struct author. **SET B** 1. WAP in go language to create structure student. Write a method show() whose receiver is a pointer of struct student. 2. WAP in go language to demonstrate working type switch in interface. 3. WAP in go language to copy all elements of one array into another using method. **SET C**

	1. WAP in go language to create an interface and display it"s values with the help of type assertion. 2. WAP in go language to store n student information(rollno, name, percentage) and write a method to display student information in descending order of percentage. 3. WAP in go language to demonstrate working embedded interfaces.
Assignment 5	**SET A** 1.WAP in Go to illustrate how to create an anonymous Goroutine. 2.WAP in Go how to create channel and illustrate how to close a channel using for range loop and close function. 3. WAP in Go maingoroutine computes the 10th fibonacci number using an inefficient recursive algorithm. **SET B** 1. WAP in GO prints out the numbers from 0 to 10, waiting between 0 and 250 ms after each one using delay function . 2.WAP in GO prints "from 1" every 2 seconds and "from 2" every 3 seconds. select picks the first channel that is ready and receives from it. If more than one of the channels are ready then it randomly picks which one to receive from. If none of the channels are ready, the statement blocks until one becomes available. 3.WAP in Go to illustrate channels buffering. **SET C** 1 WAP in GO . Lambda function handler using structured types you can also pass in structured events to your function handler: 2. WAP in GO implement multiple goroutine function and schedule is determined by the scheduler. 3. WAP in Go program such that the squares are calculated in a separate Goroutine, cubes in another Goroutine and the final summation happens in the main Goroutine
Assignment 6	**SET A** 1. WAP to create student struct with student name and marks and sort it based on student marks using sort package 2. WAP in Go language using user defined package calculator that performs one calculator operation as per the user's choice. 3. WAP in Go language to create an user defined package to find out the area of a rectangle. **SET B** 1. WAP in Go language to add two integers and write code for unit test to test this code. 2. WAP in Go language to subtract two integers and write code for table test to test this code. 3. Write a function in Go language to find square of a number and write a benchmark for it. **SET C** 1. WAP in Go language to read a XML file into structure and display structure 2. WAP in Go language to print file information. 3. WAP in Go language to add or append content at the end of text file.
Assignment 7	Understanding the connectivity of Raspberry-Pi/ Adriano with IR sensor. Write a program to detect obstacle and notify a user using LEDs

Semester VI		
BCA368: DSE VI Project Laboratory		
Teaching Scheme: **PR: 4* Hours/Week**	**Credits** **02**	**Examination Scheme:** **Continuous Evaluation : 15 Marks** **End-Semester Exam : 35 Marks**

Prerequisite Courses:
- BCA243 Software Engineering

Companion Course: BCA363 DSE VI (Software Project Management)

Course Objectives:
1. To understand concepts of Project Management
2. To know how various tools for development and management of software projects are used to carry out various tasks involved
3. To learn the importance of project documentation

Course Outcomes:

After completion of this course, learners will able to

1. Demonstrate a sound technical knowledge of selected project topic.
2. Apply techniques for project management
3. Create various documents used during the development of the project and a project report

Project Implementation Guidelines:

Sr. No.	Guidelines
1	Students shall choose any topic for project work in consultation with project guide, Project In-charge and head of the department.
2	The students shall work on a Project in a group of not more than three students.
3	Students are expected to work on the chosen project during the entire semester.
4	Students shall undertake application oriented/web-based/database-oriented/research based work.
5	Students shall successfully implement the chosen work. Only a hypothetical / theoretical study shall not be accepted.
6	Students shall choose any appropriate programming language/ platform, computational techniques and tools in consultation with the guide, In-charge and the head of the department.
7	The faculty members from affiliated college shall act as a project guide for each project group with equal distribution of groups amongst each eligible faculty.
8	The guide shall track and monitor the project progress on a weekly basis by considering the workload of 4 laboratory hours per week.
9	The project work shall be evaluated based on the novelty of the topic, scope of the work, relevance to computer science, adoption of emerging techniques/technologies and its real-world application etc.
10	Students shall prepare a project report with the following contents: a) Title Page b) Certificate c) Index Page detailing description of the following with their sub sections:- - Title: A suitable title giving the idea about what work is proposed. - Introduction: An introduction to the topic giving proper background of the topic. - Requirement Specification: Specify Software/hardware/data requirements. - System Design details :Methodology/Architecture/UML/DFD/Algorithms/protocols used(whichever is applicable) - System Implementation: Code implementation

	- Results: Test Cases/Tables/Figures/Graphs/Screen shots/Reports etc. - Conclusion and Future Scope: Specify the Final conclusion and future scope - References: Books, web links, research articles etc.
11	The Project report should be prepared in a spiral bound form with adequate number of copies. Copy shall be submitted to the guide and college for the records.
12	The Project work and report shall be certified by the concerned Project guide and Head of the department.
13	Students shall make a presentation of working project and will be evaluated as per the Project evaluation scheme as detailed below
Assignments using Gantt Project tools • Students are advised to carry out the following assignments w.r.t. their chosen project topics	
1	**Create Project Plan** • Specify project name and start and finish dates. • Identify and define project tasks. • Define duration for each project task. • Define milestones in the plan • Define dependency between tasks • Define project calendar. • Define project resources and specify resource type • Assign resources against each task and baseline the project plan
2	**Execute and Monitor Project Plan** • Update %Complete with current task status. • Review the status of each task. • Compare Planned vs Actual Status • Review the status of Critical Path • Review resources assignation status
3	**Generate Dashboard and Reports** • **Dashboard** o Project Overview o Cost Overview o Upcoming Tasks • **Resource Reports** o Over-allocated Resources o Resource Overview • Cost Reports o Earned Value Report o Resource Cost Overview o Task-Cost Overview • Progress Reports o Critical Tasks o Milestone Report o Slipping Tasks
Evaluation Scheme	

Koparagaon Taluka Education Society's
K. J. Somaiya College Koparagaon.
B. Sc Computer Science 2019 Pattern

List of Courses Addresses Crosscutting Issues (2019 Pattern)

Sr. No.	Programme Name	Coursecode	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1.	B. Sc. Computer Science	CS-111	Problem Solving Using Computer And 'C' Programming	Professional Ethics
2.	B. Sc. Computer Science	CS-112	Database Management Systems	Professional Ethics
3.	B. Sc. Computer Science	CS-113	Practical Course Based On CS101 And CS102	Professional Ethics
4.	B. Sc. Computer Science	CS-121	Advanced 'C' Programming	Professional Ethics
5.	B. Sc. Computer Science	CS-122	Relational Database Management Systems	Professional Ethics
6.	B. Sc. Computer Science	CS-123	Practical Course Based On CS201 And CS202	Professional Ethics
7.	B. Sc. Computer Science	ELC-111	Semiconductor Devices & Basic Electronics System	Professional Ethics
8.	B. Sc. Computer Science	ELC-112	Principle of Digital Electronics	Professional Ethics
9.	B. Sc. Computer Science	ELC-121	Instrumentation System	Professional Ethics
10.	B. Sc. Computer Science	ELC-122	Basics of Computer Organization	Professional Ethics
11.	B. Sc. Computer Science	ELC-113	Electronics Lab IA	Professional Ethics
12.	B. Sc. Computer Science	ELC-123	Electronics Lab IB	Professional Ethics
13.	B. Sc. Computer Science	MTC-111	Mathematics-I	Professional Ethics
14.	B. Sc. Computer Science	MTC-112	Mathematics-II	Professional Ethics
15.	B. Sc. Computer Science	MTC-113	Mathematics Practical	Professional Ethics
16.	B. Sc. Computer Science	MTC-121	Mathematics-I	Professional Ethics
17.	B. Sc. Computer Science	MTC-122	Mathematics-II	Professional Ethics
18.	B. Sc. Computer Science	MTC-123	Mathematics Practical	Professional Ethics
19.	B. Sc. Computer Science	CSST-111	Statistics -I	Professional Ethics

Sr. No.	Programme Name	Coursecode	Name of Course	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1.	B. Sc. Computer Science	CS-111	Problem Solving Using Computer And 'C' Programming	Professional Ethics
20.	B. Sc. Computer Science	CSST-112	Statistics-II	Professional Ethics
21.	B. Sc. Computer Science	CSST-113	Statistics Practical	Professional Ethics
22.	B. Sc. Computer Science	CSST-121	Statistics-I	Professional Ethics
23.	B. Sc. Computer Science	CSST-122	Statistics-II	Professional Ethics
24.	B. Sc. Computer Science	CSST-123	Statistics Practical	Professional Ethics
25.	B. Sc. Computer Science	CS-231	Data Structures And Algorithms – I	Professional Ethics
26.	B. Sc. Computer Science	CS-232	Software Engineering	Professional Ethics
27.	B. Sc. Computer Science	CS-233	Practical Course Based On CS301	Professional Ethics
28.	B. Sc. Computer Science	CS-241	Data Structures And Algorithms – II	Professional Ethics
29.	B. Sc. Computer Science	CS-242	Computer Networks – I	Professional Ethics
30.	B. Sc. Computer Science	CS-243	Practical Course Based On CS401	Professional Ethics
31.	B. Sc. Computer Science	MTC-231	Group & Coding Theory	Professional Ethics
32.	B. Sc. Computer Science	MTC-232	Numerical Technique	Professional Ethics
33.	B. Sc. Computer Science	MTC-233	Mathematics Practical: Python Programming Language-I	Professional Ethics
34.	B. Sc. Computer Science	MTC-241	Computational Geometry	Professional Ethics
35.	B. Sc. Computer Science	MTC-242	Operation Research	Professional Ethics
36.	B. Sc. Computer Science	MTC-243	Mathematics Practical: Python Programming Language-II	Professional Ethics
37.	B. Sc. Computer Science	ELC-231	8051 Microcontroller architecture & Its Programming	Professional Ethics
38.	B. Sc. Computer Science	ELC-232	Digital Communication & Networking	Professional Ethics
39.	B. Sc. Computer Science	ELC-241	Wireless Communication & IoT	Professional Ethics
40.	B. Sc. Computer Science	ELC-242	Advanced Embedded System Design	Professional Ethics
41.	B. Sc. Computer Science	ELC-233	Practical Course I	Professional Ethics
42.	B. Sc. Computer Science	ELC-243	Practical Course II	Professional Ethics
43.	B. Sc. Computer Science	CS-351	Operating Systems –I	Professional Ethics

44.	B. Sc. Computer Science	CS-352	Computer Networks –II	Professional Ethics
45.	B. Sc. Computer Science	CS-357	Practical Course Based On CS501	Professional Ethics
46.	B. Sc. Computer Science	CS-353	Web Technologies – I	Professional Ethics
47.	B. Sc. Computer Science	CS-354	Foundations Of Data Science	Professional Ethics
48.	B. Sc. Computer Science	CS-358	Practical Course Based On CS503	Professional Ethics
49.	B. Sc. Computer Science	CS-355	Object Oriented Programming – I (Core Java)	Professional Ethics
50.	B. Sc. Computer Science	CS-356	Theoretical Computer Science And Compiler Construction – I	Professional Ethics
51.	B. Sc. Computer Science	CS-359	Practical Course Based On CS505	Professional Ethics
52.	B. Sc. Computer Science	CS-3510	Python Programming / R Programming	Professional Ethics
53.	B. Sc. Computer Science	CS-361	Operating Systems – II	Professional Ethics
54.	B. Sc. Computer Science	CS-362	Software Testing	Professional Ethics
55.	B. Sc. Computer Science	CS-367	Practical Course Based On CS601	Professional Ethics
56.	B. Sc. Computer Science	CS-363	Web Technologies – II	Professional Ethics
57.	B. Sc. Computer Science	CS-364	Data Analytics	Professional Ethics
58.	B. Sc. Computer Science	CS-368	Practical Course Based On CS603 And CS604	Professional Ethics
59.	B. Sc. Computer Science	CS-365	Object Oriented Programming – II (Advanced Java)	Professional Ethics
60.	B. Sc. Computer Science	CS-366	Theoretical Computer Science And Compiler Construction - II	Professional Ethics
61.	B. Sc. Computer Science	CS-369	Practical Course Based On CS605	Professional Ethics
62.	B. Sc. Computer Science	CS-3610	Mobile Application Development Or Software Testing Tools	Professional Ethics
63.	B. Sc. Computer Science	CS-3611	Project	Professional Ethics
64.	M. Sc. Computer Science	CSUT111	Paradigm Of Programming Language	Professional Ethics
65.	M. Sc. Computer Science	CSUT 112	Design And Analysis Of Algorithms	Professional Ethics
66.	M. Sc. Computer Science	CSUT 113	Database Technologies	Professional Ethics
67.	M. Sc. Computer Science	CSDT114B	Artificial Intelligence	Professional Ethics

68.	M. Sc. Computer Science	CSDP114B	Artificial Intelligence Practical	Professional Ethics
69.	M. Sc. Computer Science	CSUP115	PPL And Database Technologies Practical	Professional Ethics
70.	M. Sc. Computer Science	CSUT121	Advanced Operating System	Professional Ethics
71.	M. Sc. Computer Science	CSUT122	Mobile Technologies	Professional Ethics
72.	M. Sc. Computer Science	CSUT123	Software Project Management	Professional Ethics
73.	M. Sc. Computer Science	CSDT124A	Project	Professional Ethics
74.	M. Sc. Computer Science	CSDP124A	Project Related Assignments	Professional Ethics
75.	M. Sc. Computer Science	CSUP125	Practical On Advanced OS &Amp; Mobile Technologies	Professional Ethics
76.	M. Sc. Computer Science	CSUT231	Software Architecture And Design Patterns	Professional Ethics
77.	M. Sc. Computer Science	CSUT232	Machine Learning	Professional Ethics
78.	M. Sc. Computer Science	CSUT233	Web Frameworks	Professional Ethics
79.	M. Sc. Computer Science	CSDT234C	Project	Professional Ethics
80.	M. Sc. Computer Science	CSDP234C	Project Related Assignments	Professional Ethics
81.	M. Sc. Computer Science	CSUP235	Practical On CSUT231, CSUT232 And CSUT233	Professional Ethics
82.	M. Sc. Computer Science	CSUIT241	Industrial Training /Institutional Project	Professional Ethics

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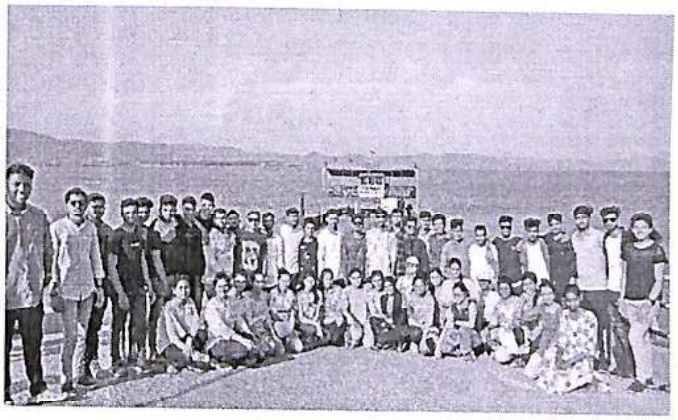
List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Computer Science	Computer Hardware & Network	CC.918	2019-20	Professional Ethics

List Showing Curricular and Extra Curricular activities to address Crosscutting Issues (Similar/repeated activities are not listed).

Sr. No.	Name of Activity and Date of Implementation	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)	Representative Photograph
1	Department has organized one day workshop on "Cyber Security & Ethical Hacking" on 24th August 2018.	Professional Ethics, Human Values, Gender,	
2	Department has District level **"Techno-Fest"** event on 19th December 2018. The event includes activities such as paper presentation, poster presentation, technical rangoli competition, Aptitude test, computer Game zone.	Professional Ethics, Gender, Human Values, Environment and Sustainability	
3	Guest lecture by **Mr. Sagar Tarade** from "TCS Pvt. Ltd." was organized On 22nd September 2018 in the Subject **"Web Development & Designing"**	Professional Ethics,	

4	Guest lecture was organized on technology **"Photoshop"** Mr. Ronak Soni & Mr. Abhijeet Kote from "Zyma Pvt. Ltd." on 1st February 2019.	Professional Ethics	
5	**"Welcome Function" and Induction Program** was organized on 3th August 2018	Professional Ethics, Human Values	
6	Department organized a Two Day workshop on **"Python"** on 20th & 21st December 2019.	Professional Ethics	
7	Department organized a guest lecture by Mr. Rahul Wable from "SPARK Pvt. Ltd." on 24th January 2020 in the Subject **"Android".**	Professional Ethics	
8	A One day Webinar on **"E-content development in Covid-19 Pandemic"** was organized on 5th November 2020.	Professional Ethics	
9	A one day webinar on **"Strategies to Crack Interview in I.T. Industries"** was organized on 27th Feb 2021.	Professional Ethics, Human Values	
10	In the academic year 2020-21 the **"Welcome Function"** was organized on 12th July 2020.	Professional Ethics, Human Values	
11	In the academic year 2021-2022, the Welcome function of first year students was organized dated 2nd December in the presence of Hon. Principal Dr. B. S. Yadav.	Professional Ethics, Human Values	

12	In the academic year 2022-23 the **"Welcome Function"** was organized on 30th September. 2022.	Professional Ethics, Human Values	
13	Department of Computer Science organized one day workshop on **C Programming on 6th September 2022**	Professional Ethics	
14	Department of Computer Science has Organized **Two-Days Educational Tour** for S.Y.B.Sc.(CS) and T.Y.B.Sc.(CS) Students. It was held on 14/04-15/04/2023.	Professional Ethics, Gender, Human Values, Environment and Sustainability	

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Sr.No.	Title of the Activity	Period		Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
		From	To	
1.	One day workshop on "Cyber Security & Ethical Hacking"	24th August 2018.		Professional Ethics
2.	"Techno-Fest" event	19th December 2018.		Professional Ethics
3.	"Welcome Function"	Every academic Year		Professional Ethics, Human Values,
4.	Short term Course on Computer Hardware & Networking	From academic Year 2019-20		Professional Ethics
5.	A One day Webinar on "E-content development in Covid-19 Pandemic"	5th November 2020.		Professional Ethics, Gender, Human Values, Environment and Sustainability
6.	Two Day workshop on "Python" on 20th & 21st December 2019.	20th to 21st December 2019.		Professional Ethics,
7.	A one day webinar on "Strategies to Crack Interview in I.T. Industries".	27th Feb 2021.		Professional Ethics, Human Values,
8.	One Day workshop on C Programming on	6th September 2022		Professional Ethics

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Detailed Syllabus:

Semester- I
Paper - I
Course Type: Core Credit **Course Code: CS101**
Course Title : Problem Solving Using Computer and 'C' Programming - I

Teaching Scheme	No. of Credits	Examination Scheme
2 Hours / Week	2	IE : 15 Marks UE: 35 Marks

Course Objectives

1. To introduce the foundations of computing, programming and problem- solving using computers.
2. To develop the ability to analyze a problem and devise an algorithm to solve it.
3. To formulate algorithms, pseudocodes and flowcharts for arithmetic and logical problems
4. To understand structured programming approach.
5. To develop the basic concepts and terminology of programming in general.
6. To implement algorithms in the 'C' language.
7. To test, debug and execute programs.

