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)

2020-2021

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 2020-2021

(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

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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.
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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

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

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

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

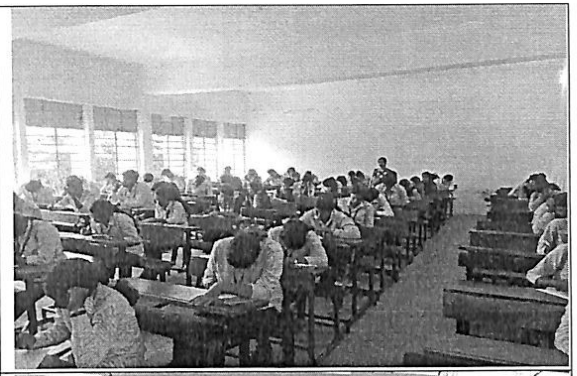
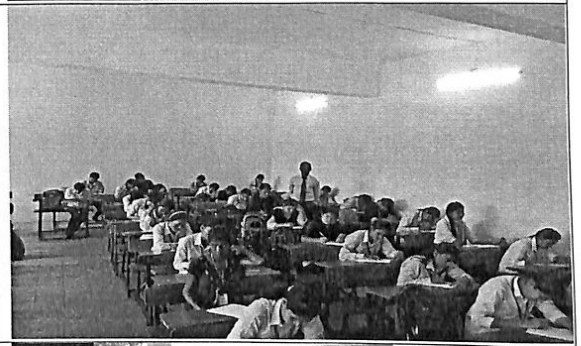
2. Overview of Elections in India
a) Election Commission
b) i. People's Representation Act ii. Model Code of conduct
c) Landmark Elections: 1952, 1967, 1977, 1996, 2004 and 2014

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

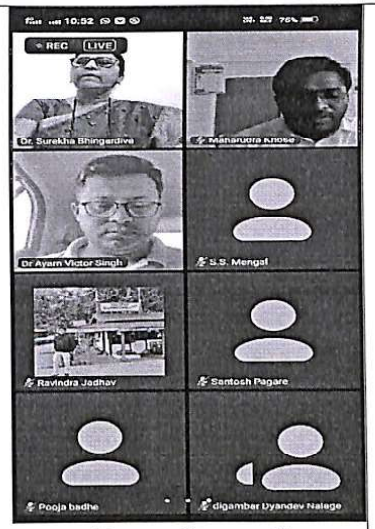
4. Major Determinants of Election
a) Social Identities b) Media c) Funding

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

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

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

3	**Theory of Employment** 3.1 Say's Law of Market 3.2 Classical Theory of Employment 3.3 Criticism by Keynes on Classical Theory 3.4 Keynesian Theory of Employment	12
4	**Consumption and Investment** 4.1 Meaning of Consumption Function 4.2 Average and Marginal Propensity to Consume 4.3 Psychological Law of Consumption 4.4 Factors influencing Consumption Function 4.5 Saving- concept & Function 4.6 Investment- Meaning & Types 4.7 Investment Multiplier- Concept and Limitations 4.8 Principle of Acceleration - Concept	14
	Second Term	
5	**Value of Money** 5.1 Money- Definition and Functions 5.2 Quantity Theory of Money 5.3 Cash balance approach	12
6	**Inflation and Deflation:** 6.1 Inflation - Meaning and Causes 6.2 Demand Pull and Cost Push Inflation 6.3 Effects of Inflation 6.4 Measures to control Inflation 6.5 Deflation- Meaning, Causes and Consequences	12
7	**Business Cycles** 7.1 Meaning and Features of Business Cycle 7.2 Phases of Business Cycle 7.3 Causes and Effects of Business Cycle. 7.4 Control of Business Cycles- Monetary and Fiscal Controls	12

Savitribai Phule Pune University

T.Y. B.A. Economics
General Paper III

G.3 Economic Development & Planning

(From June 2015)

Revised Syllabus

PREAMBLE:

The Study of Economic Development has gained importance because of stained interest of the developing countries in uplifting their economic conditions by restructuring their economics to acquire greater diversity, efficiency and equity in Consonance with their priorities. While few success stories can be counted, many have grappled with chronic problems of narrow economic base, inefficiency and low standard of living. For this and other reasons, their have been many approaches to economic development. In recent times, besides hard core economic prescriptions to development, concern hitherto relegated to background, like education, health, sanitation and infrastructural development, have found place of pride in explaining the preference of various economies incorporated in this paper are devoted to the theories of economic development, approaches to economic development, social and institutional aspects of development, constraints on development process, macro economic policies, roll of foreign capital and economic planning etc. in developing countries.

Section I	Lectures
1. Economic Development and Growth 1.1 Meaning of Economic Development and Growth 1.2 Indicators of Economic Growth 1.3 Indicators of Economic Development 1.4 Differences between Economic Development & Growth	10
2. Developing Countries 2.1 Concept- Developed, Developing Countries 2.2 Characteristics of Developing Countries 2.2.1 Economic Characteristics 2.2.2 Demographic Characteristics 2.2.3 Technological Characteristics 2.2.4 Socio - Cultural Characteristics 2.2.5 Other Characteristics	14
3. Constraints on Development Process 3.1 Vicious Circle of Poverty 3.2 Population Explosion 3.3 Low Productivity of Agriculture	12

3.4 Scarcity of Capital
3.5 Inappropriate Technology
3.6 Socio- Cultural Constraints
3.7 Political and Administrative Constraints
3.8 External Bottleneck

4. Theories of Economic Development 12
4.1 Classical Theories- Adam Smith, Ricardo & Malthus
4.2 Karl Mark's Theory of Economic Development
4.3 Schumpeterian Theory of Economic Development

Section II

5. Approaches to Economic Development 10
5.1 Big Push Theory
5.2 Balanced Growth
5.3 Imbalanced Growth

6. Foreign Capital and Development 14
6.1 Meaning & Role of Foreign Capital in Economic Development
6.2 Problems of Foreign Capital
6.3 Private Foreign Investment- Types & Role
6.4 Public Foreign Investment-Types
6.5 Foreign Aid- Tide and Untied

7. Macro Economic Policy 12
7.1 Monetary Policy- Objectives, Instruments and Limitations
7.2 Fiscal Policy- Objectives, Instruments and Limitations
7.3 Fiscal Policy in Cyclical Fluctuations

8. Economic Planning
8.1 Meaning & Definition
8.2 Need of Planning
8.3 Objective of Economic Planning- Economic, Social and Political
8.4 Inclusive Growth Approach & 11th five year plan
8.5 National Institution for Transforming India Aayog (NITI AYOG)

Basic Reading List

- Adelmen, I. (1961) Theories of Economic Growth and Development, Stanford University Press,Stanford.
- Behrman, S. and T.N Srinivrsan,(1995) Handbook of Development Economic, Vol. 1 to 3, Elsevire, Amsterdam,

Savitribai Phule Pune University

T.Y. B.A. Economics
Special Paper III

S.3 International Economics

(From June 2015)

Revised Syllabus

PREAMBLE

This course provides the students a thorough understanding and deep knowledge about the basic principles that tend to govern the free flow of trade in goods and services at the global level. The contents of the Paper spread over various modules, lay stress both on theory and applied nature of the subject that have registered rapid changes during the last decade. Besides this, the contents prepare the students to know the impact of free trade and tariffs on the different sectors of the economy as well as at the macro level. The students would also be well trained about the rationale of recent changes in the export import policies of India. This paper has become relatively more relevant from the policy point of view under the present waves of globalization and liberalization both in the North and in the South.