Course Outcomes:- On completion of this course, students will be able to :

1. Explore algorithmic approaches to problem solving.
2. Develop modular programs using control structures and arrays in 'C'.

Course Contents

Chapter 1	**Problem Solving Aspects**	**5 Hours**

1.1. Introduction to problem solving using computers.
1.2. Problem solving steps.
1.3 Algorithms-definition, characteristics , examples ,advantages and limitations.
1.4 Flowcharts - definition, notations , examples , advantages and limitations, Comparison with algorithms.
1.5 Pseudo codes - notations, examples, advantages and limitations.
1.6 Programming Languages as tools, programming paradigms, types of languages
1.7 Converting pseudo-code to programs.
1.8 Compilation process (compilers , interpreters), linking and loading, syntax and semantic errors, testing a program
1.9 Good Programming Practices (naming conventions , documentation, indentation).

Chapter 2	**'C' Fundamentals**	**7 Hours**

2.1 History of 'C' language.
2.2 Application areas.
2.2 Structure of a 'C' program.
2.3 'C' Program development life cycle.

Semester- I
Paper - II

Course Type: Core Credit **Course Code: CS102**

Course Title : Database Management Systems

Teaching Scheme	No. of Credits	Examination Scheme
02 Hours / Week	2	IE : 15 Marks UE: 35 Marks

Prerequisites

- Basic Knowledge of file system; storing data in file system and Operations on sets

Course Objectives

- To understand the fundamental concepts of database.
- To understand user requirements and frame it in data model.
- To understand creations, manipulation and querying of data in databases.

Course Outcomes

On completion of the course, student will be able to–

- Solve real world problems using appropriate set, function, and relational models.
- Design E-R Model for given requirements and convert the same into database tables.
- Use SQL.

Course Contents

Chapter 1	**Introduction to DBMS**	**3 Hours**

1.1. Introduction
1.2. File system Vs DBMS
1.3. Levels of abstraction & data independence
1.4.Structure of DBMS (Roles of DBMS Users)
1.5. Users of DBMS Advantages of DBMS

Chapter 2	**Conceptual Design**	**11 Hours**

2.1. Overview of DB design process
2.2. Introduction to data models (E-R model, Relational model, Network model, Hierarchical model)
2.3. Conceptual design using ER data model (entities, attributes, entity sets, relations, relationship sets)
2.4. Constraints (Key constraints, Integrity constraints, referential integrity, unique constraint, Null/Not Null constraint, Domain, Check constraint, Mapping constraints)
2.5. Extended features – Specialization, Aggregation, Generalization
2.6. Pictorial representation of ER(symbols)
2.7. Structure of Relational Databases (concepts of a table)
2.8. DBMS Versus RDBMS
2.9. Case Studies on ER model

Semester- I
Paper - III

Course Type: Core Credit **Course Code: CS103**

Title : Practical course on Problem Solving using Computer and 'C' programming and Database Management Systems

Teaching Scheme	No. of Credits	Examination Scheme
3 Hrs / week	1.5	IE : 15 Marks UE: 35 Marks

Course Objectives

- To understand the program development life cycle.
- Solve simple computational problems using modular design and basic features of the 'C' language.
- Understand basic database management operations.
- Design E-R Model for given requirements and convert the same into database tables.

Course Outcomes:-

On completion of this course, students will be able to :

- Devise pseudocodes and flowchart for computational problems.
- Write, debug and execute simple programs in 'C'.
- Create database tables in postgreSQL.
- Write and execute simple, nested queries.

Guidelines :

Lab Book: The lab book is to be used as a hands-on resource, reference and record of assignment submission and completion by the student. The lab book contains the set of assignments which the student must complete as a part of this course.

Submission:

Problem Solving Assignments:

The problem solving assignments are to be submitted by the student in the form of a journal containing individual assignment sheets. Each assignment includes the Assignment Title, Problem statement, Date of submission, Assessment date, Assessment grade and instructors sign.

Programming Assignments:

Programs should be done individually by the student in the respective login. The codes should be uploaded on either the local server, Moodle, Github or any open source LMS. Print-outs of the programs and output may be taken but not mandatory for assessment.

DBMS Assignments:

For each problem/case study, the student must design the database model in the form of an E-R

Semester- II
Paper - I

Course Type: Core Credit **Course Code: CS201**
Course Title : Advanced 'C' Programming

Teaching Scheme	No. of Credits	Examination Scheme
2 Hours / Week	2	IE : 15 Marks UE: 35 Marks

Prerequisites

- Problem Solving tools like algorithms, flowcharts and pseudocodes.
- Basic knowledge of 'C' language.

Course Objectives :-

- To study advanced concepts of programming using the 'C' language.
- To understand code organization with complex data types and structures.
- To work with files.

Course Outcomes:- Student will be able to :-

- Develop modular programs using control structures, pointers, arrays, strings and structures
- Design and develop solutions to real world problems using C.

Course Contents

Chapter 1	**Pointers**	**8 Hours**

1.1. Introduction to Pointers.
1.2. Declaration, definition, initialization, dereferencing.
1.3. Pointer arithmetic.
1.4. Relationship between Arrays & Pointers- Pointer to array, Array of pointers.
1.5. Multiple indirection (pointer to pointer).
1.6. Functions and pointers- Passing pointer to function, Returning pointer from function, Function pointer.
1.7. Dynamic memory management- Allocation(malloc(),calloc()), Resizing(realloc()), Releasing(free()).,
1.8. Memory leak, dangling pointers.
1.9. Types of pointers.

Chapter 2	**Strings**	**6 Hours**

2.1 String Literals, string variables, declaration, definition, initialization.
2.2 Syntax and use of predefined string functions
2.3 Array of strings.
2.4. Strings and Pointers
2.5. Command line arguments.

Semester- II
Paper - II

Course Type: Core Credit **Course Code: CS202**
Course Title : Relational Database Management Systems

Teaching Scheme	No. of Credits	Examination Scheme
2 Hours / Week	2	IE : 15 Marks UE: 35 Marks

Prerequisites

- Basic Knowledge of DBMS
- Knowledge of SQL Queries
- Basics of relational design
- Basics of ER model

Course Objectives

- To teach fundamental concepts of RDBMS (PL/PgSQL)
- To teach database management operations
- Be familiar with the basic issues of transaction processing and concurrency control
- To teach data security and its importance

Course Outcomes

On completion of the course, student will be able to–

- Design E-R Model for given requirements and convert the same into database tables.
- Use database techniques such as SQL & PL/SQL.
- Explain transaction Management in relational database System.
- Use advanced database Programming concepts

Course Contents

Chapter 1	**Relational Database Design Using PLSQL**	**8 Hours**

1.1 Introduction to PLSQL
1.2 PL/PgSqL: Datatypes, Language structure
1.3 Controlling the program flow, conditional statements, loops
1.4 Stored Procedures
1.5 Stored Functions
1.6 Handling Errors and Exceptions
1.7 Cursors
1.8 Triggers

Semester- II
Paper - III

Course Type: Core Credit **Course Code:CS203**

Title : Practical Course on Advanced 'C' Programming and Relational Dstabase Management Systems

Teaching Scheme	No. of Credits	Examination Scheme
3 Hours / week	1.5	IE : 15 Marks UE: 35 Marks

Course Objectives

- To solve real world computational problems.
- To perform operations on relational database management systems.

Course Outcomes:-

On completion of this course, students will be able to :

- Write, debug and execute programs using advanced features in 'C'.
- To use SQL & PL/SQL.
- To perform advanced database operations.

Guidelines :

Lab Book: The lab book is to be used as a hands-on resource, reference and record of assignment submission and completion by the student. The lab book contains the set of assignments which the student must complete as a part of this course.

Submission:

Programming Assignments:

Programs should be done individually by the student in respective login. The codes should be uploaded on either the local server, Moodle, Github or any open source LMS. Print-outs of the programs and output may be taken but not mandatory for assessment.

RDBMS Assignments:

For each problem/case study, the student must design the database model in the form of an E-R diagram. Table design should be based on the same and must include proper constraints and integrity checks. The students have to create, populate the tables and then perform the activities specified in each of the assignments. A separate softcopy of the table creation statements and queries must be maintained for each assignment.

Assessment

Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall

Detail Syllabus:

SEMESTER I

Paper I

ELC-111: Semiconductor Devices and Basic Electronic Systems

(2 Credits, 36 lectures)

Objectives :

1. To study various types of semiconductor devices
2. To study elementary electronic circuits and systems

Term I

Unit 1. Semiconductor Diodes **(6 L)**

Semiconductor, P and N type semiconductors, Formation of PN junction diode, it's working, Forward and Reverse bias characteristics, Zener diode: working principle, breakdown mechanism and characteristics, Working principle of Light emitting diode, photo diode, optocoupler, Solar cell working principle and characteristics

Unit 2. Bipolar Junction Transistor (BJT) **(7 L)**

Bipolar Junction Transistor (BJT) symbol, types, construction, working principle, Transistor amplifier configurations - CB, CC (only concept), CE configuration: input and output characteristics, Definition of α, β and Υ , Concept of Biasing (numerical problems not expected), Potential Divider bias, Transistor as amplifier (Concept of Gain and Bandwidth expected), Transistor as a switch.

Unit 3. MOSFET **(5 L)**

MOSFET types, Working principle, Characteristics, Application of MOSFET as a Switch.

Unit 4. POWER SUPPLY **(6 L)**

Block Diagram of Regulated Power Supply, Rectifiers (half wave, full wave, Bridge), rectifier with capacitor-filter, Use of Zener Diode as a Voltage Regulator, IC 78XX and 79XX as regulator, Block Diagram and explanation of SMPS, Block diagram and explanation of UPS

Unit 5. OSCILLATORS **(6 L)**

Barkhauson Criteria, Low frequency Wein-bridge oscillator, High frequency crystal oscillator, IC 555 as astable multivibrator used as square wave generator / clock

Unit 6. DATA CONVERTERS **(6 L)**

Need of Digital to Analog converters, parameters, weighted resistive network, R-2R ladder network, need of Analog to Digital converters, parameters, Flash ADC, successive approximation ADC.

Text/reference books :

1. Electronic Devices and Circuits I – T. L. Floyd- PHI Fifth Edition
2. Principles of Analog Electronics - A.P.Malvino
3. Sedha R.S., A Text Book Of Applied Electronics, S.Chand& CompanyLtd

SEMESTER I

PAPER II

ELC 112: Principles of Digital Electronics

(2 Credits, 36 lectures)

Objectives:

1. To get familiar with concepts of digital electronics
2. To learn number systems and their representation
3. To understand basic logic gates, Boolean algebra and K-maps
4. To study arithmetic circuits, combinational circuits and sequential circuits

Unit 1: Number Systems and Digital codes **(10 L)**

Introduction to Decimal, Binary and Hexadecimal number systems and their inter-conversions, binary addition and binary subtraction using 2's complement, Binary Coded Decimal number, Gray Codes, Gray to Binary and Binary to Gray conversion, Alphanumeric representation in ASCII codes.

Unit 2: Logic gates and Boolean Algebra **(14)**

Logic gates (NOT, AND, OR, NAND, NOR, XOR gate) with their symbol, Boolean equation and truth table, Universal gates

Introduction of CMOS and TTL logic families, Parameters like voltage levels, propagation delay, noise margin, fan in, fan out, power dissipation (TTL NAND, inverter, CMOS gates etc. not expected)

Rules and laws of Boolean algebra, De Morgan's theorem, simplification of Logic equations using Boolean algebra rules, Min terms, Max terms, Boolean expression in SOP and POS form, conversion of SOP/POS expression to its standard SOP/POS form Introduction to Karnaugh Map, problems based on SOP (upto 4 variables), digital designing using K Map for: Gray to Binary and Binary to Gray conversion,

Unit 3: Combinational Circuits **(12 L)**

Half adder and full adder, 4-Bit Universal adder/ Subtractor, applications of Ex-OR gates as parity checker and generator, study of Multiplexer (4:1) and Demultiplexer (1:4), Encoders - Decimal/BCD to binary, 3X4 matrix keyboard encoder, priority encoder, Decoder- BCD to seven segment decoder, IC 74138 and IC 7447, Digital comparator,

Reference Books:

1. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education
2. Digital Electronics: Jain R.P., Tata McGraw Hill
3. Digital Principles and Applications: Malvino Leach, Tata McGraw-Hill
4. M.Morris Mano, " Digital Design " 3rdEdition, PHI, NewDelhi.
5. Ronald J. Tocci. "Digital Systems-Principles and Applications" 6/e. PHI. New Delhi. 1999.(UNITS I to IV)
6. G.K.Kharate-Digital electronics-Oxford university press
7. S.Salivahana & S.Arivazhagan-Digital circuits and design

SEMESTER I

Paper III

ELC-113: ELECTRONICS LAB IA (1.5 Credits)

The practical course consists of **10 experiments** out of which two will be preparatory experiments. These will be evaluated in an oral examination for 15% marks at internal and external semester examination. **Each Practical batch will have maximum 15 students.**

Preparatory Experiments (Minimum 2/3)

1.Identification of Components (Passive and Active) /Tools

- Minimum 10 different types of components must be given
- Identification based on visual inspection / data sheets be carried out

2.Use of Digital Multimeters

- Measurement of AC/DC voltage and Current – on different ranges
- Measurement of R &C
- Testing of Diodes &Transistors
- Measurement of β.
- Use of Multimeter in measurement of Resistance of LDR and Thermistor

3.Study of Signal Generator & CRO

- Understand how to use Signal Generator, CRO
- Study of front panel controls of both
- Measurement of amplitude and frequency of Sine/Square waveform
- Measurement of Phase with the help of RC circuit
- Demonstration of Lissajous figures
- Demonstrate the use of Component testing facility

Semester I List of Practical's (Minimum 08, 4 from each group)

Group A

1. Study of breakdown characteristics and voltage regulation action of Zener diode, Use of 3 Pin Regulator IC 78XX & 79XX as a regulator.
2. Study of half wave, full wave and bridge rectifier circuit with and without capacitor filters.
3. Study of Opto-coupler using LED and Photodiode (Package may be used here), it's application as burglar alarm.
4. Study of Bipolar Junction Transistor as a Switch.
5. Study of Single stage RC coupled CE transistor Amplifier (Gain/ Bandwidth).
6. Study of output and transfer characteristics of MOSFET.
7. Study of SMPS.
8. Study of IC 555 as an Astable Multivibrator.
9. Study of 4-Bit R-2R Ladder Network type of DAC.
10. Study of 3-bit Flash ADC.

SEMESTER II

PAPER I

ELC 121: Instrumentation Systems
(2 Credits, 36 lectures)

Objectives :

1. To study Instrumentation System
2. To study various blocks of Instrumentation System
3. To study Smart Instrumentation System

Unit 1: Introduction to Instrumentation System **(6 L)**

Block diagram of Instrumentation system, Definition of sensor, transducer and Actuators, Classification of sensors: Active and passive sensors. Specifications of sensors: Accuracy, range, linearity, sensitivity, resolution, reproducibility.

Unit 2: Sensors and Actuators **(12 L)**

Temperature sensor (Thermistor, LM-35), optical sensor (LDR), Passive Infrared sensor (PIR), Tilt Sensor, ultrasonic sensor, Motion sensor, Image Sensor, Actuators: DC Motor, stepper motor

Unit 3: Smart Instrumentation System and Smart Sensors **(6 L)**

Block diagram of Smart Instrumentation system, Concept of smart sensor, Film sensors, Nano sensor

Unit 4: OPAMP as signal Conditioner **(12 L)**

Concept, block diagram of Op amp, basic parameters (ideal and practical): input and output impedance, bandwidth, differential and common mode gain, CMRR, slew rate, IC741/ LM324, Concept of virtual ground, Op amp as inverting and non inverting amplifier, Unity gain follower, Opamp as adder, substractor, Op amp as current to voltage and voltage to current convertor, Voltage to frequency converter, Op amp as comparator, Problems based on above Op Amp applications.

Reference Books:

1. Sensors and Transducers : D. Patranabis, PHI publication, 2nd Edition
2. Sensors and Transducers : Prof A.D.Shaligram
3. Op Amp and Linear Integrated Circuits: Ramakant Gaykwad

SEMESTER II

PAPER II

ELC 122 : Basics of Computer Organisation
(2 Credits, 36 lectures)

Objectives:

1. To get familiar digital sequential circuits
2. To study Basic computer Organization
3. To study Memory architecture

Unit 1: Flip-flops **(5 L)**

RS Flip Flop using NAND gate, clocked RS Flip Flop, D Latch, J K Flip Flop,T Flip Flop

Unit 2: Shift registers and Counters **(9 L)**

Shift registers - SISO, SIPO, PISO, PIPO shift registers, Ring Counter using D Flip flop. Counters -Synchronous and Asynchronous type, 3-bit Up, Down and Up-Down counter, Concept of modulus Counters
(Timing Diagram of all above are expected)

Unit 3: Basics of Computer System **(12 L)**

Basic Computer Organization, Concept of Address Bus, Data Bus, Control Bus. CPU Block Diagram and Explanation of each block, Register based CPU organization, Concept of Stack & its organization, I/O organization: need of interface, block diagram of general I/O interface

Unit 4: Memory Organization **(10 L)**

Memory Architecture, Memory hierarchy, Types of Memories, Data Read/ Write process, Vertical and Horizontal Memory Expansion, Role of Cache memory, Virtual Memory.

Reference Books:

1. Digital Fundamentals: Floyd T.M., Jain R.P., Pearson Education
2. Digital Electronics: Jain R.P., Tata McGraw Hill
3. Digital Logic and Computer Design : M. Morris Mano, Pearson Education
4. Computer Organization and Architecture, William Stallings, Pearson, 10th Edi.