Section I

No of Lectures

1. Introduction 12
1.1 International economics- meaning, Scope & Importance
1.2 Inter-regional and international trade
1.3 Importance of International Trade

2.Theories of International Trade 12
2.1 Theory of absolute cost advantage and comparative cost advantage
2.2 Heckscher-Ohlin theory
2.3 Leontief's paradox, Rybczynski theorm, Intra-Industry Trade

3. Gains from Trade 12
3.1 Measurement of gains, static and dynamic gains
3.2 Terms of trade – Importance, types and determinants
3.3 Causes of unfavorable terms of trade to developing countries.

4. Balance of Payments 12
4.1 Balance of trade and Balance of payments- Concepts and components
4.2 Equilibrium and disequilibrium in balance of payments; causes and consequences
4.3 Measures to correct deficit in the balance of payments

Section II

5. Trade policy & Exchange Rate 12
5.1 Free trade policy - case for and against
5.2 Protection Policy – case for and against
5.3 Types of tariffs and quotas
5.4 Exchange rates-Fixed and flexible

6. India's Foreign Trade and Policy 12

6.1 Growth of India's foreign trade
6.2 Changes in the composition and direction of foreign trade since 2000-2001
6.3 Foreign Trade policy 2015-2020.
6.4 India and WTO

7. Export Promotion measures 12

7.1 Export promotion - Contribution of SEZ
7.2 Role of multinational corporations in India.
7.3 FEMA-provisions and impact
7.4 Convertibility of Indian rupee

8. Regional and International Co-operation 12

Nature and Functions of-
8.1 South Asian Association for Regional Co-operation (SAARC)
8.2 Brazil, Russia, India, China and South Africa (BRICS)
8.3 European Economic Community (EEC)

BASIC READING LIST

1. Kenan, P.B. (1994), The International Economy, Cambridge University Press, London.
2. Kindlberger, C.P. (1973), International Economics, R.D. Irwin, Homewood.
3. Krugman, P.R. and M. Obstgeld (1994), International Economics : Theory and Policy, Glenview, Foresman.
4. Salvatore, D.L. (1997), International Economics, Prentice-Hall, Upper Saddle River, N.J.
5. Sodersten, Bo (1991), International Economics, Macmillan Press Ltd., London.
6. International Economics , M.L. Jhingan

ADDITIONAL READING LIST

1. Bhagwati, J. (Ed.) (1981), International Trade, Selected Readings, Cambridge University Press, Mass.
2. Greenaway, D. (1983), International Trade Policy, Macmillan Publishers Ltd., London.
3. Joshi V. and I.M.D. Little (1998), India's Economic Reforms, 1999-2001, Oxford University Press, Delhi.
4. Panchmukhi, V.R. (1978), Trade Policies of India : A Quantitative Analysis, Concept Publishing Company, New Delhi.
5. Patel, S.J. (1995), Indian Economy Towards the 21st Century, University Press Ltd., India.
6. Misra and Puri, Indian Economy, Himalaya Publishing House
7. Dangat Nilesh (2015), 'International Economics' Success Publication, Pune.
8. Gite T.G. (2015), 'International Economics' (Marathi Edition), Success Publication, Pune.

Savitribai Phule Pune University

T.Y. B.A. Economics
Special Paper IV

S 4. Public Finance

(From June 2015)

Revised Syllabus

PREAMBLE

Role and functions of the Government in an economy has been changing with the Passas of time. The term 'Public Finance' has traditionally been applied to the package of those policies and operations which involve the use of tax and expenditure measures while budgetary policy is an important part to understand the basic problems of use of resources, distribution of Income, etc. There are vast array of fiscal institutions -tax systems, expenditure programs budgetary procedures, stabilization instruments, debt issues, levels of government, etc., which Raise a spectrum of issues arising from the operation of these institutions. Further, the existence of externalities, concern for adjustment in the distribution of income and wealth, etc. require political processes for their solution in a manner which combines individual freedom and justice.

Section I **No of Lectures**

1 Public Finance 10

1.1The role of Government in an economy
1.2 Meaning, Nature, Scope and Importance of Public Finance
1.3 Private Finance and Public Finance
1.4 Principle of Maximum Social Advantage- Dr. Dalton

2. Public Expenditure 12

2.1 Meaning and Principle of Public Expenditure
2.2 Classification of Public Expenditure
2.3 Trends of Public Expenditure in India.
2.4 Causes of increase in Public Expenditure
2.5 Effects of Public Expenditure

3. Public Revenue 14

3.1 Sources of Public Revenue
3.2 Meaning and Objectives of Taxation
3.3 Principles of taxation- Benefit approach, Ability to pay
3.4 Concepts- Impact of Tax, incidence of Tax, Shifting of Tax and Taxable Capacity
3.5 Indian Tax Structure- Direct and Indirect tax, Progressive, proportional and Regressive

4. Public Debt 12

4.1 Meaning and types of Public Debt
4.2 Sources of internal and external Public Debt
4.3 Effects of Public Debt
4.4 Methods of repayment

	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

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

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.

4. Bhargava, R., Vanaik, A. (2010) *Understanding Contemporary India: Critical Perspective.* New Delhi: Orient Blackswan.
5. Chandhoke. N., Proyadardhi.P, (ed) (2009), '*Contemporary India: Economy, Society, Politics*', Pearson India Education Services Pvt. Ltd, ISBN 978-81-317-1929-9.
6. Chandra, B. (1999). *Essays on contemporary India.* Har-Anand Publications.
7. Chaterjee, P. (1997). State and Politics in India.
8. Dasgupta. S., (ed) (2011), *'Political Sociology'*, Dorling Kindersley (India) Pvt. Ltd., Licensees of Pearson Education in south Asia. ISBN: 978-317-6027-7.
9. Deshpande, S. (2003). Contemporary India: A Sociological View, New Delhi:Viking Publication.
10. Guha, R. (2007). India After Gandhi: The History of the World's Largest. *Democracy, HarperCollins Publishers, New York.*
11. Guha, R. (2013). *Gandhi before India.* Penguin UK.
12. Jayal. N.G. (2001). *Democracy in India.*New Delhi: Oxford University Press.
13. Kohli, A. (1990). *Democracy and discontent: India's growing crisis of governability.* Cambridge University Press.
14. Kohli, A., Breman, J., & Hawthorn, G. P. (Eds.). (2001). *The success of India's democracy* (Vol. 6). Cambridge University Press.
15. Kothari, R. (1989). *State against democracy: In search of humane governance.* Apex Pr.
16. Kothari, R. (1970). *Politics in India.* New Delhi: Orient Blackswan.
17. Kothari, R. (1995). *Caste in Indian politics.* Orient Blackswan.
18. Sarkar, S. (2001). *Indian democracy: the historical inheritance. the Success of India's Democracy*, 23-46.

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१. राही श्रुती गणेश., आवटे श्रीरंजन, (२०१९), *'आपलं आयकार्ड'*, सुहास पळशीकर द युनिक अकॅडमी पब्लिकेशनप्रा.लि..
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

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

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 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 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
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Coordinator
IQAC, K. J. Somaiya College
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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	

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		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		

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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

Head
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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

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)

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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

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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.

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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

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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

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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.

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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)

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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

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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

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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

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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

			Modern West	
22	M.A History	CC-12	World after World War II (1945-2000)	Human Values
23	M.A History	OC-19	Maharashtra in the 20th Century	Human Values

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.A History	G-1	Early India: From Prehistory to the Age of the Mauryas	Human Values
2	B.A History	G-1	Early India: Post Mauryan Age to the Rashtrakutas	Human Values
3	B.A History	CC-1(3)	History of the Marathas: (1630-1707)	Human Values
4	B.A History	DSE-1A (3)	Medieval India - Sultanate Period	Human Values
5	B.A History	DSE-2A (3)	Glimpses of the Modern World - Part I	Human Values
6	B.A History	SEC -2 A (2)	Tourism Management	Human Values
7	B.A History	CC-2	History of Marathas (1707-1818)	Human Values
8	B.A History	DSE-1B(3)	Medieval India – Mughal Period	Human Values
9	B.A History	DSE-2B (3)	Glimpses Of the Modern World Part-2	Human Values
10	B.A History	SEC-2B (2)	Travel Agency and Tour business	Human Values
11	B.A History	CC- 3(3)	Indian National Movement (1885-1947)	Human Values
12	B.A History	DSE-3 C (3)	Introduction to Historiography	Human Values
13	B.A History	DSE-4 D (3)	8.Maharashtra in the 19th Century	Human Values
14	B.A History	SEC 2 C (2)	Museology Fourier Series	Human Values
15	B.A History	CC- 4(3)	India After Independence-(1947-1991)	Human Values
16	B.A History	DSE-3 C (3)	Applied History	Human Values

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17	B.A History	DSE-4 D (3)	Maharashtra in the 20th Century	Human Values
18	B.A History	SEC 2 D (2)	Archaeology	Human Values
19	M.A History	CC-01	History: Theory and Method	Human Values
20	M.A History	CC-02	Evolution of Ideas and Institutions in Early India	Human Values
21	M.A History	CC-03	Maratha Polity	Human Values
22	M.A History	EC-01	History of the Deccan: Pre-History to Chalukya	Human Values
23	M.A History	CC-04	Approaches to History	Human Values
24	M.A History	CC-05	Ideas and Institutions in Medieval India	Human Values
25	M.A History	CC-06	Socio-Economic History of the Marathas	Human Values
26	M.A History	EC-09	Marathas in 17th and 18th century: Power Politics	Human Values
27	M.A History	CC-07	Cultural History of Maharashtra	Human Values
28	M.A History	CC-08	Intellectual History of the Modern World	Human Values
29	M.A History	CC-09	Economic History of Modern India	Human Values
30	M.A History	EC-18	East Asia: Japan (1853-2000)	Human Values
31	M.A History	CC-10	Modern Maharashtra: History of Ideas	Human Values
32	M.A History	CC-11	Debates in Indian Historiography	Human Values
33	M.A History	CC-12	World after World War II (1945-2000)	Human Values
34	M.A History	EC- 28	Modern India	Human Values
35	M.A History	10091	HUMAN RIGHTS - I	Human Values
36	M.A History	10092	INTRODUCTION TO CYBER SECURITY - I	Professional Ethics
37	M.A History	20091	HUMAN RIGHTS - II	Human Values
38	M.A History	20092	INTRODUCTION TO CYBER SECURITY - II	Professional Ethics
39	M.A History	30092	INTRODUCTION TO CYBER SECURITY - III	Professional Ethics
40	M.A History	30094	SKILL DEVELOPMENT - I	Human Values
41	M.A History	40092	INTRODUCTION TO CYBER SECURITY - IV	Professional Ethics
42	M.A History	40094	SKILL DEVELOPMENT - II	Human Values

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17	B.A History	DSE-4 D (3)	Maharashtra in the 20th Century	Human Values
18	B.A History	SEC 2 D (2)	Archaeology	Human Values
19	M.A History	CC-01	History: Theory and Method	Human Values
20	M.A History	CC-02	Evolution of Ideas and Institutions in Early India	Human Values
21	M.A History	CC-03	Maratha Polity	Human Values
22	M.A History	EC-01	History of the Deccan: Pre-History to Chalukya	Human Values
23	M.A History	CC-04	Approaches to History	Human Values
24	M.A History	CC-05	Ideas and Institutions in Medieval India	Human Values
25	M.A History	CC-06	Socio-Economic History of the Marathas	Human Values
26	M.A History	EC-09	Marathas in 17th and 18th century: Power Politics	Human Values
27	M.A History	CC-07	Cultural History of Maharashtra	Human Values
28	M.A History	CC-08	Intellectual History of the Modern World	Human Values
29	M.A History	CC-09	Economic History of Modern India	Human Values
30	M.A History	EC-18	East Asia: Japan (1853-2000)	Human Values
31	M.A History	CC-10	Modern Maharashtra: History of Ideas	Human Values
32	M.A History	CC-11	Debates in Indian Historiography	Human Values
33	M.A History	CC-12	World after World War II (1945-2000)	Human Values
34	M.A History	EC- 28	Modern India	Human Values
35	M.A History	10091	HUMAN RIGHTS - I	Human Values
36	M.A History	10092	INTRODUCTION TO CYBER SECURITY - I	Professional Ethics
37	M.A History	20091	HUMAN RIGHTS - II	Human Values
38	M.A History	20092	INTRODUCTION TO CYBER SECURITY - II	Professional Ethics
39	M.A History	30092	INTRODUCTION TO CYBER SECURITY - III	Professional Ethics
40	M.A History	30094	SKILL DEVELOPMENT - I	Human Values
41	M.A History	40092	INTRODUCTION TO CYBER SECURITY - IV	Professional Ethics
42	M.A History	40094	SKILL DEVELOPMENT - II	Human Values



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	History	Travel and Tourism Management	CC. 012	2008-09	Human Values
2	History	Modi Script	CC. 017	2013-14	Human Values

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	National Conference topic National Integrity and Sardar Vallabhbhai Patel ' on 7th and 8th January 2019	Professional Ethics, Human Values	

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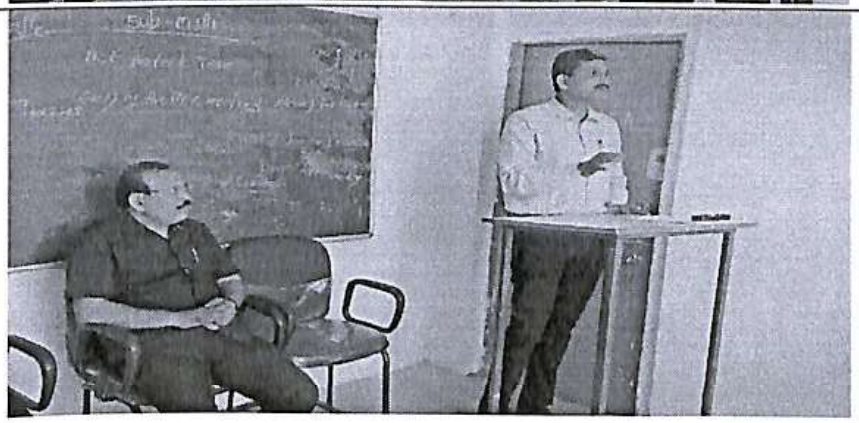
2	National Conference topic National Integrity and Sardar Vallabhbhai Patel ' on 7th and 8th January 2019	Professional Ethics, Human Values	
3	department of History organized a certificate course 'Modi Script 18th January 2019	Professional Ethics, Human Values	
4	Guest lecture of Dr. J.C. Sonawane , Department of History, Arts Commerce and Science College Sonai on 15 March 2019	Professional Ethics, Gender, Human Values,	