SEMESTER II

Paper III

ELC-123: Electronics Lab IB

The practical course consists of **10 experiments** out of which one will be activity equivalent to 2 practical sessions.
Activity will carry 15% marks at internal and external semester examination. Activity can be any one of the following :

1.Hobby projects
2.Industrial visit / live work experience
3.PCB Making
4.Market Survey of Electronic Systems
5.Circuit Simulations and CAD tools

GROUP A (Minimum 4/8)

1. To study temperature sensor LM 35
2. Use of LDR to control light intensity
3. Study of PIR and tilt sensor.
4. Study of stepper motor.
5. Use of OPAMP as comparator and its use in DC motor driving.
6. Build and test Inverting and non inverting amplifier using OPAMP.
7. Build and test adder and subtractor circuits using OPAMP.
8. Build and test voltage to frequency converter

GROUP B (Minimum 4/8)

1. Study of RS, JK and D flip flops using NAND gates
2. Study of Four bit ALU
3. Study of asynchronous Up/Down Counter
4. Study of decade counter IC circuit configurations
5. Study of 4-bit SISO Shift register and it's use as Ring Counter
6. Study of read and write action of RAM (using IC 2112/4 or equivalent).
7. Study of Diode Matrix ROM
8. Study of Computer hardware system

Paper II	MTC-102 : Algebra and Calculus	MTC-112 : Discrete Mathematics and MTC-122 : Graph Theory
Paper III	MTC-103 : Mathematics Practical	MTC – 113 : Mathematics Practical and MTC – 113 : Mathematics Practical

Detailed Syllabus:

Semester - I

MTC-111: Matrix Algebra

Unit 1 : Introduction **(4 lectures)**

1.1 Matrix Operations
1.2 The Inverse of a Matrix
1.3 Characterization of invertible matrices

Unit 2 : Linear Equations in Linear Algebra-I **(12 lectures)**

2.1 System of Linear equations
2.2 Row reduction and echelon forms
2.3 Vector equations
2.4 The matrix equation Ax=b
2.5 Solution sets of linear systems

Unit 3 : Linear Equations in Linear Algebra -II **(12 lectures)**

3.1 Partitioned Matrices
3.2 Matrix factorization [Lu decomposition]
3.3 Linear Independence
3.4 Introduction to linear transformation
3.5 The matrix of linear transformation
3.6 Subspaces of R^n
3.7 Dimension and Rank

Unit 4 : Determinants **(8 lectures)**

4.1 Introduction to determinants
4.2 Properties of determinants

4.3 Cramer's rule, Volume and linear transformations

Text Book : Linear Algebra and its Applications, David C Lay, Steven R. Lay, Judi J. MacDonald Pearson Publication,2016, Fifth Edition.

Unit 1: Chapter 2: Sec. 2.1, 2.2, 2.3
Unit 2: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5
Unit 3: Chapter 2: Sec. 2.4, 2.5,2.8, 2.9, Chapter 1: 1.7, 1.8, 1.9
Unit 4: Chapter 3: Sec. 3.1, 3.2, 3.3

Reference Books :

1. Elementary Linear Algebra with supplemental Applications,Howard Anton and others ,Wiley Student Edition.
2. Matrix and Linear Algebra (aided with MATLAB),KantiBhushanDatta, Eastern Economic Edition.

MTC 112: Discrete Mathematics

UNIT 1 : LOGIC (7 Lectures)

1.1 Revision : Propositional Logic, Propositional Equivalences.
1.2 Rules of Inference : Argument in propositional Logic, Validity Argument(Direct and Indirect methods) Rules of Inference for Propositional Logic, Building Arguments.
1.3 Predicates and Quantifiers : Predicate, n-Place Predicate or ,n-ary Predicate, Quantification and Quantifiers, Universal Quantifier, Existential Quantifier, Quantifiers with restricted domains, Logical Equivalences involving Quantifiers.

Unit 2 : Lattices and Boolean Algebra (13 Lectures)

2.1 Relations, types of relations, equivalence relations, Partial ordering relations
2.2 Digraphs of relations, matrix representation and composition of relations.
2.3 Transitive closure and Warshall's Algorithm
2.3 Poset, Hasse diagram.
2.4 Lattices, Complemented lattice, Bounded lattice and Distributive lattice.
2.5 Boolean Functions : Introduction, Boolean variable, Boolean Function of degree n, Boolean identities, Definition of Boolean Algebra.
2.6 Representation of Boolean Functions : Minterm, Maxterm Disjunctive normal form, Conjunctive normal Form.

Unit 3 : Counting Principles (7 Lectures)

3.1 Cardinality of Set : Cardinality of a finite set.
3.2 Basics of Counting : The Product Rule, The Sum Rule, The Inclusion- Exclusion Principle.
3.3 The Pigeonhole Principle: Statement, the Generalized Pigeonhole Principle, Its Applications.

3.4 Generalized Permutations and Combinations : Permutation and
3.5 Combination with Repetitions, Permutations with Indistinguishable Objects

Unit 4: Recurrence Relations **(9 Lectures)**

4.1 Recurrence Relations: Introduction, Formation.
4.2 Linear Recurrence Relations with constant coefficients.
4.3 Homogeneous Solutions.
4.4 Particular Solutions.
4.5 Total Solutions.

TextBooks:
1. Discrete Mathematics and its applications, by Kenneth Rosen, Tata McGraw Hill, Seventh Edition.
2. Discrete Mathematical Structures, by Kolman, Busby, Ross, Rehman, Prentice Hall,
3. Elements of Discrete Mathematics, by C. L. Liu, Tata McGraw Hill,

Unit 1: Text Book 1: Chapter 1: Sec. 1.1, 1.2, 1.3, 1.4, 1.5
Unit 2: Text Book 2: Chapter 6: Sec. 6.1, 6.2, 6.3, 6.4, 6.5
Unit 3: Text Book 1: Chapter 2: Sec. 2.1, Chapter 5: Sec.5.1, 5.2, 5.3
Unit 4: Text Book 3: Chapter 10: Sec. 10.1, 10.2, 10.3, 10.4, 10.5, 10.6

MTC 113: Mathematics Practical

(Practical based on the applications of articles in MTC-111 and MTC - 112)

In Semester-I, we should conduct 3 written practical and 3 practical on maxima software for each paper MTC -111 and MTC -112.

List of Practical

Practical 1 : Problems on Unit 1 and 2 (Written) from MTC-111.
Practical 2 : Problems on Unit 3 (Written) from MTC-111.
Practical 3 : Problems on Unit 4 (Written) from MTC-111.
Practical 4 :Introduction to maxima software for MTC-111.
Practical 5 : Problems on unit 1 and unit 2 from MTC-111using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MTC-111using maxima software.
Practical 7: Problems on Unit 1 and Unit 2(Written) from MTC-112.
Practical 8 : Problems on Unit 3 (Written) from MTC-112.
Practical 9 : Problems on Unit 4(Written) from MTC-112.
Practical 10 :Introduction to maxima software for MTC-112.
Practical 11 : Problems on unit 1 and unit 2 from MTC-112 using maxima software.
Practical 12 : Problems on Unit 3 and Unit 4 from MTC-112 using maxima software.

Note:

1. The soft copy of practical on maxima software will be prepared and provided by the Board of Studies in mathematics.
2. Practical on maxima software can be performed on computer and android mobiles.
3. Android mobiles are allowed for practical examination on maxima software.
4.Practical examination of 25 marks on written problems, 10 marks for problems on maxima software (5 marks for writing syntax and 5 marks to perform the same on android mobile or computer).

Semester -II

MTC-121: Linear Algebra

Unit 1: Vector Spaces **(10 lectures)**

1.1 Vector spaces and subspaces
1.2 Null spaces, column spaces and linear tranformations.
1.3 Linearly independent sets : Bases
1.4 Coordinate systems
1.5 The dimension of a vector space
1.6 Rank

Unit 2: Eigen values and Eigen vectors **(10 lectures)**

2.1 Eigen values and Eigen vectors
2.2 The characteristic equation
2.3 Diagonalization
2.4 Eigen vectors and Linear transformations

Unit 3:Orthogonality and Symmetric Matrices **(10 lectures)**

3.1 Inner product, length and orthogonality
3.2 Orthogonal sets
3.3 Orthogonal Projections
3.4 Diagonalization of Symmetric Matrices
3.5 Quadratic forms

Unit 4: The Geometry of vector spaces **(6lectures)**

4.1 Affine combinations
4.2 Affine independence
4.3 Convex combinations

Text Book :

Linear Algebra and its Applications (5th Edition) David C Lay, Steven R. Lay, Judi J. MacDonaldPearson Publication, Fifth Edition, 2016.

Unit 1:Chapter 4: Sec.4.1, 4.2, 4.3,4.4, 4.5, 4.6
Unit 2: Chapter 5: Sec. 5.1, 5.2, 5.3, 5.4
Unit 3: Chapter 6: Sec. 6.1, 6.2, 6.3, Chapter 7: 7.1,7.2
Unit 4: Chapter 8:Sec. 8.1, 8.2*,8.3
*From section 8.2 omit Barycentric coordinates.

Reference Books:

1. Elementary Linear Algebra with supplemental Applications, by Howard Anton and others,Wiley Student Edition, Fourth edition.
2. Matrix and Linear Algebra (aided with MATLAB), byKantiBhushanDatta, Eastern Economic Edition, Fourth edition.

MTC-122: Graph Theory

Unit 1: An Introduction to graph **(10 lectures)**

1.1. Definitions, Basic terminologies and properties of graph, Graph models.
1.2. Special types of graphs, basic terminologies, properties and examples of directed graphs .Types of diagraphs.
1.3. Some applications of special types of graph.
1.4. Matrix representation and elementary results, Isomorphism of graphs.

Unit 2: Connected graph **(8 lectures)**

2.1. Walk, trail, path, cycle, elementary properties of connectedness. Counting paths between vertices (by Warshall's algorithm).
2.2. Cut edge (Bridge), Cut vertex, cut set, vertex connectivity, edge connectivity, and Properties.
2.3. Shortest path problem, Dijkstra's algorithm.

Unit 3. Euler and Hamilton path. **(8 lectures)**

3.1. The Konigsberg bridge problem, Euler trail, path, circuit and tour, elementary properties and Fleury's algorithm.
3.2. Hamilton path, circuit, elementary properties and examples.
3.3. Introduction of Travelling salesman problem, Chinese postman problem.

Unit 4. Trees **(10 lectures)**

4.1. Definitions, basic terminologies, properties and applications of trees.
4.2. Weighted graph, definition and properties of spanning tree, shortest spanning tree, Kruskal's algorithm, Prim's algorithm.

4.3. M-ary tree, binary tree, definitions and properties, tree traversal: preorder, inorder, postorder, infix, prefix, postfix notations and examples.

Text Book:

Kenneth Rosen, Discrete Mathematics and its applications, Tata McGraw Hill, Seventh Edition.

Unit 1: Chapter 8: Sec. 8.1, 8.2, 8.3
Unit 2: Chapter 8: Sec. 8.4
Unit 3: Chapter 8: Sec. 8.5, 8.6
Unit 4: Chapter 9: Sec. 9.1,9.2,9.3,9.4,9.5.

Reference Books:

1. John Clark and Derek Holton, A first look at Graph theory, Allied Publishers.
2. NarsinghDeo, Graph Theory with applications to computer science and engineering, Prentice Hall.
3. C.L.Liu, Elements of Discrete Mathematics, Tata McGraw Hill, Fourth edition
4. Douglas B. West, Introduction to Graph Theory, Pearson Education, second edition.

MTC 123: Mathematics Practical

(Practical based on the applications of articles in MTC- 121 and MTC- 122)

In Semester- II, we should conduct 4 written practical and 2 practical on maxima software for each paper MTC-121 and MTC-122.

List of Practical

Practical 1 : Problems on Unit 1 (Written) from MTC-121.
Practical 2 : Problems on Unit 2 (Written) from MTC-121.
Practical 3 : Problems on Unit 3(Written) from MTC-121.
Practical 4 :Problems on Unit 4(Written) from MTC-121.
Practical 5 : Problems on unit 1 and unit 2 from MTC-121using maxima software.
Practical 6 : Problems on Unit 3 and Unit 4 from MTC-121using maxima software.
Practical 7: Problems on Unit 1 (Written) from MTC-122.
Practical 8 : Problems on Unit 2 (Written) from MTC-122.
Practical 9 : Problems on Unit 3 (Written) from MTC-122.
Practical 10 :Problems on Unit 4 (Written) from MTC-122.
Practical 11 : Problems on unit 1 and Unit 2 from MTC-122 using maxima software.
Practical 12: Problems on Unit 3 and Unit 4 from MTC-122 using maxima software.

Note:

Semester I

Paper-I

CSST 111 :Descriptive Statistics

No. of Credits :2No. of lectures: 40

TOPICS/CONTENTS:

UNIT1: Data Condensation and Presentation of Data (9L)

1.1 Definition, importance, scope and limitations of statistics.

1.2 Data Condensation: Types of data (Primary and secondary), Attributes and variables, discrete and Continuous variables.

1.3 Graphical Representation: Histogram,Ogive Curves, Steam and leaf chart. [Note: Theory paper will contain only procedures. Problems to be included in practical]

1.4 Numerical problems related to real life situations.

UNIT2: Descriptive Statistics(14L)

2.1 Measures of central tendency:Concept of central tendency, requisites of good measures of central tendency.

2.2 Arithmetic mean: Definition, computation for ungrouped and grouped data, properties of arithmetic mean (without proof) combined mean, weighted mean, merits and demerits.

2.3 Median and Mode: Definition, formula for computation for ungrouped and grouped data, graphical method, merits and demerits. Empirical relation between mean, median and mode (without proof)

2.4 Partition Values: Quartiles, Box Plot.

2.5 Concept of dispersion, requisites of good measures of dispersion, absolute and relative measures of dispersion.

2.6 Measures of dispersion : Range and Quartile Deviation definition for ungrouped and grouped data and their coefficients, merits and demerits,
Variance and Standard deviation: definition for ungrouped and grouped data, coefficient of variation, combined variance & standard deviation, merits and demerits.

2.7 Numerical problems related to real life situations.

Semester I

Paper-II

CSST 112 :Mathematical Statistics

No. of Credits : 2 No. of lectures: 40

TOPICS/CONTENTS:

UNIT 1:Theory of Probability **(10L)**

1.1 Counting Principles, Permutation, and Combination.

1.2 Deterministic and non-determination models.

1.3 Random Experiment, Sample Spaces (Discrete and continuous)

1.4 Events: Types of events, Operations on events.

1.5 Probability - classical definition, probability models, axioms of probability, probability of an event.

1.6 Theorems of probability (without proof)

i) $0 \leq P(A) \leq 1$ ii) $P(A) + P(A') = 1$ iii) $P(\Phi) = 0$ iv)$P(A) \leq P(B)$ when $A \subset B$

iv) $P(A \cup B) = P(A) + P(B) - P(A \cap B)$

1.7 Numerical problems related to real life situations.

UNIT 2: Conditional Probability and Independence **(8L)**

2.1Concepts and definitions of conditional probability, multiplication theorem $P(A \cap B)=P(A).P(B|A)$

2.2 Bayes' theorem (without proof). True positive , false positive and sensitivity of test as application of Bayes' theorem.

2.3 Concept of Posterior probability, problems on posterior probability.

2.4 Concept and definition of independence of two events.

2.5 Numerical problems related to real life situations.

UNIT 3: Random Variable **(10L)**

3.1 Definition of random variable (r.v.) , discrete and continuous random variable.

3.2 Definition of probability mass function (p.m.f.) of discrete r.v. and Probability density function of continuous r.v..

3.3 Cumulative distribution function (c.d.f.) of discrete and continuous r.v. and their properties. (Characteristic properties only)

Semester I

Paper-III

CSST113: Statistics Practical

No. of Credits : 1.5

TOPICS/CONTENTS

Pre-requisites: Knowledge of the topics in theory papers I and II

Objectives: At the end of the course students are expected to be able

i) To tabulate and make frequency distribution of the given data.
ii) To use various graphical and diagrammatic techniques and interpret.
iii) To compute various measures of central tendency, dispersion, Skewness and kurtosis.
iv) To fit the Binomial and Poisson distributions.
v) To compute the measures of attributes.
vi) The process of collection of data, its condensation and representation for real life data.
vii) To study free statistical softwares and use them for data analysis in project.

Sr. No.	Title of the practical
1	Tabulation and construction of frequency distribution. (Use of at least two data sets more than 50 observations- each for constructing frequency distribution)
2	Diagrammatic and graphical representation using EXCEL and data interpretation. (problems on the basis of SET and NET examination in Paper I to be taken)
3	Summary statistics for ungrouped data and comparison for consistency using EXCEL.
4	Summary statistics for grouped frequency distribution. (Problems based on central tendency, dispersion, measures of skewness: Karl Pearson's and Quartile measure to be covered)
5	Measure of Skewness and kurtosis based on moments.
6	Fitting of Binomial distribution and computation of expected frequencies. (Use the observed and expected frequencies for the next semester χ^2 test)
7	Fitting of Poisson distribution and computation of expected frequencies. (Use the observed and expected frequencies for the next semester χ^2 for test.) (Give one data set for fitting both Poisson and Binomial distributions.)
8	Measure of attributes. (Two attributes only)
9	Study of free statistical softwares and writing a report on it. (individual activity)
10	Project(Part-I) -Data collection, its condensation and representation.

Notes:

1) For project, a group of maximum 8 students be made.
2) All the students in a group are given equal marks for project.
3) Different data sets from primary or secondary sources may be collected.

Semester II

Paper-I

CSST 121 :Methods of Applied Statistics

No. of Credits: 2 No. of lectures: 40

TOPICS/CONTENTS:

UNIT 1:Correlation (For ungrouped data) (10L)

1.1Concept of bivariate data, scatter diagram, its interpretation, concept of correlation, Positivecorrelation, negative correlation, zero correlation.

1.2 Karl Pearson's coefficient of correlation, properties of correlation coefficient, Interpretation of correlation coefficient, coefficient of determination with interpretation.

1.3 Spearman's rank correlation coefficient (formula with and without ties).

1.4Numerical problems

UNIT 2: Regression (for ungrouped data) (12L)

2.1Concept of linear and nonlinear regression.

2.2 Illustrations, appropriate situations for regression and correlation

2.3 Linear regression :Fitting of both lines of regression using least square method.

2.4 Concept of regression coefficients.

2.5 Properties of regression coefficients : $b_{xy} \cdot b_{yx} = r^2$, $b_{xy} * b_{yx} \leq 1$, $b_{xy} = r\,(\sigma_x / \sigma_y)$ and$b_{yx} = r\,(\sigma_y / \sigma_x)$.