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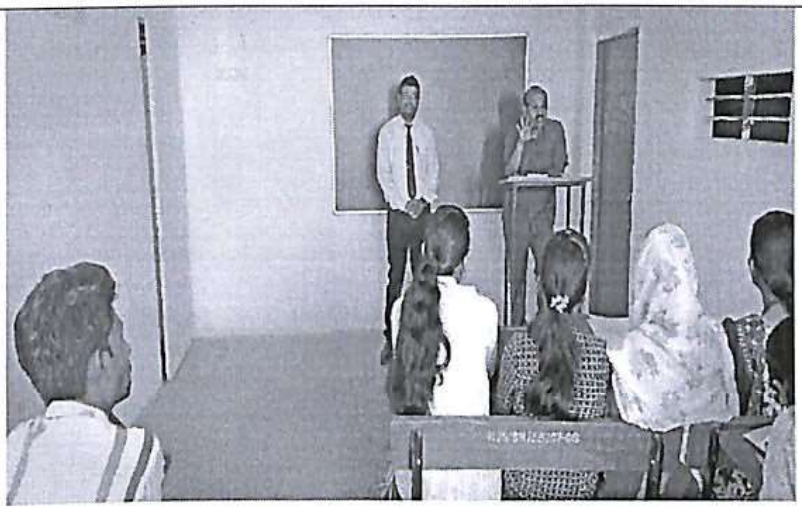
5	department of History organized a certificate course 'Travel and Tourism Management' 1 march to 30 march 2019	Professional Ethics	
6	department of History organized a certificate course 'Modi Script 16 Sep 2019	Professional Ethics	
7	Guest lecture on the topic 'History of Mathematics' on20th December 2019	Professional Ethics, Human Values	
8	One day College level Seminar on Value Education 30 January 2020	Professional Ethics, Human Values	

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KOPARGAON

Second Term

Unit - 5) Thoughts and work of Intellectuals 16

a) Mahadev Govind Ranade

b) Gopal Ganesh Agarkar

c) Gopal Krishna Gokhale

d) Rajarshri Chatrapati Shahu Maharaj

e) Maharshi Dhondo Keshav Karve

f) Karmaveer Bhaurao Patil

g) Dr. Babasaheb Ambedkar

h) Maharshi Vitthal Ramji Shinde

Unit - 6) Contribution of Maharashtra in Indian Freedom Movement 12

a) 1818 to 1885 (Uprising of Ramoshi, Bhills, Koli, & Deccan Riots (1875) (b) Revolt of 1857, Moderates, Extremists & Revolutionaries.

b) Non- Cooperation, Civil Disobedence & Quit India Movement

Unit - 7) Popular Movements in Maharashtra

a) Non-Brahmin Movement 10

b) Dalit

c) Peasants

d) Workers

e) Tribals

Unit - 8) Maharashtra after independence

a) Marathwada Muktisangram 10

b) Samyukta Maharashtra Movement

MODERN MAHARASHTRA

Book For Study : English :

1. Ballhatchet Kenneth, Social Policy and Social Change in Western India. 1817-1830, OUP, 1961.

HISTORY OF THE WORLD IN 20TH CENTURY (1914-1992)

OBJECTIVES

1. To help the student to know Modern World. To acquaint the student with the Socio-economic & Political developments in other countries. And understand the contemporary world in the light of its background History.

2. To orient the students with political history of Modern World.

3. To acquaint Students about the main developments in the Contemporary World (To understand to important development in 20th century World.)

4. Impart knowledge about world concepts.

5. To enable students to understand the economic transition in World during the 20th Century.

6. Become aware of the principles, forces, processes and problems of the recent times.

7. To acquaint the students with growth of various political movements that shaped the modern world.

8. To highlight the rise and growth of nationalism as a movement in different parts of the world.

FIRST TERM

1. CONCEPTUAL STUDY (08)

- 1.1 Capitalism
- 1.2 Economic Imperialism
- 1.3 Dictatorship
- 1.4 Communism
- 1.5 Socialism
- 1.6 Nazism
- 1.7 Fascism
- 1.8 Cold War
- 1.9 Non – Alignment
- 1.10 Globalization
- 1.11 Feminism
- 1.12 Humanism

2. FIRST WORLD WAR (10)

- 2.1 Causes
- 2.2 Impacts / Consequences
- 2.3 Paris Peace settlement (1919)
- 2.4 League of Nations

3. RUSSIAN REVOLUTION (10)

- 3.1 Socio – Economic and Political background of revolution
- 3.2 Contribution of Lenin and New Economic Policy (NEP)
- 3.3 Contribution of Stalin and Five Year Plan

4. RISE OF DICTATORSHIP (10)

- 4.1 Italy
- 4.2 Germany
- 4.3 Turkestan

5. GREAT DEPRESSION (10)

- 5.1 Nature
- 5.2 Causes
- 5.3 Consequences

SECOND TERM

6. WORLD WAR II (12)

- 6.1 Causes
- 6.2 Emergence and Scope

6.3 Consequences

6.4 United Nations

7. RISE OF WORLD POWERS

7.1 America (12)

7.2 Russia

7.3 Star War

8. THIRD WORLD

8.1 Roll of India in Non – Alignment Movement (12)

8.2 SAARC

8.3 OPEC

9. TOWARDS GLOBALIZATION

9.1 End of Cold War and Disintegration of USSR (12)

9.2 Liberalization

9.3 GATT and WTO

9.4 Fundamentalism – As a World Problem (Terrorism)

INTRODUCTION TO HISTORY

OBJECTIVES

1. To orient students about how history is studied, written and understood.
2. To explain methods and tools of data collection
3. To understand the meaning of Evolution of Historiography.
4. To study the Various Views of Historiography.
5. To study the approaches to Historiography.
6. To study the types of Indian Historiography.
7. To describe importance of inter-disciplinary research.
8. To introduce students to the basics of research.
9. To acquaint the student with the recent research in History.
10. Learn how to use sources in their presentation.

FIRST TERM

1. Conceptual Study (08)

1.1 History

1.2 Heuristic

1.3 Archives

1.4 Oral History

1.5 Cronical

1.6 Sanad / Farman

1.7 Marxism

1.8 New Marxism

1.9 Modernism

1.10 Post - Modernism

1.11 Structuralism

1.12 Post – Structuralism

2. NATURE AND SCOPE OF HISTORY (10)

2.1 Meaning and Definition

2.2 Nature and Scope of History

2.3 Importance

3. SOURCES OF HISTORICAL RESEARCH (10)

3.1 Primary and Secondary

3.2 Written and Un- written

3.3 Importance of Sources

4. HISTORICAL RESEARCH (10)

4.1 Selection of Research Problem

4.2 Historical Methods

4.3 External Criticism

4.4 Internal Criticism

4.5 Interpretation

5. MAJOR ARCHIVES IN MAHARASHTRA: BRIEF STUDY (10)

5.1 Mumbai Archives

5.2 Pune Archives

5.3 Bharat Itihas Sanshodhak Mandal, Pune

5.4 Nagpur Archives

5.5 Kolhapur Archives

5.6 V.K.Rajwade Itihas Sanshodhak Mandal, Dhule

5.7 Deccan College

SECOND TERM

6. HISTORY AND SOCIAL SCIENCE (10)

6.1 History and Geography

6.2 History and Political Science

6.3 History and Economics

6.4 History and Sociology

7. SCHOOL OF HISTORIOGRAPHY (10)

7.1 Imperialist

7.2 Nationalist

7.3 Marxist

7.4 Subaltern

7.5 Local History

8. HISTORIANS OF MAHARASHTRA (10)

8.1 V. K. Rajwade

8.2 G. S. Sardesai

8.3 T. S. Shejwalkar

8.4 G. H. Khare

8.5 J. Sarkar

9. INDIAN HISTORIANS (10)

9.1 R. C. Mujumdar

9.2 K. A. Niolkanth Shastri

9.3 D. D. Kosambi

9.4 Romila Thapar

10. HISTORICAL STUDY TOUR OR PROJECT WORK

PROJECT WORK & EVALUATION SCHEME

1. Term end examination of 60 marks shall be held at the end of the first term.
2. Candidate shall submit a report of minimum 3000 words i.e. 10 to 15 pages to the department by end of the February.
3. A viva-voce should be conducted before theory examination and the results should be sent to the University as immediately
4. The result should be prepared as follows:

a) 60 marks of term end examination converted in to 20 marks

b) 50 marks Annual examination for 2 hours conducted by University of Pune Equal weightage for all topics

c) 30 Marks exam should be conducted by the department 20 marks for Project work & 10 marks Viva-voce exam.