2.6 Nonlinear regression models: Second degree curve, exponential curves of the type $Y=ab^x$ and $Y=ax^b$.

2.7 Numerical problems related to real life situations

UNIT3: Multiple Regression and Multiple, partial Correlation (For Trivariate Data)(10L)

3.1 Concept of multiple regressions, Yule's Notations.

3.2 Fitting of multiple regression planes.[Derivation of equation to the plane of regression of X_1on X_2 and X_3 is expected. Remaining two equations to be written analogously.]

3.3 Concept of partial regression coefficients, interpretations.

3.4 Concept of multiple correlation: Definition of multiple correlation coefficientand its formula..

Semester II

Paper-II

CSST122: Continuous Probability Distributions and Testing of Hypotheses

No. of Credits : 2 No. of lectures: 40

TOPICS/CONTENTS:

UNIT 1:Standard Continuous Probability Distributions (10L)

1.1 Uniform Distribution: statement of p.d.f., mean, variance, nature ofprobability curve. Theorem (without proof): The distribution function of any continuous r.v. if it is invertible follows U(0, 1) distribution

1.2 Exponential Distribution: statement of p.d.f. of the form,$f(x) = (1/\theta)\, e(-x/\theta)$, mean, variance, nature of probability curve, lack ofmemory property.(with proof)

1.3 Paratodistribution :Form of pdf $f(x):\alpha/ x^{(\alpha+1)}$; $x \geq 1$, $\alpha > 0$. Mean, variance, symmetry, applications

1.3 Normal Distribution: statement of p.d.f., identification of parameters,nature of probability density curve, standard normal distribution,symmetry, distribution of aX+b, aX+bY+c where X and Y areindependent normal variables, computations ofprobabilities usingnormal probability table, normal approximation to binomial and Poissondistribution, central limit theorem (statement only), normal probabilityplot. Box Muller transformation

1.4 Numerical problems related to real life situations.

UNIT 2:Concepts and definitions related to testing of hypothesis (4L)

2.1 Concepts of population and sample.

2.2 Definitions: random samplefrom a probability distribution, parameter, statistic, standard error ofestimator.

2.3 Concept of null hypothesis and alternative hypothesis (Research hypothesis), critical region,level of significance, type I and type II error, one sided and two sided tests, Test of hypothesis,p-value.

Semester II

Paper-III

CSST 123: Statistics Practical

No. of Credits : 1.5

Pre-requisites: Knowledge of the topics in theory papers I and II

Objectives: At the end of the course students are expected to be able

i) To understand the relationship between two variables using scatter plot.
ii) To compute coefficient of correlation, coefficient of regression.
iii) To fit various regression models and to find best fit.
iv) To fit the Normal distribution.
v) To understand the trend in time series and how to remove it.
vi) To apply inferential methods for real data sets.
vii) To generate model sample from given distributions.
viii) To understandthe importance and functions of different statistical organizations in the development of nation.

Sr. No.	Title of the Practical
1	Linear correlation and regression (use of scatter plot for explaining the linear relationship between two variables)
2	Fitting of non-linear regression. (use of scatter plot for explaining the non-linear relationship between two variables)
3	Fitting of normal distribution and computation of expected frequencies.
4	Fitting of linear regression model (Simple and Multiple) and non-linear regression models and finding the best fit byusing EXCEL.
5	Modelsampling from continuous uniform, exponential and normal distributions using Excel.
6	Large sample tests.
7	F test, t test, χ^2 test using EXCEL (one problem each with equal and unequal variance)(χ^2 test – for goodness of fit-use fitted problems of Binomial, Poisson and Normal distribution in previous practical problems)
8	Time Series- Estimation of trend by using the method of moving averages
9	Write a report on application of some statistical technique in the field of computers.(individual activity)
10	Project (Part-II) - Analysis of data collected in semester-I

Notes:

i) For project, a group of maximum 8 students be made.
ii) All the students in a group are given equal marks for project.
iii) Students will be asked to use Statistical methods which they have learnt and use of free statistical software for data analysis.

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper - I
Course Code: CS 231
Title : Data Structures and Algorithms – I

Teaching Scheme	No. of Credits	Examination Scheme
3 Lectures / week (50 mins duration)	2	IE : 15 marks UE: 35 marks

Prerequisites:
Basic knowledge of algorithms and problem solving
Knowledge of C Programming Language

Course Objectives
1. To learn the systematic way of solving problem
2. To understand the different methods of organizing large amount of data
3. To efficiently implement the different data structures
4. To efficiently implement solutions for specific problems
5. To apply linear data structures.

Course Outcomes: On completion of the course, student will be able to
1. To use well-organized data structures in solving various problems.
2. To differentiate the usage of various structures in problem solution.
3. Implementing algorithms to solve problems using appropriate data structures.

Course Contents

Chapter 1 Introduction to Data Structures and Algorithm Analysis **4 lectures**

1.1 Introduction
- 1.1.1 Need of Data Structure
- 1.1.2 Definitions - Data and information, Data type, Data object, ADT, Data Structure
- 1.1.3 Types of Data Structures

1.2 Algorithm analysis
1.2.1 Space and time complexity, Graphical understanding of the relation between different functions of n, examples of linear loop, logarithmic,quadratic loop etc.
1.2.2 Best, Worst, Average case analysis, Asymptotic notations (Big O, Omega Ω, Theta θ), Problems on time complexity calculation.

Chapter 2 Array as a Data Structure **10 lectures**

2.1 ADT of array, Operations
2.2Array applications - Searching
2.2.1 Sequential search, variations - Sentinel search, Probability search, ordered list search
- 2.2.2 Binary Search
- 2.2.3 Comparison of searching methods

2.3 Sorting Terminology- Internal, External, Stable, In-place Sorting
- 2.3.1 Comparison Based Sorting - Lower bound on comparison based sorting, Methods- Bubble Sort, Insertion Sort, Selection Sort, Algorithm design strategies - Divide and Conquer strategy, Merge Sort, Quick Sort, complexity analysis of sorting methods.

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper -II
Course Code: CS 232
Title : Software Engineering

Teaching Scheme	No. of Credits	Examination Scheme
3 lectures / week (50 mins duration)	**2**	IE : 15 marks UE: 35 marks

Prerequisites
ER Modeling

Course Objectives

1. To get knowledge and understanding of software engineering discipline.
2. To learn analysis and design principles for software project development.

Course Outcomes
On completion of the course, student will be able to-

1. Compare and chose a process model for a software project development.
2. Identify requirements analyze and prepare models.
3. Prepare the SRS, Design document, Project plan of a given software system.

Course Contents

Chapter 1	**Title : Introduction To Software Engineering and Process Models**	**8 lectures**

1.1 Definition of Software
1.2 Nature of Software Engineering
1.3 Changing nature of software
1.4 Software Process
  1.4.1 The Process Framework
  1.4.2 Umbrella Activities
  1.4.3 Process Adaptation
1.5 Generic Process Model
1.6 Prescriptive Process Models
  1.6.1 The Waterfall Model
  1.6.2 Incremental Process Models
  1.6.3 Evolutionary Process Models
  1.6.4 Concurrent Models
  1.6.5 The Unified Process

Chapter 2	**Title : Agile Development**	**5lectures**

2.1 What is Agility?
2.2 Agile Process
  2.2.1 Agility Principles
  2.2.2 The Politics Of Agile Development
  2.2.3 Human Factors
2.3 Extreme Programming(XP)
  2.3.1XP Values
  2.3.2XP Process
  2.3.3 Industrial XP

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper - III
Course Code: CS 233
Title : Practical course on CS 231 (Data Structures and Algorithms I) and CS 232 (Software Engineering)

Teaching Scheme	No. of Credits	Examination Scheme
4 hrs 20 mins / week Batch Size : 12	2	IE : 15 marks UE: 35 marks

Operating Environment:
For Data Structures:

- **Operating system:** Linux
- **Editor:** Any linux based editor like vi, gedit etc.
- **Compiler** : cc or gcc

Lab Book:
The lab book is to be used as a hands-on resource, reference and record of assignment submission and completion by the student. The lab book contains the set of assignments which the student must complete as a part of this course.

Programming Assignments:
Programs should be done individually by the student intheir respective login. The codes should be uploaded on either the local server, Moodle, Github or any open source LMS. Print-outs of the programs and output may be taken but not mandatory for assessment.

Assessment:
Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include-timely completion, performance, innovation, efficient codes and good programming practices.

- **Internal Evaluation :**
  - 10 marks will be given based on a mini project of Software Engineering.
  - 5 marks will be allocated for Assignment completion and practical attendance.
- **University Evaluation :**
  - The Practical slip will be of 35 Marks which will be based on Data structures.

Course Contents:

Suggested Assignments for Data Structures – I

Assignment1: Searching Algorithms
Implementation of searching algorithms to search an element using: Linear Search, Sentinel Search, Binary Search (with time complexity)

Assignment 2: Sorting Algorithms - I
Implementation of sorting algorithms: Bubble Sort, Insertion Sort, Selection Sort

Assignment 3: Sorting Algorithms - II
Implementation of sorting algorithms: Quick Sort, Merge Sort , Counting Sort

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper - I
Course Code: CS 241
Title : DATA STRUCTURES AND ALGORITHMS-II

Teaching Scheme	No. of Credits	Examination Scheme
3 Lectures / week (50 mins. duration)	02	IE : 15 marks UE: 35 marks

Prerequisites :
- Knowledge of C Programming Language
- Basic knowledge of algorithms
- Basic knowledge of linear data structures

Course Objectives
- To learn the systematic way of solving problems
- To design algorithms
- To understand the different methods of organizing large amount of data
- To efficiently implement the non-linear data structures

Course Outcomes: On completion of this course students will be able to
- Implementation of different data structures efficiently
- Usage of well-organized data structures to handle large amount of data
- Usage of appropriate data structures for problem solving

Course Contents **10 lectures**

Chapter 1 Tree

1.1 Concept and Terminologies
1.2 Types of Binary trees - Binary tree, skewed tree, strictly binary tree, full binary tree, complete binary tree, expression tree, binary search tree, Heap
1.3 Representation – Static and Dynamic
1.4 Implementation and Operations on Binary Search Tree - Create, Insert, Delete, Search, Tree traversals– preorder, inorder, postorder (recursive implementation), Level-order traversal using queue, Counting leaf, non-leaf and total nodes, Copy, Mirror.
1.5 Applications of trees
1.5.1 Heap sort, implementation
1.5.2 Introduction to Greedy strategy, Huffman encoding (implementation using priority queue)

Chapter 2 Efficient Search Trees **8 lectures**

2.1 Terminology: Balanced trees - AVL Trees, Red Black tree, splay tree, Lexical search tree -Trie
2.2 AVL Tree- concept and rotations
2.3 Red Black trees - concept, insertion and deletion.
2.4 Multi-way search tree - B and B+ tree - Insertion, Deletion

Chapter 3 Graph **12 lectures**

3.1 Concept and terminologies
3.2 Graph Representation –Adjacency matrix, Adjacency list, Inverse Adjacency list, Adjacency multilist
3.3 Graph Traversals – Breadth First Search and Depth First Search (with implementation)
3.4 Applications of graph

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper - I Semester II
Course Code: CS 242 Title : Computer Networks-I

Teaching Scheme	No. of Credits	Examination Scheme
3 lectures / week (50 mins. duration)	02	IE : 15 marks UE: 35 marks

Prerequisites
Principles of Digital Electronics
Communication Principles

Course Objectives
To prepare students with basic networking concepts: data communication, protocolsand standards, various topologies and applications of network.

Course Outcomes
1. Have a good understanding of the OSI and TCP/IP Reference Models and in particular have a good knowledge of Layers.
2. Understand the working of various protocols.
3. Analyze the requirements for a given organizational structure and select the most appropriate networking architecture and technologies

Course Contents

Chapter 1	**Introduction to Networks and Network Models**	**4 lectures**

1.1 Data communication, components, data representation
1.2 Networks, network criteria, network types - LAN, WAN, Switching, The Internet, Accessing the Internet
1.3 Network Software- Protocol hierarchies, Design Issues of the layer, Connection Oriented and Connectionless Services,
1.4 Reference models - OSI Reference Models, TCP/IP Reference model, Connection devices in different layers, Comparison of OSI and TCP/IP Reference Models.

Chapter 2	**Lower Layers**	**10 lectures**

2.1 Communication at the physical layer, data rate limits - Noiseless channel (Nyquist bit rate), noisy channel (Shannon capacity), Performance - bandwidth, throughput, latency, bandwidth-delay product, jitter
2.2 Design issues of Data Link Layer, Services - Framing, flow control, error control, congestion control, Link layer addressing
2.3 Framing Methods - Character Count, Flag bytes with Byte Stuffing, Flags bits with Bit Stuffing, Physical Layer Coding Violations
2.4 The Channel allocation problem, Static and dynamic allocation, Media Access Methods - Taxonomy of multiple-access protocols
2.5 Switching and TCP/IP layers, Types - circuit switching, packet switching and message switching
2.6 Wired LANs - Standard Ethernet characteristics, Addressing, Access method, implementation, Fast and Gigabit Ethernet
2.7 Wireless LANs - Architectural comparison, Characteristics, Access control, IEEE 802.11

Savitribai Phule Pune University
S.Y.B.Sc. (Computer Science)
Computer Science Paper - III
Course Code: CS 243
Title : Practical course on CS 241(Data Structures and Algorithms II) and CS 242 (Computer Networks I)

Teaching Scheme	No. of Credits	Examination Scheme
4 hrs 20 mins / week Batch size : 12	2	IE : 15 marks UE: 35 marks

Lab Book:
The lab book is to be used as a hands-on resource, reference and record of assignment submission and completion by the student. The lab book contains the set of assignments which the student must complete as a part of this course.

Programming Assignments:
Programs should be done individually by the student in the respective login. The codes should be uploaded on either the local server, Moodle, Github or any open source LMS. Print-outs of the programs and output may be taken but not mandatory for assessment.

Assessment:
Continuous assessment of laboratory work is to be done based on overall performance and lab assignments performance of student. Each lab assignment assessment will be assigned grade/marks based on parameters with appropriate weightage. Suggested parameters for overall assessment as well as each lab assignment assessment include-timely completion, performance, innovation, efficient codes and good programming practices.

- **Internal Evaluation :**
  - 10 marks will be given based on Networking assignments.
  - 5 marks will be allocated for Assignment completion and practical attendance
- **University Evaluation :**
  - The Practical slip will be of 35 Marks which will be based on Advanced Data structures.

Operating Environment:
For Data Structures:

- **Operating system:** Linux
- **Editor:** Any linux based editor like vi, gedit etc.
- **Compiler** : cc or gcc

Course Contents :-

Paper III	MTC-233: Mathematics Practical: Python Programming Language-I	MTC-213 : Mathematics Practical	MTC-243: Mathematics Practical: Python Programming Language-II	MTC–223: Mathematics Practical

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Semester III

MTC-231 : Groups and Coding Theory

[05 Lectures]

Unit 1. Integers

1.1 Division Algorithm (without Proof)
1.2 G.C.D. using division algorithm and expressing it as linear combination
1.3 Euclid's lemma
1.4 Equivalence relation (revision), Congruence relation on set of integers, Equivalence class partition

[03 Lectures]

Unit 2. Groups

2.1 Binary Operation
2.2 Group: Definition and Examples
2.3 Elementary Properties of Groups

[10 Lectures]

Unit 3. Finite Groups and Subgroups

3.1 Order of a group, order of an element
3.2 Examples (Zn, +) and (U(n), *)
3.3 Subgroup definition, Finite subgroup test, subgroups of Zn
3.4 Generator, cyclic group, finding generators of Zn(Corollary 3,4 without proof)
3.5 Permutation group, definition, composition of two permutations, representation as product of disjoint cycles, inverse and order of a permutation, even/ odd permutation
3.6 Cosets: Definition, Examples and Properties, Lagrange Theorem(without Proof)

[18 Lectures]

Unit 4. Groups and Coding Theory

4.1 Coding of Binary Information and Error detection
4.2 Decoding and Error Correction
4.3 Public Key Cryptography

Text Books:-

1. **Contemporary Abstract Algebra By J. A, Gallian (Seventh Edition)**
   Unit 1:Chapter 0, Unit 2: Chapter 2, Unit 3: Chapter 3 ,4, 5 and 7
2. **Discrete Mathematical Stuctures By Bernard Kolman, Robert C. Busby and Sharon Ross (6th Edition) Pearson Education Publication**
   Unit 4: Chapter 11

MTC-232 : Numerical Techniques

MTC-232
Numerical Techniques

Unit 1: Algebraic and Transcendental Equation **[04 Lectures]**

1.1 Introduction to Errors

1.2 False Position Method

1.3 Newton-Raphson Method

Unit 2: Calculus of Finite Differences and Interpolation **[16 Lectures]**

2.1 Differences

2.2. Forward Differences

2.3 Backward Differences

2.4 Central Differences

2.5 Other Differences (δ, μ operators)

2.6 Properties of Operators

2.7 Relation between Operators

2.8 Newton's Gregory Formula for Forward Interpolation

2.9 Newton's Gregory Formula for Backward Interpolation

2.10 Lagrange's Interpolation Formula

2.11 Divided Difference

2.12 Newton's Divided Difference Formula

Unit 3: Numerical Integration **[08 Lectures]**

3.1 General Quadrature Formula

3.2 Trapezoidal Rule

3.3 Simpson's one-Third Rule

3.4 Simpson's Three-Eight Rule

Unit 4: Numerical Solution of Ordinary Differential Equation **[08 Lectures]**

4.1 Euler's Method

4.2 Euler's Modified Method

4.3 Runge-Kutta Methods

India.
3. Perkovic, L., Introduction to Computing Using Python, 2/e, John Wiley, 2015.
4. Zelle, J., Python Programming: An Introduction to Computer Science, Franklin, Beedle & Associates Inc.
5. Sandro Tosi, Matplotlib for Python Developers, Packt Publishing Ltd.(2009)

Practicals:

Practical 1: Introduction to Python, Python Data Types-I (Unit 1)
Practical 2: Python Data Types- II (Unit 2)
Practical 3: Control statements in Python-I (Unit 3- 3.1, 3.2)
Practical 4: Control statements in Python-II (Unit 3- 3.3)
Practical 5: Application : Matrices (Unit 4 – 4.1-4.3)
Practical 6: Application : Determinants, system of Linear Equations (Unit 4- 4.4, 4.5)
Practical 7: Application : System of equations (Unit 4- 4.5)
Practical 8: Application : Eigenvalues, Eigenvectors (Unit 4 – 4.6)
Practical 9: Application : Eigenvalues, Eigenvectors (Unit 4 – 4.6)
Practical 10: Application : Roots of equations (Unit 5 – 5.1)
Practical 11: Application : Numerical integration (Unit 5 – 5.2, 5.3)
Practical 12: Application : Numerical integration (Unit 5 – 5.4)

Semester - IV

MTC-241: Computational Geometry

[12 Lectures]

Unit 1. Two dimensional transformations:

1.1 Introduction.
1.2 Representation of points.
1.3 Transformations and matrices.
1.4 Transformation of points.
1.5 Transformation of straight lines
1.6 Midpoint Transformation
1.7 Transformation of parallel lines
1.8 Transformation of intersecting lines
1.5 Transformation: rotations, reflections, scaling, shearing.
1.6 Combined transformations.
1.7 Transformation of a unit square.
1.8 Solid body transformations.
1.9 Translations and homogeneous coordinates.
1.10 Rotation about an arbitrary point.
1.11 Reflection through an arbitrary line.