BOOKS FOR STUDY

ENGLISH

1.Avneri S., Social and Political Thought of Karl Marx, Cambrige, 1968.

2.Barnes H.E., History of Historical Writing, Dover, NewYork, 1963.

HISTORY OF ASIA IN 20TH CENTURY (1914 – 1992)

OBJECTIVES

1. To orient the students with political history of Asia.

2. To enable students to understand the economic transition in Asia during 20th Centuries.

3. Understand the important developments in the 20th century Asia in a

Thematic approach.

4. To provide students with an overall view and broad perspective different movements connected with Nationalist aspirations in the region of Asia in general.

5. To empower students to cope with the challenges of globalization.

FIRST TERM

1. CONCEPTUAL STUDY (08)

1.1 Long March

1.2 Communism

1.3 Atlantic Charter

1.4 Jenro

1.5 Pan - Islamism

1.6 Yani – Turanism

1.7 Welfare Dictatorship (*Kalyankari Hukumshahi*)

1.8 Mandate System

1.9 White – Paper (*Shwait Patrika*)

1.10 Arab League

1.11 Third World

1.12 Arab Nationalism

2. CHINA (10)

2.1 Achievement of Dr. Sun – Yet - Sen.

2.2 Communist Revolution (1949)

2.3 Indo China War 1962

2.4 China under Communism (1949 – 1992) with reference to Economic and Foreign (Asian Countries) Policy

3. JAPAN (12)

3.1 Japan between two World War

3.2 America occupation, achievement and General Mac Arthur

3.3 Economic development and Foreign Policy 1950 – 1992 (Brief Survey)

4. EGYPT (10)

4.1 Egypt between two world war

4.2 General Nasser and modernization of Egypt

4.3 Suez Crisis

5. OIL DIPLOMACY (08)

5.1 Iran – Reza shah Pahlavi and Modernization of Iran, Iran and Second World War, Iran and Oil Diplomacy.

5.2 Political development in Iraq, Rise of Rashid Ali, 1958 Revolution, Iraq – Iran Conflict.

5.3 Kuwait – Iraq war and its Impact.

SECOND TERM

6. TURKESTAN (10)

6.1 First World War and Turkestan

6.2 Achievement of Kemal Pasha

7. ISRAEL (10)

7.1 Zionist Movement

7.2 Balfour declaration

7.3 British Mandate

7.4 London Round Table Conference, Peel Commission, Rise of Israel.

8. ARAB ISRAEL CONFLICT (10)

8.1 1948 to 1973 Arab Israel Conflict a brief survey

8.2 Rise of Arab Nationalism

9. SAUDI ARABIYA (ARABIA) (10)

9.1 Wahhabi Movement

9.2 Roll of Ibn Saud

9.3 Foreign Policy

10. SOUTH EAST ASIA (08)

10.1 Indonesia

10.2 Vietnam

10.3 Asian

10.4 Foreign Policy of Indian with special reference to south east Asia.

BOOKS FOR STUDY

ENGLISH

1 Bass Claud, Asia in the Modern World.

2 Bernard L: Turkey Today ,The Emergence of Modern Turkey.

3 Beasley, W G : The Modern History of Japan

4.Buchanaa P, A History of the Far East.

5.Clyde P.H. and B.F.Beers, The Far East (1830-1965)

6. Fisher S N : The Middle East

7.Gaikwad D.S., Civil Right Movement in America, Deep and Deep Publication, New Delhi, 1987.

8. Main ,E : Iraq: From Mandate to Independence.

9. North M : The History of Israel

10. Yale William, Near West.

Semester I: Core Paper No. 1

Credits: 4

Course Title: History and its Theory

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. History:
    a) Definition, nature, functions, concepts
    b) Modes of interaction with Humanities and Social Sciences

2. History and its theories
    a) Greco-Roman
    b) Church
    c) Arab

3. Emergence of Modern theories of history
    a) Rationalist, Romanticist, Idealist
    b) School of Scientific History
    c) Materialist Theory of history
    d) Positivism

4. Structuralism, Post-structuralism, Post modernism

5. Subaltern Studies

Select Readings

English

Barry, Peter, *Beginning Theory: An introduction to literary and cultural theory*, Manchester University Press, New York, 1995.
Carr, E.H., *What is History*, Penguin Books, Harmondsworth, 1971.
Childs, Peter, *Modernism*, Routledge, London, 2000.
Collingwood, R.G., The *Idea Of History*, Oxford University Press, New York, 1976.
Eagleton, Terry, *Ideology*, Verso, 1991.
Encyclopaedia of Social Sciences
Foucault, Michel, *The Archeology of Knowledge*, translated by Sheridan Smith, Tavistock Publications, London 1982.
Hamilton,Paul, *Historicism*, London, Routledge, First Indian Edition, 2007.

Semester I: Core Paper No. 2

Credits: 4

Course Title: Evolution of Ideas and Institutions in Ancient India

Objectives

The course intends to provide an understanding of the social, economic and institutional bases of Ancient India. It is based on the premise that an understanding of Ancient Indian history is crucial to understand Indian history as a whole.

Course content

1. Defining Ancient India
   a) Historiography (colonial, nationalist)
   b) Terminology ('Hindu', 'Ancient', 'Early')

2. Sources: Perceptions, Limitations, Range
   a) Archaeological
   b) Literary sources (Sanskrit, Prakrit, Pali; Religious, non-religious)
   c) Inscriptions
   d) Foreign accounts

3. Political Ideas and Institutions
   a) Lineage Polities (Rig Vedic)
   b) Pre-State formations (Janapadas, Mahajanapadas)
   c) Early State Formations (From Mahajanapadas to Maurya)
   d) Administrative Institutions (Kingship: Rajanya-Samrat, Sabha and Samiti to Council of ministers
   e) Saptanga Theory

4. Social ideas and institutions
   a) Kin and Lineage society
   b) The emergence of caste based societies, marginalization and subordination
   c) Social protest and the emergence of new social and religious forms
   d) Concept of Kaliyuga and post-Mauryan social formations

5. Economy
   a) Pre-historic to Chalcolithic developments
   b) Development of Agriculture and Trade (Iron Age, Magadha, Gupta)
   c) Expanding Trade Economy
   d) The Mauryan State

6. Deccan and South India
   a) Sangam Age
   b) The emergence of states in the Deccan – the Satavahanas
   c) Urban economy

Semester I: Core Paper No.3.

Credits: 4

Course Title: 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
   a) Literary
   b) Foreign
   c) Archival
   d) Miscellaneous

3. Maratha State
   a) Formation of the Maratha State
   b) Nature

4. Administrative Structure
   a) Administrative Structure of the Deccani Kingdoms: a brief survey
   b) Principles underlying Maratha Administration
   c) Central: the institution of kingship, theory, problem of legitimacy, Ashta Pradhan Mandal
   d) Provincial and Village: administrative units
   e) Fiscal administration: Public income and expendture

5. Socio-Political Power Structure
   a) Religion
   b) Caste
   c) Gota
   d) Watan

6. Administration of Justice
   a) Sources of law
   b) Judicial structure – central, provincial
   c) Judicial institutions – political, traditional
   d) Crime and punishment – police

8. Military system
   a) Infantry
   b) Cavalry
   c) Navy

Semester I: Optional Paper No. 1

Credits: 4

Course Title: Cultural History of Maharashtra

Objectives:

To introduce the student to regional history within a broad framework of Indian culture; to enable the student to understand the internal dynamics of Marathi culture.

Course content

1. Defining the term 'culture'

2. Maharashtra as a cultural region
   a) Physical and geographical features
   b) Origin of Marathi people
   c) Nomenclature of Maharashtra
   d) Origin of Marathi language

3. Maharashtra Dharma
   a) Meaning
   b) Different views

4. Movements and cults: philosophy and teaching
   a) Nath
   b) Mahanubhav
   c) Varkari
   d) Ramdasi
   e) Datta
   f) Sufi
   g) Shakti

5. Literature
   a) Bhakti
   b) Bakhar
   c) Panditi
   d) Shahiri
   e) Folk

6. Interaction with Islamic Culture
   a) Language
   b) Literary forms
   c) Socio-cultural practices

7. Art and Architecture
   a) Art: Visual and Performing Art
   b) Architecture: Religious, Secular, Military

Semester II: Core Paper No. 5

Credits: 4

Course Title: Evolution of 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
   a) The Transition to the Medieval
   b) Historiography of the study of Medieval India

2. Sources: Perceptions, Limitations, Range
   a) Persian sources
   b) Regional language sources
   c) Foreign sources: Travellers' accounts, European records

3. The state in medieval India: perceptions and practice
   a) Modern theories of the medieval state: Theocracy, Autocracy, Feudal, Segmentary, Patrimonial-Bureaucratic
   b) Medieval Theories of the State: Farabi, Ghazzali, Shukracharya, Barani, Abul Fazl, Ramachandrapant Amatya
   c) State formation in peninsular India – Chola, Bahamani, Vijayanagar

4. Administrative Systems
   a) Central and Provincial
   b) Mansabdari

5. Medieval Indian society
   a) Social Mobility and Stratification in medieval India
   b) The emergence of new classes: Administrative, agrarian and mercantile classes in medieval India
   c) Bhakti and social change
   d) Sufism
   e) Towards a composite culture

6. Economic institutions
   a) Agrarian systems, north and south India
   b) Trade, internal and external
   c) Financial Institutions: Banking, Bills of Exchange

Select Readings

SEMESTER II

Semester II: Core Paper No. 4

Credits: 4

Course Title: History and its Practice

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.Defining Historical Research Methodology

2. Operations in Research Methodology
   a) Preliminary Operations: Choice of subject, preparation of outline
   b) Analytical Operations: Heuristics and Hermeneutics
   c) Synthetic Operations: Determining and grouping of facts, constructive reasoning
   d) Concluding Operations: Valid generalisations, footnotes and bibliography

3. Schools of History Writing
   1. Indian:
   a) Colonial
   b) Nationalist
   c) Marxist
   d) Subaltern

   2. Non-Indian:
   a) Cambridge
   b) Annales
   c) Dakar

4. Recent developments in methodology
   a) Myth, legend, folklore, oral history: their methodologies
   b) The linguistic turn in history: methodologies of Deconstruction, Post-structuralism, Post-modernism

Select Readings

English

Carr, E.H., *What is History*, Penguin Books, Harmondsworth, 1971.

Semester II: Core Paper No. 6

Credits: 4

Course Title: 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
   a) Historiography of Socio-economic History.

2. Sources: Perceptions, Limitations, Range
   a) Literary
   b) Foreign
   c) Archival
   d) Miscellaneous

3. Village community
   a) Land Tenures
   b) Residents of the village
   c) Balutedari system

4. Social institutions
   a) Varna and caste
   b) Communities
   c) Marriage'
   d) Family

5. Social Stratification and mobility

6. Fairs and Festivals

7. Education
   a) Educational institutions
   b) Primary education
   c) Higher education

8. Agrarian System
   a) Types of land
   b) Assessment of land
   c) Methods of land revenue collection

9. Trade, Industries and handicraft
   a) Centres of trade
   b) Trade routes
   c) Major and minor industries

10. Currency and Banking
   a) Types of coins
   b) Banking houses

Select Readings

English

Chitnis K.N., *Socio-Economic History of Medieval India*, Atlantic Publishers, Delhi, 2002.
Desai, Sudha, *Social life in Maharashtra under the Peshwas*, Bombay, 1980
Kulkarni, A.R., *Medieval Maratha Country*, Books and Books, New Delhi, 1996.
Kulkarni, A.R., *Medieval Maharashtra*, Books and Books, New Delhi, 1996
Kulkarni A.R., *Maharashtra: Society and Culture*, Books & Books, Delhi, 2000.
Kulkarni A.R., *Explorations in the Deccan History*, Pragati Publications in association with ICHR, Delhi, 2006.
Kumar, Dharma (ed.), *The Cambridge Economic History of India*, Vol. II, Orient Longman, in association with OUP, Delhi, 2005.
Mahajan T.T., *Trade, Commerce and Industries under the Peshwas*, Pointer Publishers, Jaipur, 1989.
Raychaudhuri, Tapan and Habib, Irfan (ed.), *Cambridge Economic History of India*, Vol. I, Orient Longman, in association with OUP, Delhi, 2005.

Marathi

Atre, Trimbak Narayan, Gav-Gada, Varada, Pune, 1995
Bhave, V.K., *Peshwekalin Maharashtra*, Varada, Pune, 1998.
Chapekar, N.G., *Peshwaichya Savlit*, Pune, 1936.
Joshi, S.N., *Marathekalin Samaj Darshan*, Anath Vidyarthi Gruha, Pune, 1960.
Oturkar, R.V., *Peshwekalin Samajik Va aarthik Patravyavahar*, BISM, Pune, 1950.

ALL COURSES ARE OPEN FOR INTERDISCIPLINARY CREDITS

SEMESTER III

Semester III: Core Paper No. 7

Credits :4

Course Title: Ancient and Medieval Civilizations of the World

Objectives

The paper intends to examine Ancient and Medieval civilizations with a view to understand, reinterpret and present them in historical perspective; to enable the student to understand intellectual trends in the modern world; to enable the student to have a better understanding of Indian History in the World context.

Course content

1. Civilization: Concept and Meaning — 02
2. Ancient civilizations: Egypt, Mesopotamia, Persia, India, China — 15
   (a) Political Systems
   (b) Society and Economy
   (c) Religion and Philosophy
   (d) Literature, Art and Architecture, Science and technology
3. Classical Civilizations: Greece and Rome — 08
   (a) Political Systems
   (b) Society and Economy
   (c) Religion and Philosophy
   (d) Literature, Art and Architecture, Science and technology
4. Arabic Culture — 02
5. Medieval West — 13
   (a) Dark Ages
   (b) Feudal System
   (c) Church and State
   (d) Rise of the Nation-States: France and England
   (e) Medieval Economy – Revival of trade and its impact
   (f) Literature, Art and Architecture

Semester II: Optional Paper No. 7

Credits: 4

Course Title: Marathas in 17th and 18th Century Power Politics

Objectives

The course intends to study the role played by the Marathas in the context of India, the changing nature of Maratha State, to understand and analyse the Maratha expansionism and its significance in various spheres.