[08 Lectures]

Unit 2. Three dimensional transformations:

2.1 Introduction.
2.2 Three dimensional – Scaling, shearing, rotation, reflection, translation.
2.3 Multiple transformations.
2.4 Rotation about – an axis parallel to coordinate axes, an arbitrary line
2.5 Reflection through – coordinate planes, planes parallel to coordinate planes , an arbitrary plane

[08 Lectures]

Unit 3. Projection

3.1 Orthographic projections.
3.2 Axonometric projections.
3.3 Oblique projections
3.4 Single point perspective projection [08 Lectures]

Unit 4. Plane and space Curves:

4.1 Introduction.
4.2 Curve representation.
4.3 Parametric curves.
4.4 Parametric representation of a circle and generation of circle.
4.5 Bezier Curves – Introduction, definition, properties (without proof), Curve fitting (up to n = 3), equation of the curve in matrix form (upto n = 3)

Textbook:

1. D. F. Rogers, J. A. Adams, Mathematical elements for Computer graphics, Mc Graw Hill Intnl Edition.

Unit 1: Chapter 2: Sec. 2-1 to 2.17
Unit 2: Chapter 3: Sec. 3.1 to 3.10,
Unit 3: Chapter 3: Sec. 3.12 to 3.14
Unit 4: Chapter 4: Sec. 4.1, 4.2, 4.5, Chapter 5: Sec. 5.1, 5.8

Reference books:

1. Computer Graphics with OpenGL, Donald Hearn, M. Pauline Baker, Warren Carithers, Pearson (4th Edition)
2. Schaum Series, Computer Graphics.

MTC-242: Operations Research

[12 Lectures]

Unit 1: Linear Programming Problem I

1.1 Introduction Definition and Examples
1.2 Problem solving using Graphical method
1.3 Theory of Linear Programming, Slack and surplus variables, Standard form of LPP, Some important definitions, Assumptions in LPP, Limitations of Linear programming, Applications of Linear programming, Advantages of Linear programming Techniques
1.4 Simplex method, Big- M-method [08 Lectures]

Unit 2: Linear Programming Problem II

2.1 Special cases of LPP : Alternative solution, Unbounded solution, Infeasible solution
2.2 Duality in Linear Programming, Primal to dual conversion, Examples [06 Lectures]

Unit 3: Assignment Models

3.1 Assignmment Model -Introduction
3.2 Hungerian method for Assignment problem [10 Lectures]

Unit 4: Transportation Models

4.1 Introduction, Tabular representation

4.2 Methods of IBFS (North-West rule, Matrix-minima, Vogel's Approximation), Algorithms

4.3 The Optimality Test of Transportation Model (MODI method only)

Text Book:-

Operation Research (12 th Edition), by S.D.Sharma.

Unit 1: Chapter 1: Sec. 1.1, 1.3-1, 1.3-2, 1.5, 1.6, 1.8, 1.9, 1.10, 1.11, 1.12,
Chapter 3: Sec. 3.1, 3.2, 3.3, 3. 4, 3.5-4,
Unit 2: Chapter 3: Sec. 3.8-1,3.8-2, Chapter 5: Sec. 5.1-1, 5.2-1,5.3,5.7-1, 5.7-2
Unit 3: Chapter 9: Sec. 9.1, 9.2, 9.4-1, 9.4-2, 9.5, 9.6, 9.7-1, 9.7-2
Unit 4: Chapter 10: 10.1, 10.2, 10.5, 10.8-1,10.9, 10.10

Reference Books:-

1. Operations Research by H. A. Taha
2. Operations Research by R. Panneerselvam, Prentice Hall of India.
3. Principles of Operations Research by H. M. Wagner, Prentice Hall of India.
4. Operations Research by Gupta and Hira.
5. Operation Research by J.K. Sharma

MTC-243: Mathematics Practical: Python Programming Language-II

Unit 1: 2D, 3D Graphs

1.1 Installation of numpy, matplotlib packages
1.2 Graphs plotting of functions such as ... etc.
1.3 Different formats of graphs.
1.3 Three-dimensional Points and Lines
1.4 Three-dimensional Contour Plots
1.5 Wireframes and Surface Plots
1.6 Graphs plotting of functions such as... etc.

Unit 2: Computational Geometry

1.1 Points: The distance between two points, Lists of Points - the PointList class, Integer point lists, Ordered Point sets, Extreme Points of a PointList, Random sets of Points not in general position

2.2 Points: Displaying Points and other geometrical objects, Lines, rays, and line segments, The geometry of line segments, Displaying lines, rays and line segments

2.3 Polygon : Representing polygons in Python, Triangles, Signed area of a triangle, Triangles and the relationships of points to lines, is Collinear, is Left, is Left On, is Right, is Right On, Between

2.4 Two dimensional rotation and reflection

2.5 Three dimensional rotation and reflection

2.6 Generation of Bezier curve with given control points

Unit 3: Study of Operational Research in Python

S.Y.B.Sc.(Computer Science), Electronics- Semester III

Paper-I: Microcontroller Architecture & Programming (ELC 231)

Objectives:

1. To study the basics of 8051microcontroller
2. To study the Programming of8051microcontroller
3. To study the interfacing techniques of 8051microcontroller
4. To design different application circuits using 8051microcontroller

Course Outcomes : On completion of the course, student will be able

1. To write programs for 8051 microcontroller
2. To interface I/O peripherals to 8051 microcontroller
3. To design small microcontroller based projects

COURSE CONTENTS

UNIT- 1: Basics of Microcontroller & Intel 8051 architecture **[08]**

Introduction to microcontrollers, difference in controller and processor.
Architecture of 8051, Internal block diagram, Internal RAM organization, SFRS, pin functions of 8051, I/O port structure & Operation, External Memory Interface.

UNIT-2: Programming model of 8051 **[10]**

Instruction classification, Instruction set, Addressing Modes: Immediate, register, direct, indirect and relative, assembler directives (ORG, END), features with examples, I/O Bit & Byte programming using assembly language for LED and seven segment display (SSD) interfacing.
Introduction to 8051 programming in C.

UNIT- 3: Timer /Counter, Interrupts **[10]**

Timer / counter: TMOD, TCON, SCON, SBUF, PCON Registers, Timer modes, programming for time delay using mode 1 and mode 2.
Interrupts: Introduction to interrupt, Interrupt types and their vector addresses, Interrupt enable register and interrupt priority register (IE, IP)

S.Y.B.Sc. Computer Science), Electronics, Semester III

Paper-II, Digital Communication and Networking, ELC- 232

Objectives:

1. To introduce to all aspects of data communication system
2. To introduce various digital modulation schemes
3. To identify the need of data coding and error detection/correction mechanism.
4. To study bandwidth utilization techniques : multiplexing and Spectrum spreading
5. To know data link layer protocol: Media Access Control
6. To study OSI and TCP/IP models of Networking.

Course Outcomes : On completion of the course, student will be able

1. Define and explain terminologies of data communication
2. Understand the impact and limitations of various digital modulation techniques
3. To acknowledge the need of spread spectrum schemes.
4. Identify functions of data link layer and network layer while accessing communication link
5. To choose appropriate and advanced techniques to build the computer network

COURSE CONTENTS

UNIT 1: Introduction to Electronic Communication **(9)**

Introduction to Communication: Elements of Communication system, types of noise sources, Electromagnetic spectrum, signal and channel bandwidth,

Types of communication: simplex, half duplex, full duplex, baseband and broadband,

Serial communication: asynchronous and synchronous,

Information Theory: Information entropy, rate of information (data rate, baud rate), channel capacity, Nyquist theorem, Signal to noise ratio, Noise Figure, Shannon theorem,

Error handling codes: Necessity, Hamming code, CRC

UNIT 2: Modulation and Demodulation **(5)**

Introduction to modulation and demodulation: Concept and need of modulation and demodulation,

Digital Modulation techniques: Pulse Code Modulation (PCM), FSK, QPSK, QAM.

S.Y.B.Sc.(Computer Science), Electronics, Semester III
Paper III, Practical Course (ELC-233)

Objectives:

1. To get hands on training of Embedded C
2. To study experimentally interfacing of microcontroller
3. To design, build and test modulator and demodulators of digital communication
4. To build and test experimentally various techniques of wired communication
5. To develop practical skills of network setup

Course Outcomes : On completion of the course, student will be able

1. To design and build his/her own microcontroller based projects.
2. To acquire skills of Embedded C programming
3. To know multiplexing and modulation techniques useful in developing wireless application
4. Do build and test own network and do settings.

Guidelines for Practical:

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- At least five practical from each Group
- Electronics lab should have set up for embedded programming (Computers and microcontroller target and interfacing boards)

COURSE CONTENTS

Group A: (Any 5)

1. Arithmetic, logical & code conversion problems using assembly/C programming
2. Interfacing of thumbwheel & seven segment display to 8051 microcontroller
3. Traffic light controller using 8051 microcontroller
4. Interfacing LCD to 8051Microcontroller
5. Waveform generation using DAC Interface to 8051Microcontroller

S.Y.B. Sc. (Computer Science), Electronics, Semester IV

Paper I : Embedded System Design (ELC-241)

Objectives:

1. To understand the concept of Embedded systems.
2. To study the design flow and available tools for an Embedded system.
3. To understand the implementation of embedded system using firmware and hardware components.
4. To acquire programming skills for the development of Embedded system design.
5. To develop practical skills for designing embedded system Applications.

Course Outcomes : On completion of the course, student will be able

1. To understand the difference between general computing and the Embedded systems.
2. To know the fundamentals of embedded systems.
3. Understand the use of Single board Computer (Such as Raspberry Pi) for an embedded system application.
4. Familiar with the programming environment to develop embedded systems and their interfaces with peripheral devices.
5. To develop familiarity with tools used to develop in an embedded environment.

COURSE CONTENTS

Unit 1:Introduction to Embedded systems using single board computers (SBC) **(08)**

Single boards computer block diagram, types, Comparison of SBC models, Specifications, I/O devices (Storage, display, keyboard and mouse), Network access devices

Unit 2: Architecture of System on Chip (SOC) **(08)**

Architecture of SoC, Basic version Broad Coprocessor, Pin Description of Raspberry Pi, Architectural features: CPU Overview, CPU Pipeline stages, CPU Cache Organization, Branch Prediction & Folding (Concept), GPU Overview

Unit 3:Programming using Python **(10)**

Overview of Rasberian OS (Operating System), Installation, different types of Operating Systems

S.Y.B.Sc.(Computer Science), Electronics, Semester IV

Paper II: Wireless Communication and Internet of Things (ELC242)

Objectives:

1. To learn and understand applications of wireless communication system
2. To learn and understand cellular system
3. To learn and understand architecture of short range Wireless Technologies
4. To learn and understand basics of Internet of Things
5. To study applications of IoT

Course Outcomes: Students will be able to

1. Know working of wireless technologies such as Mobile communication, GSM, GPRS
2. Become familiar with 3G and 4G Cellular Network Technologies for Data Connections.
3. Understand working principles of short range communication application
4. Get introduce to upcoming technology of Internet of Things
5. Explore themselves and develop new IoT based applications

COURSE CONTENTS

Unit1: Wireless Communication: Cellular Telephony **(12)**

Overview of wireless communication,

Introduction of cellular telephony system: Frequency reuse, handoff strategies, Co-channel and adjacent channel interference, block diagram of mobile handset

Overview of Cellular Telephony generations: 1G to 5G,3G (W-CDMA, UMTS), 4G(LTE)

GSM: architecture, frame structure, mobility management,

GPRS : architecture, application

S.Y.B.Sc.(Computer Science), Electronics, Semester IV
Paper III, Practical Course (ELC-243)

Objectives:

1. To use basic concepts for building various applications of embedded electronics.
2. To build experimental setup and test the circuits.
3. To develop skills of analyzing test results of given experiments.
4. Developing Trained Personals for educating and training for upcoming graduates in wireless communication.
5. Implement basic IoT applications on embedded platform

Course Outcomes : On completion of the course, students will be able

1. To design and develop own smart applications using Rasberry-Pi
2. To write Python program for simple applications
3. To build own IoT based system

Guidelines :

- Practical batch size : 12
- Minimum no of Practical to be performed : 10
- Eight compulsory experiments: At least four practical from each Group
- One activity equivalent to 2 experiments by the student.
  a. Continuation of F. Y. activity.
  b. Electronics project Based on the Theory Courses learnt
  c. Documentation type experiments
  d. Presentation/Seminar on Electronics /advanced topic/research topics.

Prerequisite: Rasberry Pi boards, Arduino / LoRa boards

COURSE CONTENTS

Group A (any 4)

1. Programming of Raspberry Pi to control LEDs attached to the GPIO pins
2. Programming of Raspberry Pi to get feedback from a switch connected to the GPIO pins

SavitribaiPhule Pune University
T.Y.B.Sc. (Computer Science) - Sem – V
Course Type: DSEC – I Course Code : CS - 351
Course Title : Operating Systems – I

Teaching Scheme: 03 Lect / week	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Prerequisites
Data structures like stack, queue, linked list, tree, graph, hashing, file structures, any structured programming language

Course Objectives:
1. To understand the concept of operation system and its principle
2. To study the various functions and services provided by operating system
3. To understand the notion of process and threads

Course Outcomes: After completion of this course students will be able to understand the concept of
1. Processes and Thread Scheduling by operating system
2. Synchronization in process and threads by operating system
3. Memory management by operating system using with the help of various schemes

Course Contents

Chapter 1 Introduction to Operating Systems — **6 lectures**

- Operating Systems Overview- system Overview and Functions of operating systems
- What does an OS do?
- Operating system Operations
- Operating system structure
- Protection and security
- Computing Environments- Traditional, mobile , distributed, Client/server, peer to peer computing
- Open source operating System
- Booting
- Operating System services,
- System calls Types of System calls and their working.

Chapter 2 Processes and Threads — **6 lectures**

- Process Concept – The processes, Process states, Process control block.
- Process Scheduling – Scheduling queues, Schedulers, context switch
- Operations on Process – Process creation with program using fork(), Process termination
- Thread Scheduling- Threads, benefits, Multithreading Models, Thread Libraries

Chapter 3 Process Scheduling — **7 lectures**

- Basic Concept – CPU-I/O burst cycle, Scheduling Criteria ,CPU scheduler, Preemptive scheduling, Dispatcher
- Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round-robin scheduling, Multiple queue scheduling, Multilevel feedback queue scheduling

Chapter 4 Synchronization — **5 lectures**

- Background
- Critical Section Problem
- Semaphores: Usage, Implementation

SavitribaiPhule Pune University
T.Y.B.Sc. (Computer Science) Sem - V
Course Code: DSEC - I **Course Code : CS - 352**
Course Title :Computer Networks - II

Teaching Scheme	No. of Credits	Examination Scheme
03 Lect/ week	2	IE :15 marks UE: 35 marks

Prerequisites:
Prerequisites: Basic knowledge of Networking and ISO/OSI model

Course Objectives
- To understand different protocols of application layer.
- To understand concepts of multimedia.
- Explore the different methods used for Network/INTERNET security.

Course Outcomes
On completion of the course, student will be able to–
- Student will understand the different protocols of Application layer.
- Develop understanding of technical aspect of Multimedia Systems
- Develop various Multimedia Systems applicable in real time.
- Identify information security goals.
- Understand, compare and apply cryptographic techniques for data security.

Course Contents **10 Lect**

Chapter 1 **Application Layer**

Domain Name System
- Name space-Flat name space, Hierarchical name space
- Domain Name Space -Label ,Domain name, FQDN,PQDN
- Distribution of Domain Name Space-Hierarchy of name servers, zone, Root server, Primary and secondary servers.
- DNS in the Internet: Generic domains, Country domains,inverse domain
- Resolution-Resolver,mapping names to address,mapping addresses to names,recursive resolution,iterative resolution,caching

Electronic Mail-
- Architecture-First scenario, second scenario, Third scenario, Fourth scenario
- User agent-services of user agent, types of UA Format of e-mail
- MIME-MIME header
- Message transfer agent-SMTP
- Message Access Agent: POP and IMAP

File Transfer
FTP-Communication over data control connection,File type,data structure,Transmission mode,anonymous FTP

Chapter 2 **Multimedia** **08 Lect**

Digitizing audio and video, Audio and Video compression
Streaming Stored audio/video
- First approach
- Second approach
- Third approach
- Fourth approach

Streaming live audio/video

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) - Sem - V

Course Type: DSEC - I **Course Code: CS - 357**

Course Title : Practical Course based on CS - 351

Teaching Scheme: 5 Lect/ week	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Course Objectives:

1. To understand the concept of process scheduling with the help of simulation.
2. To study the concept demand paging concepts in operating system.
3. To understand the working of operating system shell.