Course Content

1. Origin and Basis of Maratha political power
2. Ideologies and Institutions of the Marathas
   a) Maharashtra Dharma
   b) Swarajya
   c) Watan
   d) Saranjam
3. Nature of Maratha State
   a) State in the 17th century
   b) State in the 18th century
   c) Excursus of theories on the state
4. Maratha Confederacy
   a) Concept
   b) Nature
5. Maratha Expansionism
   I. Conquest and Stay
      a) Malwa
      b) Bundelkhand
      c) Gujarat
      d) North Karnataka
      e) Orissa

   II. Sphere of Influence
      a) Bengal and Orissa
      b) Rajasthan
      c) Antarveda
6. Incorporation of Maratha State into colonial state

Select Readings

Alavi, Seema (ed.), *The Eighteenth Century in India*, OUP, New Delhi, 2002

Semester III: Core Course No. 8.

Credits :4

Course Title: Debates in Indian History

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.

Course content:

1. The Aryan Debate — 04
2. The State in Indian History : Debates and Theories — 08
   (a) Ancient State
      i. Pre-State Formation – Mahajanapadas
      ii. State formation – Mauryan State and Gupta Empire
      iii. Decline of the Mauryan State
   (b) Medieval State
      i. Sultanate – Theocratic
      ii. Mughals – Theocratic, Patrimonial-Bureaucratic
      iii. Chola and Vijayanagara – Segmentary
      iv. Marathas
3. Urbanisation and Urban Decay — 08
4. Feudalism — 08
   (a) Concept
   (b) 'Feudalism Debate'
5. Orientalism — 08
   (a) Meaning
   (b) Contribution of Orientalist scholars
   (c) Critique of Orientalism
6. 18th Century Debate — 04

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 internalisation by Indians of new economic ideas, principles and practices.

Course content

1. European economic interests in India and colonial economy
   a) Mercantilist phase
   b) Free trade phase
   c) Financial imperialism phase — 06

2. Agrarian settlements
   a) Permanent settlement
   b) Ryotwari system
   c) Mahalwari system
   d) Commercialization of agriculture and its effects — 08

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 — 14

4. Trade : internal and foreign — 04

5. Fiscal System — 04

6. Banking — 04

Select Readings

English

Bagchi, A.K., Private Investment in India, 1900-1939, Cambridge, 1972.

Charlesworth, Neil, British Rule and the Indian Economy 1880-1914, London, 1983.

Semester III: Optional Paper No. 14

Credits :4

Course Title: British Administrative Policies in India, 1765-1892

Objectives

The paper intends to make an in-depth study of various aspects of British administrative policies in India.

Course content

1. Ideological influences on British Administrative Policy — 03

2. Administrative Structure — 04
   a) Charter Acts
   b) Regulating Act

3. Emergence of Executive and Judiciary — 03

4. Economic Policy — 04
   a) Land Revenue
   b) Trade
   c) Industry

5. Social and Educational Policy — 04

6. Famine Policy — 02

7. Policy towards Native rulers — 02

8. Press — 02

9. Bureaucracy — 02

10. India under the Crown — 07
    a) Government of India Act - 1858
    b) Queen's Proclamation

11. Indian Councils Acts of 1861 and 1892 — 07

Select Readings

Ambirajan, S., Classical Economy and British Policy in India,

Bearce, G.D., British Attitude Towards India, London, 1959.

Gopal, S., British Administrative Policies in India, 1857-1905, Oxford, 1965.

Metcalfe, T., Ideologies of the Raj, New Cambridge History of India, Cambridge.

Mishra, B.B., Administration of East India Company, New York, 1960.

Stokes, E., The English Utilitarians and India, Oxford, 1959.

Semester IV: Core Paper no. 10

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
   d. Tribal movements
   e. Dalit movement
   f. Women's issues

Semester IV: Core Paper 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 — 08
   a) Berlin Crisis (1948)
   b) Korean War
   c) Cuban Crisis
   d) Military Alliances: NATO, CENTO, SEATO, ANZUS, Warsaw Pact
2. Non-Aligned movement — 04
3. Issues in West Asia — 10
   a) Oil Politics
   b) Arab-Israel conflicts
   c) Palestine issue
   d) Suez Crisis
   e) Kuwait – Iraq War and its Impact
4. Developments in South-east Asia — 04
   Vietnam War
5. Towards a Uni-polar World — 10
   a) Reunification of Germany
   b) Disintegration of the USSR and its consequences
6. Globalisation and its Impact — 04
   i. European Union
   ii. BRIC

Select Readings

English

Buzan Barry and Richard Little, International Systems in World History, OUP, 2000.

Cornwall R.D., World History in 20th Century, Longman, London, 1976. Halle, Cold War a History.

Knapp Wilfrid , A History of War and Peace, Oxford , 1967.

Semester IV: Core Paper no. 11

Credits :

Course Title: Intellectual History of the Modern West

Objectives

The paper is seen as a prerequisite for understanding the concepts that are used in history, both of west Europe and India; to acquaint the student with the intellectual activity that played an important role in shaping events; the transition from medieval to modern times.

Course content

1. Renaissance
    a) Background – Scholasticism
    b) Nature — 08
    c) Contribution and Impact
2. Reformation
    a) Background
    b) Nature
    c) Impact — 04
3. Revolution in Scientific thinking and its impact
    a) Copernican Revolution
    b) Galilean Revolution — 06
    c) Newtonian Revolution
4. Intellectual Revolution in 17th & 18th century
    a) Nature and Impact
    b) The Enlightenment – meaning and nature — 04
5. Darwinism and its Impact
6. Major Concept and ideologies
    a) Democracy
    b) Nationalism — 02
    c) Capitalism — 14
    d) Imperialism
    e) Liberalism
    f) Socialism
    g) Totalitarianism
    h) Existentialism

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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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

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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

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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

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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

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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

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

15)To standardize $KMnO_4$ soln. & hence find strength of the given solution

D Any One of the following:

16) Estimation of % purity of a given sample of sodium chloride.

17) Analysis of brass

Organic Chemistry (Minimum 7 experiments)

18. Techniques (**any two**) - To be carried out on micro-scale
    i. Thin layer chromatography
    ii. Crystallization with M.P. and % yield of purified compound
    iii. Distillation with B.P. and % yield of purified compound
    iv. Sublimation with M.P. and % yield of purified compound
19. Estimations (**any one**)
    i. To determine amount of acetic acid in commercial vinegar
    ii. To determine amount of aspirin in APC tablets
20. Organic qualitative analysis of single organic compound at least one belonging from each type (**any four**)

    Type, Preliminary tests, elements, functional group, physical constants

    a. Benzoic acid, Salicylic acid, Cinnamic acid, Phthalic acid, oxalic acid
    b. β-Naphthol, α-naphthol
    c. Aniline, N,N-Dimethyl aniline
    d. Napthalene, Thiourea, Urea, m-Dinitrobenzene, chloroform, ethyl methyl ketone, ethyl acetate, chlorobenzene

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S.Y.B.Sc.

Practical Course in Chemistry CH – 223

A) Physical Chemistry practicals (Any Five)

i. To determine critical solution temperature of phenol water system
ii. To determine molecular weight of given organic liquid by steam distillation
iii. Determination of solubility of benzoic acid at different temperature and to determine ΔH of dissociation process.
iv. To study neutralization of acid (HCl) base (NaOH) and CH_3COOH by NaOH and H_2SO_4 by NaOH.
v. To determine the rate constant (or to study kinetics) of acid catalyzed ester hydrolysis.
vi. To determine the rate constant of base catalyzed ester hydrolysis.
vii. Partition coefficient of iodine between water and carbon tetrachloride.