Course Outcomes: After completion of this course students will be able to understand the concept of

1. Process synchronization
2. Processes and Thread Scheduling by operating system
3. Memory management by operating system using with the help of various schemes

Guidelines:

1. Operating system platform – Linux
2. Programming language - C

List of Assignments:

- Operations on processes : (2 slot)
  (Create a child process using fork() and commands like exec(),execv() and execvp())
- Simulation of Operating System Shell and its working (commands)(2 slots)
- Simulation of CPU Scheduling Algorithms – FCFS, SJF, Priority and Round Robin(4 slots)
- Simulation of demand paging using memory page replacement algorithms – FIFO, LRU, OPT, MFU(4 slots)

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) - Sem - V

Course Type:DSEC – II **Course Code: CS - 353**

Course Title : Web Technologies - I

Teaching Scheme	No. of Credits	Examination Scheme
03 Lect/ week	2	IE : 15 marks UE: 35 marks

Prerequisites

HTML basics for form designing

Course Objectives

- To Design dynamic and interactive Web pages.
- To Learn Core-PHP, Server Side Scripting Language
- To Learn PHP-Database handling

Course Outcomes

On completion of the course, student will be able to–

- Understand how to develop dynamic and interactive Web Page

Course Contents

Chapter 1 **Introduction to HTML, HTTP and PHP** **10 Lects**

Overview of HTML and Basic Tags , Creating Forms ,Tables, HTML5 Semantics.
CSS basic concept ,Three ways to use CSS, Box Model, Navigation Bar .
Introduction to Web server and Web browser .
HTTP basics .
PHP Basics: Use of PHP, Lexical structure, Language basics .

Chapter 2 **Function and String** **8 Lects**

Defining and calling a function
Default parameters
Variable parameters, Missing parameters
Variable function, Anonymous function
Types of strings in PHP
Printing functions
Encoding and escaping
Comparing strings
Manipulating and searching strings
Regular expressions

Chapter 3 **Arrays** **6 Lectures**

Indexed Vs Associative arrays
Identifying elements of an array
Storing data in arrays
Multidimensional arrays
3.4Extracting multiple values
Converting between arrays and variables
Traversing arrays
Sorting
Action on entire array

Chapter 4 **Files and database handling** **10 Lectures**

Working with files and directories
Opening and Closing, Getting information about file, Read/write to file,
Splitting name and path from file, Rename and delete files
Reading and writing characters in file
Reading entire file

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) – Sem - V
Course Type:DSEC – II **Course Code: CS - 354**
Paper Title : Foundations of Data Science

Teaching Scheme	No. of Credits	Examination Scheme
03 lectures / week	2	IE : 15 marks UE: 35 marks

Prerequisites

- Problem solving using computers
- Basic mathematics and statistics
- Knowledge of Databases

Course Objectives

- Provide students with knowledge and skills for data-intensive problem solving and scientific discovery
- Be prepared with a varied range of expertise in different aspects of data science such as data collection, visualization, processing and modeling of large data sets.
- Acquire good understanding of both the theory and application of applied statistics and computer science based existing data science models to analyze huge data sets originating from diversified application areas.
- Be better trained professionals to cater the growing demand for data scientists in industry.

Course Outcomes

On completion of the course, student will be able to–

- Perform Exploratory Data Analysis
- Obtain, clean/process, and transform data.
- Detect and diagnose common data issues, such as missing values, special values, outliers, inconsistencies, and localization.
- Demonstrate proficiency with statistical analysis of data.
- Present results using data visualization techniques.
- Prepare data for use with a variety of statistical methods and models and recognize how the quality of the data and the means of data collection may affect conclusions.

Course Contents

Chapter 1	**Introduction to Data Science**	**6 lectures**

Introduction to data science, The 3 V's: Volume, Velocity, Variety
Why learn Data Science?
Applications of Data Science
The Data Science Lifecycle
Data Scientist's Toolbox
Types of Data
Structured, semi-structured, Unstructured Data, Problems with unstructured data
Data sources
Open Data, Social Media Data, Multimodal Data, standard datasets
Data Formats
Integers, Floats, Text Data, Text Files, Dense Numerical Arrays, Compressed or Archived Data, CSV Files, JSON Files, XML Files, HTML Files , Tar Files, GZip Files, Zip Files, Image Files: Rasterized, Vectorized, and/or Compressed

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) Sem – V

Course Type: DSEC - II **Course Code: CS - 358**

Course Title : Practical Course based on CS - 353 and CS - 354

Teaching Scheme: 5 Lect/ week Batch Size : 12	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Course Objectives:

- To Design dynamic and interactive Web pages.
- To Learn Core-PHP, Server Side Scripting Language
- To Learn PHP- Database handling
- To apply statistical, data preprocessing and visualization techniques on data sets

Course Outcomes:

- Understand how to develop dynamic and interactive Web Page
- Prepare data for use with a variety of statistical methods and recognize how the quality of the data may affect conclusions.
- Perform exploratory data analysis

Guidelines:

Operating Environment for web technologies: HTML5.0, PHP 5.0 and above , Webserver

Operating Environment for Data Science: Linux + python

List of Assignments on web technologies:

1 : HTML and HTML5.0
2 : CSS, Box Model, Navigation Bar
3 : Bootstrap
4 : Function and String
5 : Arrays
6: Files
7: Databases (PHP-PostgreSQL)

Suggested Assignments for Foundations of Data Science

Assignment 1: The Data Science environment

Getting introduced to Python IDLE, command line, online tools like google colaboratory and essential packages like NumPy, SciPy, pandas, scikit-learn, matplotlib, jupyter, beautiful-soup, etc.

Assignment 2: Loading the dataset

Select a dataset from a list of publicly available datasets at UCI Machine Learning Repository and load it using Pandas. (Import different dataformat files like .CSV,.htm,.json etc. Briefly describe what the dataset is about and size of the dataset (e.g. number of tables, number of instances and attributes, etc.)

Assignment 3: Basic statistical operations

Apply basic statistical operations on a dataset. For example - compute the mean, median, mode, range, quartiles, and variance for one or more attributes.

SavitribaiPhule Pune University
T.Y.B.Sc. (Computer Science) Sem – V
Course Type:DSEC – III **Course Code: CS - 355**
Course Title: Object Oriented Programming using Java - I

Teaching Scheme	No. of Credits	Examination Scheme
03 Lect / week	2	IE : 15 marks UE: 35 marks

Prerequisites

- Knowledge of C Programming language

Course Objectives

- To learn Object Oriented Programming language
- To study various java programming concept like Interface, File and Exception Handling etc.
- To design User Interface using Swing and AWT

Course Outcomes

On completion of the course, student will be able to–

- Understand the concept of classes, object, packages and Collections.
- To develop GUI based application.

Course Contents

Chapter 1	**An Introduction to Java**	**6 Lect**

Object Oriented Programming Concepts
A short history of Java
Features OR Buzzwords of Java
Java Environment
Simple Java Program
Java Tools – jdb, javap, javadoc
Types of Comments
Data Types
Final Variable
Declaring 1D, 2D Array
Accepting Input
(Command Line Arguments, BufferedReader, Scanner)

Chapter 2	**Objects and Classes**	**7 Lect**

Defining your own classes
Access Specifiers
(public, protected, private, default)
Array of Objects
Constructors, Overloading Constructors and Use of 'this' keyword
static block, static fields And methods
Predefined Classes

- Object Class, Methods (equals(), toString(),hashcode(), getClass())
- String Class And StringBuffer Class,Formatting String data using format() method

Creating , Accessing And Using Packages
Wrapper Classes

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) Sem - V

Course Type: DSEC - III **Course Code: CS - 356**

Paper Title: Theoretical Computer Science

Teaching Scheme	No. of Credits	Examination Scheme
3 Lect/ week	2	IE : 15 marks UE: 35 marks

Prerequisites

- Mathematical Preliminaries Sets (Subset, Set Operations), Relations (Properties of Relations, Closure of Relations) and Functions
- Discrete Mathematics- Graphs, Trees, Logic and Proof Techniques

Course Objectives

- To understand the Finite Automata, Pushdown Automata and Turing Machine.
- To understand the Regular Language, Context Free Language, Context Sensitive Language and Unrestricted Language.
- To understand the relation between Automaton and Language

Course Outcomes

On completion of the course, student will be able to–

- Understand the use of automata during language design.
- Relate various automata and Languages.

Course Contents **10 Lect**

Chapter 1 **Finite Automaton**

Introduction: Symbol, Alphabet, String, Prefix & Suffix of Strings, Formal Language, Operations on Languages.
Deterministic finite Automaton – Definition, DFA as language recognizer, DFA as pattern recognizer.
Nondeterministic finite automaton – Definition and Examples.
NFA To DFA (Myhill Nerode Method)
NFA with ε- transitions Definition and Examples.
NFA with ε-Transitions to DFA & Examples
Finite automaton with output – Mealy and Moore machine, Definition and Examples.
Minimization of DFA, Algorithm & Problem using Table Method.

Chapter 2 **Regular Expressions and Languages** **6 Lect**

Regular Expressions (RE): Definition & Example
Regular Expressions Identities.
Regular language-Definition and Examples.
Conversion of RE to FA-Examples.
Pumping lemma for regular languages and applications.
Closure Properties of regular Languages

SavitribaiPhule Pune University
T.Y.B.Sc. (Computer Science) - Sem – V
Course Type: DSEC - III **Course Code: CS - 359**
Course Title : Practical Course based on CS - 355

Teaching Scheme	No. of Credits	Examination Scheme
5 Lect / week Batch Size : 12	2	IE : 15 marks UE: 35 marks

Course Objectives:

Covers the complete scope of the syllabus.

1. Bringing uniformity in the way course is conducted across different colleges.
2. Continuous assessment of the students.

Course Outcomes:

1. Use an integrated development environment to write, compile, run, and test simple object-oriented Java programs.
2. Read and make elementary modifications to Java programs that solve real-world problems.
3. Validate input in a Java program.

Guidelines:

Operating Environment :

- **Operating system :** Linux
- **Editor :** Anylinux based editor like vi, gedit and Use of IDE – Eclipse etc.
- **Compiler** : javac

Submission :

Each assignment will be assessed on a scale of 0 to 5 as indicated below.

- Not done 0
- Incomplete 1
- Late Complete 2
- Needs improvement 3
- Complete 4
- Well Done 5

Assessment :

Easy : All exercises are compulsory.
Medium : All exercises are compulsory.

List of Assignments :

Assignment 1 : Java Tools and IDE, Simple java programs [Slot – 1]

Introduction to the java environment
Use of java tools like java, javac, jdb and javadoc
Defining simple classes and creating objects.

Assignment 2 : Array of Objects and Packages [Slot – 2]

Defining a class.
Creating an array of objects.
Creating a package.

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – V
Course Type: SECC – II **Course Code : CS-3511**
Course Title: Blockchain Technology

Teaching Scheme	No. of Credits	Examination Scheme:
03 Lect / week	2	IE : 15 marks UE: 35 marks

Prerequisite:
Understanding of Object Oriented Programming Concepts
Knowledge of Python

Course Objectives

1. Understand what and why of blockchain technology.
2. Explore major components of blockchain.
3. Learn about Bitcoin, Cryptocurrency and Ethereum.
4. To learn blockchain programming using Python, Flask Web Framework, and HTTP client Postman.

Course Outcomes
On completion of the course, student will be able to–
1. Learn the fundamentals of Blockchain Technology.
2. Learn Blockchain programming
3. Basic knowledge of Smart Contracts and how they function.

Course Contents

Chapter 1	**Introduction to Blockchain**	**7 Lect**

- Foundational Computing Concepts (Client-Server systems vs Peer to Peer Systems)
- Evolution of Blockchain
- Blockchain Vs Database
- Essentials of Blockchain (Blockchain generations, types of blockchain, benefits and challenges of blockchain usage)
- Types of Networks
- Layered Architecture of Blockchain Ecosystem
- Components of blockchain
- Cryptography (private and public keys, Hashing & Digital Signature)
- Consensus Mechanisms
- Cryptocurrency, Digital Currency Bitcoin and Ethereum
- Smart Contracts
- Blockchain use cases

Chapter 2	**How Blockchain Works?**	**5 Lect**

- Understanding SHA256 Hash
- Immutable Ledger
- Distributed P2P Network
- How Mining Works? (The NONCE and Cryptographic Puzzle)
- Byzantine Fault Tolerance
- Consensus Protocols: Proof of Work, Proof of State, Défense Against Attackers, Competing Chains
- Blockchain Demo

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – V
Course Type: SECC – I **Course Code : CS-3510**
Course Title: Python Programming

Teaching Scheme	No. of Credits	Examination Scheme:
03 Lect / week	2	IE : 15 marks UE: 35 marks

Course Objectives

1. To introduce programming concepts using python
2. Student should be able to develop Programming logic using python
3. To develop basic concepts and terminology of python programming
4. To test and execute python programs

Course Outcomes

On completion of the course, student will be able to–

- Develop logic for problem solving
- Determine the methods to create and develop **Python programs** by utilizing the data
- structures like lists, dictionaries, tuples and sets.
- To be familiar about the basic constructs of programming such as data, operations, conditions, loops, functions etc.
- To write python programs and develop a small application project

Course Contents

Chapter 1	**An Introduction to Python**	**3 Lect**

Introduction to Python

The Python Programming Language, History, features, Applications, Installing Python, Running Simple Python program

Basics of Python

Standard data types - basic, none, Boolean (true & False), numbers, Variables, Constants,Python identifiers and reserved words, Lines and indentation, multi-line statements and Comments,Input/output with print and input ,functions Declaration, Operations on Data such as assignment, arithmetic, relational, logical and bitwise operations, dry run, Simple Input and output etc.

Chapter 2	**Control Statements**	**4 Lect**

Sequence Control – Precedence of operators, Type conversion

Conditional Statements: if, if-else, nested if-else,

Looping- for, while, nested loops, loop control statements (break, continue, pass)

a. **Strings**: declaration, manipulation, special operations, escape character, string formatting operator, Raw String, Unicode strings, Built-in String methods.

Chapter 3	**Lists, functions, tuples and dictionaries, Sets**	**7 Lect**

Python Lists: Concept, creating and accessing elements, updating & deleting lists, traversing a List, reverse Built-in List Operators, Concatenation, Repetition, In Operator, Built-in List functions and methods.

Functions: Definitions and Uses, Function Calls, Type Conversion Functions, Math Functions, Composition, Adding New Functions, Flow of Execution, Parameters and Arguments, Variables and Parameters, Stack Diagrams, Void Functions, Anonymous functions Importing with from, Return Values, Boolean Functions, More Recursion, Functional programming tools - filter(), map(), and reduce(),recursion, lambda forms.

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: DSEC - IV **Course Code: CS - 361**
Course Title : Operating Systems-II

Teaching Scheme: 03 Lect / week	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Prerequisites
Concepts of Operating System, Processes and Threads Scheduling, Synchronization

Course Objectives:
1. To understand the issue of Deadlocks in Process management.
2. To understand the concept of File system management & disk scheduling
3. To study the concept of distributed and mobile operating systems

Course Outcomes: After completion of this course students will be able to understand the concept of
1. Management of deadlocks and File System by operating system
2. Scheduling storage or disk for processes
3. Distributed Operating System and its architecture and the extended features in mobile OS.

Course Contents

Chapter 1	**Process Deadlocks**	**7 lectures**

- System model
- Deadlock Characterization – Necessary conditions, Resource allocation graph
- Deadlock Methods- Prevention and Deadlock Avoidance - Safe state, Resource allocation graph algorithm, Banker's Algorithm
- Deadlock Detection
- Recovery from Deadlock – Process termination, Resource preemption

Chapter 2	**File system Management**	**6 lectures**

- File concept , File attributes, File operations
- Access Methods – Sequential, Direct, Other access methods
- Directory overview, Single level directory, Two level directory, Tree structure directory, Acyclic graph directory, General graph directory
- Allocation Methods – Contiguous allocation, Linked allocation, Indexed allocation
- Free Space Management – Bit vector, Linked list, Grouping, Counting, Space maps

Chapter 3	**Disk scheduling**	**4 lectures**

- Overview, Disk Structure
- Disk Scheduling, FCFS Scheduling, SSTF Scheduling, Scan Scheduling-Scan Scheduling, Look Scheduling , Disk Management

Chapter 4	**Introduction to Distributed operating systems & Architecture**	**11 lectures**

- What is a distributed system, Design goals
- Types of distributed systems
- Architectural styles : Layered architectures , Object-based architectures, Resource-centered architectures
- System architecture – Centralized organization, Decentralized organizations, peer-to-peer systems, Hybrid architectures.

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: DSEC - IV **Course Code: CS - 362**
Course Title : Software Testing

Teaching Scheme: 3 Lect / week	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Prerequisites:

- Basic knowledge of algorithms, problem solving, expected inputs/outputs
- Knowledge of C and java Programming Language, compilation, debugging.

Course Objectives:

- To provide the knowledge of software testing techniques
- To understand how testing methods can be used as an effective tools in quality assurance of software.
- To provide skills to design test case plan for testing software.
- To provide knowledge of latest testing methods

Course Outcomes:

- To understand various software testing methods and strategies.
- To understand a variety of software metrics, and identify defects and managing those defects for improvement in quality for given software.
- To design test cases and test plans, review reports of testing for qualitative software.
- 4. To understand latest testing methods used in the software industries.

Course Contents

Chapter 1	**Introduction to Software Testing**	**5 lectures**

Basics of Software Testing – faults, errors and failures
Testing objectives
Principles of testing
Testing and debugging
Testing metrics and measurements
Verification and Validation
Testing Life Cycle

Chapter 2	**Software Testing Strategies & Techniques**	**10 lectures**

Testability - Characteristics lead to testable software.
Test characteristics
Test Case Design for Desktop, Mobile, Web application using Excel
White Box Testing - Basis path testing, Control Structure Testing.
Black Box Testing- Boundary Value Analysis, Equivalence partitioning.
Differences between BBT & WBT

Chapter 3	**Levels of Testing**	**10 lectures**

A Strategic Approach to Software Testing
Test strategies for conventional Software
Unit testing
Integration testing – Top-Down, Bottom-up integration
System Testing – Acceptance, performance, regression, Load/Stress testing, Security testing, Internationalization testing.
Alpha, Beta Testing

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: DSEC- IV **Course Code: CS - 367**
Course Title : Practical Course based on CS - 361

Teaching Scheme: 5 Lect/ week	No. of Credits: 2	Examination Scheme: IE : 15 marks UE: 35 marks

Course Objectives:

1. To implement Banker's algorithm for Deadlocks in Process management.
2. To simulate File system management
3. To study and implement various algorithms of disk scheduling

Course Outcomes: After completion of this course students will be able to understand the concept of

1. Management of deadlocks by operating system
2. File System management
3. Disk space management and scheduling for processes

Guidelines:

1. Operating system platform – Linux
2. Programming language - C

List of Assignments:

- Simulation of Banker's algorithm of deadlock avoidance in processes of operating system (3 slots)
- Simulation of File Allocation methods and free space management in storage - Contiguous allocation, Linked allocation, Indexed allocation (4 slots)
- Simulation of Disk Scheduling algorithms – FCFS, SSTF, Scan, Look (2 slots)
- Assignment based on distributed and mobile OS (3 slots)

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science)- Sem - VI
Course Type:DSEC – V **Course Code: CS - 363**
Course Title : Web Technologies - II

Teaching Scheme	No. of Credits	Examination Scheme
3 Lect / week	2	IE : 15 marks UE: 35 marks

Prerequisites
- HTML5,CSS
- Core PHP
- Bootstrap framework utility

Course Objectives
- To Learn different technologies used at client Side Scripting Language
- To Learn XML and XML parsers.
- To One PHP framework for effective design of web application.
- To Learn Java Script to program the behavior of web pages.
- To Learn AJAX to make our application more dynamic.
- Framework has

Course Outcomes
On completion of the course, student will be able to–
- Build dynamic website.
- Using MVC based framework easy to design and handling the errors in dynamic website.

Course Contents

Chapter 1	**Introduction to Web Techniques**	**6 Lect**

Variables
Server information
Processing forms
Setting response headers
Maintaining state
PHP error handling

Chapter 2	**XML**	**6 Lect**

What is XML?
XML document Structure
PHP and XML
XML parser
The document object model
The simple XML extension
Changing a value with simple XML

Chapter 3	**Java Script and Jquery**	**10 Lect**

Overview of JavaScript
Object Orientation and JavaScript Basic Syntax(JS datatypes, JS variables)
Primitives, Operations and Expressions
Screen Output and keyboard input(Verification and Validation)
JS Control statements and JS Functions
JavaScript HTML DOM Events(onmouseup, onmousedown, onclick, onload, onmouseover, onmouseout).

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) – Sem VI
Course Type:DSEC – V **Course Code: CS - 364**
Course Title : Data Analytics

Teaching Scheme	No. of Credits	Examination Scheme
03 lectures / week	2	IE : 15 marks UE: 35 marks

Prerequisites

- Basic of mathematics and statistics
- Basic programming Knowledge of python
- Knowledge of databases

Course Objectives

- Deploy the Data Analytics Lifecycle to address data analytics projects.
- Develop in depth understanding of the key technologies in data analytics.
- Apply appropriate analytic techniques and tools to analyze data, create models, and identify insights that can lead to actionable results.

Course Outcomes

On completion of the course, student will be able to–

- Use appropriate models of analysis, assess the quality of input, and derive insight from results.
- Analyze data, choose relevant models and algorithms for respective applications
- Understand different data mining techniques like classification, prediction, clustering and association rule mining
- Apply modeling and data analysis techniques to the solution of real world business problems

Course Contents

Chapter 1 | Introduction to Data Analytics — **6 lectures**

Concept of data analytics
Data analysis vs Data analytics
Types of analytics
Diagnostic Analytics, Predictive Analytics , Prescriptive Analytics, Exploratory Analysis, Mechanistic Analysis
Mathematical models - Concept
Model evaluation: metrics for evaluating classifiers - Class imbalance - AUC, ROC (Receiver-Operator Characteristic) curves, Evaluating value prediction models

Chapter 2 | Machine Learning Overview — **6 Lectures**

Introduction to Machine Learning, deep learning, Artificial intelligence
Applications for machine learning in data science
The modeling process
Engineering features and selecting a model, Training the model, Validating the model, Predicting new observations
Types of machine learning
Supervised learning, Unsupervised learning, Semi-supervised learning, ensemble techniques
Regression models
Linear Regression

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) - Sem – VI

Course Type: DSEC - V **Course Code: CS - 368**

Course Title : Practical Course based on CS - 363 and CS - 364

Teaching Scheme	No. of Credits:	Examination Scheme:
5 Lect/ week Batch Size : 12	2	IE : 15 marks UE: 35 marks

Course Objectives:

- To Learn different technologies used at client Side Scripting Language
- To Learn XML and XML parsers.
- To One PHP framework for effective design of web application.
- To Learn Java Script to program the behavior of web pages.
- To Learn AJAX to make our application more dynamic.
- Framework has some utility features that make easy to write API in more efficient way than Core PHP

Course Outcomes:

- Build dynamic website.
- Using MVC based framework easy to design and handling the errors in dynamic website.

Guidelines:

Operating Environment :Linux, HTML, PHP5.0 and above, Codeigniter, Python

List of Assignments based on Web Technology CS-363:

1 : Self Processing Forms, Sticky Forms, File Upload.
2 : COOKIES and SESSIONS.
3 : XML documents and DOM
4 : JavaScript
5 : Ajax
6 : PHP framework CodeIgniter

List of Assignments for Data Analytics

Assignment 1: Frequent itemset and association rule mining

Load Transactional data set. Do the needful data preprocessing. Display the set of frequent 2-itemsets and 3-itemsets. Repeat the process for different min_sup value.

Assignment 2: Linear and Logistic regression

For Given dataset predict the value of specific attribute.

Assignment 3: Text Analytics

Take text file as input. Create bag of words. Find frequent item sets. Display word cloud

Assignment 4: Sentiment analysis

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: DSEC – VI **Course Code : CS - 365**
Course Title : Object Oriented Programming using Java – II

Teaching Scheme	No. of Credits	Examination Scheme
03 Lect / week	2	IE : 15 marks UE: 35 marks

Prerequisites

- Knowledge of Core Java (CS – 355)

Course Objectives

- To learn database programming using Java
- To study web development concept using Servlet and JSP
- To develop a game application using multithreading
- To learn socket programming concept

Course Outcomes

On completion of the course, student will be able to–

- To access open database through Java programs using Java Data Base Connectivity (JDBC) and develop the application.
- Understand and Create dynamic web pages, using Servlets and JSP.
- Work with basics of framework to develop secure web applications.

Course Contents

Chapter 1	**Collections**	**6 Lect**

Introduction to the Collection framework
List - ArrayList, LinkedList
Set - HashSet, TreeSet,
Map - HashMap and TreeMap
Interfaces such as Comparator, Iterator, ListIterator, Enumeration

Chapter 2	**Multithreading**	**6 Lect**

What are threads?
Life cycle of thread
Creating threads - Thread class , Runnable interface
Thread priorities
Running multiple threads
Synchronization and interthread communication

Chapter 3	**Database Programming**	**12 Lect**

The design of jdbc
Types of drivers
Executing sql statements, query execution
Scrollable and updatable Resultset

Chapter 4	**Servlets and JSP**	

Introduction to Servlet and Hierarchy of Servlet
Life cycle of servlet
Handing get and post request (HTTP)
Handling data from HTML to servlet
Retrieving data from database to servlet

Savitribai Phule Pune University

T.Y.B.Sc. (Computer Science) - Sem - VI

Course Type: DSEC - VI **Course Code: CS - 366**

Course Title: Compiler Construction

Teaching Scheme	No. of Credits	Examination Scheme
3 Lect / week	2	IE: 15 marks UE: 35 marks

Prerequisites

- Knowledge of Automata Theory and Languages.

Course Objectives

- To understand design issues of a lexical analyzer and use of LEX tool.
- To understand design issues of a parser and use of YACC tool.
- To understand and design code generation and optimization techniques.

Course Outcomes

On completion of the course, student will be able to–

- Understand the process of scanning and parsing of source code.
- Learn the conversion code written in source language to machine language.
- Understand tools like LEX and YACC.

Course Contents

Chapter 1	**Introduction**	**4 Lect**

Definition of Compiler, Aspects of compilation.
The structure of Compiler.
Phases of Compiler – Lexical Analysis, Syntax Analysis, Semantic Analysis,
Intermediate Code generation, code optimization, code generation.
Error Handling.
Introduction to one pass & Multipass compilers, cross compiler, Bootstrapping.

Chapter 2	**Lexical Analysis (Scanner)**	**4 Lect**

Review of Finite automata as a lexical analyzer,
Applications of Regular Expressions and Finite Automata (lexical analyzer,
searching using RE), Input buffering, Recognition of tokens.
LEX: A Lexical analyzer generator (Simple Lex Program)

Chapter 3	**Syntax Analysis (Parser)**	**14 Lect**

Definition, Types of Parsers
Top-Down Parser –
Top-Down Parsing with Backtracking: Method & Problems
Drawbacks of Top-Down parsing with backtracking, 3.2.3Elimination of Left
Recursion (direct & indirect) 3.2.4Need for Left Factoring & examples
Recursive Descent Parsing: Definition
Implementation of Recursive Descent Parser Using Recursive Procedures
3.4 Predictive [LL (1)] Parser (Definition, Model)
3.4.1Implementation of Predictive Parser [LL (1)]
3.4.2 FIRST & FOLLOW

SavitribaiPhule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: DSEC - VI **Course Code: CS - 369**
Course Title : Practical Course based on CS - 365

Teaching Scheme	No. of Credits	Examination Scheme
5 Lect/ week Batch Size : 12	2	IE : 15 marks UE: 35 marks

Course Objectives:

1. Covers the complete scope of the syllabus.
2. Bringing uniformity in the way course is conducted across different colleges.
3. Continuous assessment of the students.
4. Advanced Java is designed to develop web based, network centric, Enterprise level applications

Course Outcomes:

1. To Learn database Programming using Java
2. Understand and Create dynamic web pagesusing Servlets and JSP.
3. Work with basics of framework to develop secure web applications

Guidelines:

Operating Environment :

- **Operating system:** Linux
- **Editor:** Anylinux based editor like vi, gedit and Use of IDE – Eclipse etc.
- **Compiler** :javac
- **Database** :postgresql

Submission :

Each assignment will be assessed on a scale of 0 to 5 as indicated below.

Not done	0
Incomplete	1
Late Complete	2
Needs improvement	3
Complete	4
Well Done	5

Assessment :

Easy : All exercises are compulsory.
Medium : All exercises are compulsory.

List of Assignments:

Assignment 1 : Database Programming [Slot-2]

Study the Collection framework in java.
To Implement various Interfaces and classes through algorithms.
To Demonstrate Cursor Objects (Enumeration, Iterator, ListIterator, Comparator)

Assignment 2 : Multithreading [Slot-2]

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem – VI
Course Type: SECC - III **Course Code: CS - 3610**
Course Title: Software Testing Tools

Teaching Scheme: 03 Lect / week	No. of Credits: 2	Examination Scheme: IE:15 marks UE: 35 marks

Prerequisites

- Basic knowledge of algorithms, problem solving, expected inputs/outputs
- Knowledge of C and Java Programming Language, compilation, debugging

Course Objectives:

- To provide the knowledge of software testing methods and strategies.
- To understand how testing methods can be used as an effective tool in quality assurance of software.
- To provide skills to design test case plan for testing software.
- 4.To provide knowledge of latest testing tools

Course Outcomes:

- To understand various software testing methods and strategies.
- To understand a variety of software metrics and identify defects and managing those defects for improvement in quality for given software.
- To design test cases and test plans, review reports of testing for qualitative software.
- 4. To understand latest testing tools used in the software industries.

Course Contents		
Chapter 1	**Introduction to Test case design**	**4 lectures**
How to identify errors, bugs in the given application. Design entry and exit criteria for test case, design test cases in excel. Describe feature of a testing method used.		
Chapter 2	**Test cases for simple programs**	**4 lectures**
Write simple programs make use of loops and control structures. Write Test Cases for above programs.		
Chapter 3	**Test cases and Test plan**	**4 lectures**
Write Test Plan for given application with resources required. Write Test case for given application. Prepare Test report for test cases executed.		
Chapter 4	**Defect Report**	**3 lectures**
Defect Life Cycle Classification of Defect Write Defect Report		
Chapter 5	**Testing Tools**	**3 lectures**
How to make use of Automation Tools Types of Testing Tools		
Demonstration	**Programming Assignments**	**18 Lect**
Out of 36 lectures, 18 are assigned for demonstration. Teacher should give demonstration of various assignments based on above theory topics in the classroom or in the laboratory as per their convenience. Demonstration of any open source testing tool should be given.		

Savitribai Phule Pune University
T.Y.B.Sc. (Computer Science) - Sem - VI
Course Type: SECC - IV **Course Code: CS - 3611**
Course Title : Project

Teaching Scheme	No. of Credits	Examination Scheme
03 Lect/ week/Batch Batch Size : 20	2	IE : 15 marks UE: 35 marks

Project Guidelines:

- Students should work in a team of minimum 3 and maximum 4 students.
- Students can choose a project topic and implement the same using any language/technology covered in the curriculum so far. The operating environment must be linux.
- The student group will work independently throughout the project work including: problem identification, information searching, literature study, design and analysis, implementation, testing, and the final reporting.
- Project guide must conduct project presentations (minimum 2) to monitor the progress of the project groups.
- At the end of the project, the group should prepare a report which should conform to international academic standards. The report should follow the style in academic journals and books, with clear elements such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report.
- The final project presentation with demonstration (UE) will be evaluated by the project guide (appointed by the college) and one external examiner (appointed by the University).

Recommended Documentation contents:

Abstract

Introduction

- motivation
- problem statement
- purpose/objective and goals
- literature survey
- project scope and limitations

System analysis

- Existing systems
- scope and limitations of existing systems
- project perspective, features
- stakeholders
- Requirement analysis - Functional requirements, performance requirements, security requirements etc.

System Design

- Design constraints
- System Model: Using OOSE
- Data Model
- User interfaces

Implementation details

Detailed Syllabus:

Course Code: CSUT111	**Course Name:** Paradigm of Programming Language	**Total Lectures (48 Hours)**
Teaching Scheme : 4 hrs/week	**Examination Scheme:** IA: 30 Marks UE: 70 Marks	**No. of Credits** 4
Course Prerequisites:	Student should have basic knowledge of: • Procedural Language like C • Object-Oriented Languages (C++ and Java) • Concepts of Operating Systems • Basic Data Structures and Algorithms.	
Course Objectives:	To Prepare student to think about programming languages analytically: • Separate syntax from semantics • Compare programming language designs • Understand their strengths and weaknesses • Learn new languages more quickly • Understand basic language implementation techniques • Learn small programs in different programming Languages	
Chapter	**Course Contents**	**No. of Lectures**
1	**Introduction** • The Art of Language Design • The Programming Language Spectrum • Why Study Programming Languages? • Compilation and Interpretation • Programming Environments	2
2	**Names, Scopes, and Bindings** • The Notion of Binding Time • Object Lifetime and Storage Management • Static Allocation, Stack-Based Allocation, Heap-Based Allocation, Garbage Collection Scope Rules • Static Scoping, Nested Subroutines, Declaration Order, Dynamic Scoping The meaning of Names in a Scope • Aliases, Overloading, Polymorphism and Related Concepts, the Binding of Referencing Environments • Subroutine Closures, First-Class Values and Unlimited Extent, Object Closures Macro Expansion •	5

Course Code: CSUT112	Course Name: Design and Analysis of Algorithm	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	☐ Basic knowledge of algorithms and programming concepts ☐ Data Structures and Advanced Data Structures ☐ Basic Knowledge of Graphs and Algorithms	
Course Objectives:	• To design the algorithms • To select the appropriate algorithm by doing necessary analysis of algorithms • To learn basic Algorithm Analysis techniques and understand the use of asymptotic notation • Understand different design strategies • Understand the use of data structures in improving algorithm performance • Understand classical problem and solutions • Learn a variety of useful algorithms • Understand classification of problems • To provide foundation in algorithm design and analysis • To develop ability to understand and design algorithms in context of space and time complexity.	

Chapter	Course Contents	No. of Lectures
1	**Basics of Algorithms** • Algorithm definition and characteristics • Space complexity • Time complexity, worst case-best case-average case • complexity, asymptotic notation • Recursive and non-recursive algorithms • Sorting algorithms (insertion sort, heap sort, bubble sort) • Sorting in linear time: counting sort, concept of bucket and radix sort • Searching algorithms: Linear, Binary	8
2	**Divide and conquer strategy** • General method, control abstraction • Binary search • Merge sort, Quick sort • Comparison between Traditional Method of Matrix Multiplication vs. Strassen's Matrix Multiplication	5

Course Code: CSUT113	Course Name: Database Technologies	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	• Knowledge of file system concepts • Strong foundation of Related database Concepts (Basic & Advanced) • A firm foundation of any RDBMS package	
Course Objectives:	• Provide an overview of the concept of NoSQL technology. • Provide an insight to the different types of NoSQL databases • Make the student capable of making a choice of what database technologies to use, based on their application needs.	

Chapter	Course Contents	No. of Lectures
1	**Introduction to NOSQL (Core concepts)**	18
	Why NoSQL	
	Aggregate Data Models	
	Data modeling details	
	Distribution Models	
	Consistency	
	Version stamps	
	Map-Reduce	
2	**Implementation with NOSQL databases**	14
	Key-Value Databases (Riak)	
	Document Databases (Mongodb)	
	Column-Family stores (Cassandra)	
	Graph databases (Neo4j)	
3	**Schema Migrations**	5
4	**Polygot Persistence (Multi model types)**	5
5	**Beyond NoSQL**	3
6	**Choosing your database**	3

References:

Sr. No.	Title of the Book	Author/s	Publication
1	NoSQL Distilled	Pramod Sadalge, Martin Fowler	
2	NoSQL for Dummies	A Willy Brand	
3	http://nosql-database.org		

Note: For Database Technologies implementation of databases/assignments can be done in all, but for university practical examination only MongoDB and Neo4j will be used/considered. Other can be for self learning/demonstration.

Course Code: CSDT114B	Course Name: Artificial Intelligence	Total Lectures (30 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 15 Marks UE: 35 Marks	No. of Credits 02
Course Prerequisites:	☐ Concepts of Data structures and Design and Analysis of algorithms. ☐ Strong data analytics skills. ☐ Strong will to learn machine learning languages.	
Course Objectives:	☐ To learn various types of algorithms useful in Artificial Intelligence (AI). ☐ To convey the ideas in AI research and programming language related to emerging technology. ☐ To understand the numerous applications and huge possibilities in the field of AI that goes beyond the normal human imagination.	

Chapter	Course Contents	No. of Lectures
1	**Introduction to Artificial Intelligence:** Introduction and Intelligent systems, What Is AI, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, Applications of AI, Early work in AI and related fields, AI problems and Techniques.	2
2	**Searching:** -Defining AI problems as a State Space Search: example, Search and Control Strategies, Problem Characteristics, Issues in Design of Search Programs, Production System. Blind Search Techniques : -BFS, DFS, DLS, Iterative Deepening, Search, Bidirectional Search, Uniform cost Search. Heuristic search techniques: -Generate and test ,Hill Climbing, Best First search, Constraint Satisfaction, Mean-End Analysis, A*,AO*.	8

CSDP114B: Artificial Intelligence Practical

Sr. No.	Assignment
1	Subject teacher should conduct first lab practical on basic programs using python for introducing and using python environment such as, a) Program to print multiplication table for given no. b) Program to check whether the given no is prime or not. c) Program to find factorial of the given no and similar programs.
2	Write a program to implement List Operations(Nested list, Length, Concatenation, Membership ,Iteration ,Indexing and Slicing), List Methods(Add, Append, Extend & Delete)
3	Write a program to Illustrate Different Set Operations.
4	Write a program to implement Simple Chatbot.
5	Write a program to implement Breadth First Search Traversal.
6	Write a program to implement Depth First Search Traversal.
7	Write a program to implement Water Jug Problem.
8	Write aprogram to implement K -Nearest Neighbor algorithm.
9	Write a program to implement Regression algorithm.
10	Write a program to implement Random Forest Algorithm.

CSUP115: PPL and Database Technologies Practical

LIST OF SCALA PROGRAMS (PPL)

Control Structures

1. Write a program to calculate average of all numbers between n1 and n2(eg.100 to 300 Read values of n1 and n2 from user)
2. Write a program to calculate factorial of a number.
3. Write a program to read five random numbers and check that random numbers are perfect number or not.
4. Write a program to find second maximum number of four given numbers.
5. Write a program to calculate sum of prime numbers between 1 to 100
6. Write a program to read an integer from user and convert it to binary and octal using user defined functions.

Arrays

1. Write a program to find maximum and minimum of an array
2. Write a program to calculate transpose of a matrix.
3. Write a program to calculate determinant of a matrix,
4. Write a program to check if the matrix is upper triangular or not.
5. Write a program to sort the matrix using insertion sort.
6. Write a program for multiplication of two matrices(Validate number of rows and columns before multiplication and give appropriate message)

String

1. Write a program to count uppercase letters in a string and convert it to lowercase and display the new string.
2. Write a program to read a character from user and count the number of occurrences of that character.
3. Write a program to read two strings. Remove the occurrence of second string in first string.
4. Create array of strings and read a string from user. Display all the elements of array containing given string.

Classes and Objects

1. Define a class CurrentAccount (accNo, name, balance, minBalance). Define appropriate constructors and operations withdraw(), deposit(), viewBalance(). Create an object and perform operations.
2. Define a class Employee (id, name, salary). Define methods accept() and display(). Display details of employee having maximum salary.
3. Create abstract class Order (id, description). Derive two classes PurchaseOrder& SalesOrder with members Vendor and Customer. Create object of each PurchaseOrder and SalesOrder. Display the details of each account.
4. Create abstract class Shape with abstract functions volume() and display(). Extend two classes Cube and Cylinder from it. Calculate volume of each and display it.

Course Code: CSUT121	Course Name: Advanced Operating System	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	• Working knowledge of C programming. • Basic Computer Architecture concepts. • Basic algorithms and data structure concepts.	
Course Objectives:	This course teaches Advanced Operating Systems Concepts using Unix/Linux. This course strikes a delicate balance between theory and practical applications In fact, most Units start with the theory and then switches focus on how the concepts are implemented in a C program. This course describes the programming interface to the Unix/Linux system - the system call interface. It is intended for anyone writing C programs that run under Unix/Linux. This course provides an understanding of the functions of Operating Systems. It also provides provide an insight into functional modules of Operating Systems. It discusses the concepts underlying in the design and implementation of Operating Systems.	
Chapter	Course Contents	No. of Lectures
1	**Introduction to UNIX/LinuxKernel** • System Structure, User Perspective, Assumptions about Hardware, Architecture of UNIX Operating System (TextBook-1: Chapter Topics: 1.2, 1.3, 1.5, 2.1) • Concepts of Linux Programming- Files and the Filesystem, Processes, Users and Groups, Permissions, Signals, Interprocess Communication (TextBook-3: Chapter 1- relevant topics)	04
2	**File and Directory I/O** • Buffer headers, structure of the buffer pool, scenarios for retrieval of a buffer, reading and writing disk blocks, inodes, structure of regular file, open, read, write, lseek, close, pipes, dup (TextBook- 1: Chapter Topics: 3.1-3.4, 4.1, 4.2, 5.1-5.3, 5.5-5.7, 5.12, 5.13) • open, creat, file sharing, atomic operations, dup2, sync, fsync, and fdatasync, fcntl, /dev/fd, stat, fstat, lstat, file types, Set-User-ID and Set-Group-ID, file access permissions, ownership of new files and directories, access function, umask function, chmod and fchmod, sticky bit, chown, fchown, and lchown, file size, file truncation, file systems, link, unlink, remove, and rename functions, symbolic links, symlink and readlink functions, file times, utime, mkdir and rmdir, reading directories, chdir, fchdir, and getcwd, device special files (TextBook-2: Chapter Topics: 3.3, 3.4, 3.10-3.14, 3.16, 4.2-4.23)	15

Course Code: CSUT121	Course Name: Advanced Operating System	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	• Working knowledge of C programming. • Basic Computer Architecture concepts. • Basic algorithms and data structure concepts.	
Course Objectives:	This course teaches Advanced Operating Systems Concepts using Unix/Linux. This course strikes a delicate balance between theory and practical applications In fact, most Units start with the theory and then switches focus on how the concepts are implemented in a C program. This course describes the programming interface to the Unix/Linux system - the system call interface. It is intended for anyone writing C programs that run under Unix/Linux. This course provides an understanding of the functions of Operating Systems. It also provides provide an insight into functional modules of Operating Systems. It discusses the concepts underlying in the design and implementation of Operating Systems.	
Chapter	Course Contents	No. of Lectures
1	**Introduction to UNIX/LinuxKernel** • System Structure, User Perspective, Assumptions about Hardware, Architecture of UNIX Operating System (TextBook-1: Chapter Topics: 1.2, 1.3, 1.5, 2.1) • Concepts of Linux Programming- Files and the Filesystem, Processes, Users and Groups, Permissions, Signals, Interprocess Communication (TextBook-3: Chapter 1- relevant topics)	04
2	**File and Directory I/O** • Buffer headers, structure of the buffer pool, scenarios for retrieval of a buffer, reading and writing disk blocks, inodes, structure of regular file, open, read, write, lseek, close, pipes, dup (TextBook- 1: Chapter Topics: 3.1-3.4, 4.1, 4.2, 5.1-5.3, 5.5-5.7, 5.12, 5.13) • open, creat, file sharing, atomic operations, dup2, sync, fsync, and fdatasync, fcntl, /dev/fd, stat, fstat, lstat, file types, Set-User-ID and Set-Group-ID, file access permissions, ownership of new files and directories, access function, umask function, chmod and fchmod, sticky bit, chown, fchown, and lchown, file size, file truncation, file systems, link, unlink, remove, and rename functions, symbolic links, symlink and readlink functions, file times, utime, mkdir and rmdir, reading directories, chdir, fchdir, and getcwd, device special files (TextBook-2: Chapter Topics: 3.3, 3.4, 3.10-3.14, 3.16, 4.2-4.23)	15

Course Code: CSUT122	Course Name: Mobile Technologies	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	☐ Concepts of Networking ☐ Conversant with OS internals ☐ Familiar with the network Protocol stack ☐ Gain knowledge about different mobile platform and application development ☐ Brief History of wireless communication	
Course Objectives:	☐ To impart basic understanding of the wireless communication systems. ☐ To expose students to various aspects of mobile and ad-hoc networks. ☐ Understand the issues relating to Wireless applications ☐ Understand the Mobile security	
Chapter	Course Contents	No. of Lectures
1	**Introduction to Mobile Computing** • Introduction and need for Mobile computing • Mobility and portability • Mobile and Wireless devices • Mobile Applications • Mobile Operating system – IOS, BlackBery, Windows phone, Plam OS, Symbian OS,PhoneGap	03
2	**Android Fundamentals** • Introduction to Android - Overview and evolution of Android , Features of Android, Android architecture • Components of an Android Application, Manifest file • Android Activity • Service Lifecycle	07
3	**Android UI Design** • Basic UI Designing (Form widgets ,Text Fields , Layouts ,[dip, dp, sip, sp] versus px) • Intent(in detail) • All components (e.g Button , Slider, Image view, Toast) Event Handling • Adapters and Widgets • Menu	07

Course Code: CSUT123	Course Name: Software Project Management	Total Lectures (48 Hours)
Teaching Scheme : 4 hrs/week	Examination Scheme: IA: 30 Marks UE: 70 Marks	No. of Credits 4
Course Prerequisites:	☐ Software Engineering ☐ Basic testing concepts	
Course Objectives:	• Software Metrics and Project Management covers skills that are required to ensure successful medium and large scale software projects. • It examines Requirements Elicitation, Project Management, Verification &Validation and Management of Large Software Engineering Projects. • Students learn to select and apply project management techniques for process modeling, planning, estimation, process metrics and risk management; perform software verification and validation using inspections, design and execution of system test cases.	

Chapter	Course Contents	No. of Lectures
1	**Introduction to Project Management** ☐ What is a Project? ☐ What is Project management? ☐ Project phases and project life cycle ☐ Organizational structure ☐ Qualities of Project Manager ☐ WBS	4
2	**Project Management Components** ☐ Project Integration Management-Project plan development and execution ☐ Change controls ☐ CCB ☐ Configuration management	6
3	**Scope Management** ☐ Strategic planning ☐ Scope planning, definition ☐ Verification and control	4
4	**Time management** ☐ Activity planning ☐ Schedule development and control ☐ GANTT Chart	2
5	**Cost Management** ☐ Cost estimation and Control ☐ COCOMO model ☐ BASIC COCOMO NUMERICALS	2
6	**Quality Management** • Quality planning and assurance	2

M. Sc. [I]

CSDP124A: Project Related Assignments

Assignment 1

Assignment 2

Assignment 3

Assignment 4

CSUT231- Software Architecture and Design Patterns Total Credits - 4

Pre-requisites

- Familiarity with UML and OOPs Concepts
- Programming in Java

Course Objectives:

- To introduce students to the basic concepts and techniques of SADP.
- To write java programs using Design Pattern and Frameworks to create reusable and flexible software systems.
- Use of patterns and architectures for solving practical problems.
- To understand about design pattern.
- To understand about the process of deploying web apps using specific Frameworks.

Course Outcomes:

- Recognize the characteristics of patterns that make it useful to solve real-world problems.
- Process available data using python libraries and predict outcomes using Machine Learning algorithms to solve given problem.
- Able to use specific frameworks as per applications need.
- Design java application using design pattern techniques.

Chapter No.	Topics	# Lectures
1.	**Introduction**	2
	1.1 UML The Notation	
	1.2 Process Unified Process / Rational Unified Process inception, elaboration, construction, transition	
	1.3 How various components fit in the life cycle The artifacts at end of each process / discipline	4
2.	**Software Architecture**	
	2.1 What Software Architecture is and what it isn't.	
	2.2 Why is architecture important?	
	2.3 Architectural structures and views	
	Architectural Styles	

CSUT232 Machine Learning — Total Credits - 4

Pre-requisites:

- Familiarity with Probability Theory, Multivariable Calculus, Linear Algebra
- Programming in Python (NumPy, SciPy, Pandas, Matplotlib, Seaborn, SciKit-Learn, StatsModel)

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To write python programs using machine learning algorithms for solving practical problems.
- To understand about Machine Learning Library and use cases.
- To understand about the process of deploying ML model.

Course Outcomes:

- Recognize the characteristics of machine learning that make it useful to real-world problems.
- Process available data using python libraries and predict outcomes using Machine Learning algorithms to solve given problem.
- Able to estimate Machine Learning models efficiency using suitable metrics.
- Design application using machine learning techniques.

Chapter No.	Topics	# Lectures
1.	**Introduction to Machine Learning**	7
1.1	Data Science, Artificial Intelligence and Machine Learning Why Learn and What is Learning, What is Machine Learning Traditional Programming Vs. Machine Learning, Machine Learning Process, Types of Data, Key Elements of Machine Learning (Representation, Evaluation and Optimization), Dimensionality Reduction (Feature Reduction)	
1.2	Descriptive and Inferential Statistics: Probability, Distribution, Distance Measures (Euclidean and Manhattan), Correlation and Regression, Hypothesis Testing.	
1.3		

CSUT233- Web Frameworks — Total Credits - 4

Pre-requisites

- Basic knowledge of Java Script.
- Basics of web application development.
- Knowledge of what is Clint and Server side programming.

Course Objectives:

- To introduce students for modern web technologies.
- To learn and use server side programming using Node.js
- To understand asynchronous programming.
- To learn and understand web application in Django a Python Web Framework.

Course Outcomes:

- Students will be ready with the technology which is used widely in Industry as a part of full stack developer.
- Students will know the powerful way to develop the web application in Python.
- Students will understand what really the asynchronous programming.
- Build and deploy robust Django Web App.
- Integrate with Restful web services.

Chapter No.	Topics	# Lectures
1.	**Java Script Basics**	4
1.1	Java Script data types	
1.2	Variables, Functions, Events, Regular Expressions	
1.3	Array and Objects in Java Script	
1.4	Java Script HTML DOM	
1.5	Promises and Callbacks	3
2.	**Introduction to Node JS**	
2.1	Introduction	
2.2	What is Node JS and its advantages	

CSDT234C: Project — Total Credits: 2

Teaching Scheme
- **Project: 2 hours/week**
- **Batch Size: 5 students**

Workload :

1. One project guide to be assigned to 5 students.
2. 2 hours /week to be allotted for 5 students

Guidelines:

- Students should work in a team of minimum 2 and maximum 3 students.
- Students can choose a project topic without any restriction on technology or domain.
- The student group will work independently throughout the project work including: problem identification, information searching, literature study, design and analysis, implementation, testing, and the final reporting.
- Project guide must conduct project presentations (minimum 2) to monitor the progress of the project groups.
- At the end of the project, the group should prepare a report which should conform to international academic standards. The report should follow the style in academic journals and books, with clear elements such as: abstract, background, aim, design and implementation, testing, conclusion and full references, Tables and figures should be numbered and referenced to in the report.
- The final project presentation with demonstration (UE) will be evaluated by the project guide (appointed by the college) and one external examiner (appointed by the University).

Evaluation guidelines:

IA (15 marks)			UE (35 marks)		
First presentation	Second presentation	Documentation	Project Logic/Presentation	Documentation	Viva
5	5	5	20	5	10

Recommended Documentation contents:

Abstract
Introduction
-motivation
-problem statement
-purpose/objective and goals
-literature survey
-project scope and limitations

CSDP234C: Project Related Assignments — Total Credits: 2

Teaching Scheme

- **2 lectures/week**

Workload :

- 2 lectures/week

Guidelines:

- The project assignments are a compulsory part of the project course and should be carried out by each project group.
- Project assignments are to be given by the guide for continuous internal evaluation.
- The project assignments are to be allotted to each group separately by the project guide on the basis of the implementation technology. A suggested list of assignments is given below.
  1. Project Time management: plan (schedule table), Gantt chart, Roles and responsibilities, data collection, Implementation
  2. Simple assignments to evaluate choice of technology
  3. Assignments on UI elements in chosen technology
  4. Assignments on User interfaces in the project
  5. Assignments on event handling in chosen technology
  6. Assignments on Data handling in chosen technology
  7. Online and offline connectivity
  8. Report generation
  9. Deployment considerations
  10. Test cases
- Each student within the group must work actively and contribute to the assignments, project work and report writing.

Evaluation guidelines:

IA (15 marks)		UE (35 marks)	
Attendance	Assignments	Assignments	Viva
5	10	25	10

CSUP235 Practical on CSUT231, CSUT232 and CSUT233 Total Credits – 4

Teaching Scheme:

- 8 hours/week
- 10 Students/Batch

Pre-requisites:

- Programming in Java
- Programming in Python
- Programming in Nodejs

Course Objectives:

- To write java programs using Design Pattern and Frameworks to create reusable and flexible software systems.
- To understand about the process of deploying web apps using specific Frameworks.
- To write python programs using machine learning algorithms for solving practical problems.
- To understand about the process of deploying ML model.

Course Outcomes:

- Able to use specific frameworks as per applications need.
- Design java application using design pattern techniques.
- Process available data using python libraries and predict outcomes using Machine Learning algorithms to solve given problem.
- Able to estimate Machine Learning models efficiency using suitable metrics.

Software Architecture & Design Pattern List of Assignments	# Practical's
1. Write a JAVA Program to implement built-in support (java.util.Observable) Weather station with members temperature, humidity, pressure and methods mesurmentsChanged(), setMesurment(), getTemperature(), getHumidity(), getPressure() Book 6: (Page No.-67)	
2. Write a Java Program to implement I/O Decorator for converting uppercase letters to lower case letters. Book 6: (Page No.-102)	
3. Write a Java Program to implement Factory method for Pizza Store with createPizza(), orederPizza(), prepare(), Bake(), cut(), box(). Use this to create variety of pizza's like NyStyleCheesePizza, ChicagoStyleCheesePizza etc. Book 6:(Page No.-125-130)	
4. Write a Java Program to implement Singleton pattern for multithreading. Book 6:(Page No.-180)	

M.Sc. Sem IV

CSUIT241 : Industrial Training /Institutional project Total Credits : 20

Teaching Scheme:
2 hours/week

The Industrial Training /Institutional project is equivalent to 5 theory courses of 4 credits each. Marks per 4 credits = 100. The total weightage for Industrial/Institutional training is 500 marks.

Workload :

1. One mentor to be assigned for 5 students.
2. 2 hours /week to be allotted for 5 students

Guidelines:

- Each student must individually complete **minimum 5 months** full time Industrial training / Institutional project in the 4th semester.
- College should assign a student mentor to every student. The mentor will monitor the progress of the student throughout the semester for continuous assessment.
- Student should submit a valid offer letter and synopsis within two weeks of starting the internship.
- There will be continuous assessment of the work done by the student during the internship period.
- Continuous assessment guidelines:
  1. Student should submit a weekly report in the college to the mentor.
  2. The report should contain the following details: Name of student, project title, company name, company mentor, daily activities and results/output, proposed work for next week.
  3. The weekly report should be duly signed by the student and company mentor/ institute guide (CM).
  4. Student Mentor should maintain weekly attendance record for every student.
  5. Two presentations should be conducted for each student (first presentation after first month and second presentation after 3rd month)
  6. Student Mentor should take feedback from the Company mentor regarding overall performance of the student.
- At the end of the internship period, each student should prepare a report which should conform to international academic standards.