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

i. Verify theoretical principles experimentally
ii. Interpret the experimental data
iii. Improve analytical skills
iv. Correlate the theory and experiments and understand their importance

B) Inorganic Qualitative Analysis (Minimum Five mixtures)

i. One simple mixture (without phosphate or borate)
ii. Two Mixtures containing PO_4^{3-} (With PO_4^{3-} removal)
iii. Two Mixtures containing BO_3^{3-} (With BO_3^{3-} removal)

Inorganic Qualitative Analysis of Binary Mixtures (including phosphate and borate removal).

Sodium carbonate extract is to be used wherever necessary for detecting acidic radicals.

C) Organic Chemistry Practical

a. Organic qualitative analysis of Binary Mixtures without ether separation (**Four only**)

Two: solid-solid, one: solid-liquid, one: liquid-liquid

b. Organic Preparation: (**Any two including Crystallization, MP, TLC**)

i) Pthalic anhydride to pthalamide

ii) Glucose to osazone

iii) Acetanilide to p-bromoactanilide

iv) Benzaldehyde to dibenzylidene acetone

After completion of practical course student should be able to –

i) Verify theoretical principles experimentally.

ii) Acquire skill of crystallisation, record correct m. p. / b. p.

iii) Perform the complete chemical analysis of the given organic compound and should be able to recognize the type of compound.

iv) Write balanced equation for all the reactions, they carry in the laboratory.

v) Perform the given organic preparation according to the given procedure.

vi) Follow the progress of the reaction by using TLC technique.

vii) Set up the apparatus properly for the given experiments.

viii) Perform all the activities in the laboratory with neatness and cleanness.

Ref. 1 Organic Qualitative Analysis: A. I. Vogel

D) Analytical Chemistry Practicals (Any Five)

i. Estimation of sodium carbonate content of washing soda. (Vogel 5th Edition: 10.30 page 295).

ii. Determination of Ca in presence of Mg using EDTA. Ref.2: Page 412

iii. a) Preparation of standard 0.05 N oxalic acid solution and standardization of approx. 0.05N $KMnO_4$ solution.

b) Determination of the strength of given H_2O_2 solution with standard 0.05 N $KMnO_4$solution.

iv. Estimation of Aspirin from a given tablet and find errors in quantitative analysis.

v. Estimation of Al (III) from the given aluminium salt solution by using Erichrome Black–T indicator (Back titration method)

vi. Iodometric estimation of copper.

vii. Report on one day industrial educational visit.

Reference books

1. Analytical Chemistry by G.D. Christian 6th edition.
2. Vogel's Textbook of Quantitative chemical analysis 6th edition R.C. Denney, J.D. Barnes, M.J.K. Thomas

Aim: To equip students to correlate theoretical and experimental knowledge

Objectives: After completion of practical course student should be able to

T.Y.B.Sc.

Physical Chemistry Practicals:CH- 347

Group A:

1. Chemical Kinetics: (Any Five):

1.To study the effect of concentration of the reactants on the rate of hydrolysis of an ester.
2.To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of hydrolysis of an ester.
3.To compare the relative strength of HCl and H_2SO_4 by studying the kinetics of Inversion of cane sugar using Polarimeter.
4.To study the kinetics of iodination of acetone
5.To determine the first order velocity constant of the decomposition of hydrogen peroxide by volume determination of oxygen.
6.To determine the energy of activation of the reaction between potassium iodide and potassium persulphate.
7.To determine the order of reaction between $K_2S_2O_8$ and KI by half-life method.

2. Viscosity:

To determine the molecular weight of a high polymer by using solutions of different concentrations.

3.Adsorption

To investigate the adsorption of oxalic acid /acetic acid by activated charcoal and test the validity of Freundlich / Langmuir isotherm

4. Phenol-water system

To study the effect of addition of salt on critical solution temperature of phenol water System

5. Transport number

To determine the transport number of cation by moving boundary method.

6. Refractometry (any two)

i)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.
ii) To determine the molecular refractivity of the given liquids A, B, C and D.
iii)To determine the molar refraction of homologues methyl, ethyl and propyl alcoholand show the constancy contribution to the molar refraction by -CH_2 group.

Group B

1. Colorimetry (any two)

i)Determination of λ_{max} and concentration of unknown solution of $KMnO_4$ in 2 N $H2SO_4$
ii)Determination of λ_{max} and concentration of unknown solution of $CuSO_4$.
iii)To titrate Cu^{2+} ions with EDTA photometrically.
iv)To determine the indicator constant of methyl red indicator

2. Potentiometry(any three)

i)To prepare standard 0.2 M Na_2HPO and 0.1 M Citric acid solution, hence prepare four different buffer solutions using them. Determine the pka value of these and unknown solutions.
ii)To determine the concentrations of strong acid and weak acid present in the mixture by titrating with strong base.
iii)To determine the formal redox potential of Fe^{2+}/ Fe^{3+} system potentriometrically

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CH-348 - INORGANIC CHEMISTRY PRACTICALS

A) Gravimetric estimations (Any 3)

1. Fe as Fe_2O_3
2. Nickel as Ni – DMG
3. Al as Aluminum oxide
4. Gravimetric estimation of Ba as $BaSO_4$ using homogeneous precipitation method.

B) Volumetric Estimations (Any 4)

1. Mn by Volhard's method
2. Estimation of NO_2^- by using $KMnO_4$.
3. Estimation of % purity of given sample of Sodium Chloride
4. Analysis of Brass-Estimation of copper by Iodometry
5. Fertilizer analysis (PO_4^{3-})

C) Inorganic preparations (Any 4)

1. Preparation of Hexamminenickel(II), $[Ni(NH_3)_6]^{2+}$.
2. Preparation of Potassium Trioxalatoferrate (III), $K_3[Fe(C_2O_4)_3]$.
3. Preparation of Tetraamminecopper (II) suplhate, $[Cu(NH_3)_4]SO_4$.
4. Preparation of Manganese (III) acetylacetonate $[Mn(acac)_3]$.
5. Preparation of Tris(Thiourea)Copper (I) Chloride $[Cu(Thiourea)_3]Cl$.

D) Colorimetric Estimations (Any 2)

1. Iron by thiocyanate method.
2. Cobalt by using R-nitroso salt method.
3. Titanium by H_2O_2.

E) Separation of binary mixture of cations by Column Chromatography (3 mixtures)

(One mixture should be colorless, Zn + Al, Zn + Mg)

OR

E) Flame Photometry (Any 3)

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.

F) Qualitative Analysis (4 mixtures including Borates and Phosphates)

G) Visit to a chemical industry and report writing is compulsory.

Reference Books: **Ref. 1** General Chemistry Experiment – Anil J Elias (University press).
Ref. 2 Vogel Textbook of Quantitative Chemical Analysis G.H. Jeffery, J. Basset.
Ref. 3 Quantitative Chemical Analysis S. Sahay (S. Chand & Co.).
Ref. 4 Quantitative Analysis R.A. Day, Underwood (Prentice Hall).
Ref. 5 Practical Chemistry K.K. Sharma, D. S. Sharma (Vikas Publication).
Ref. 6 Vogel's Textbook of Quantitative Chemical Analysis.
Ref. 7 Monograph on Green Chemistry Laboratory Experiments by Green Chemistry Task Force Committee, DST.
Ref. 8"Experimental Methods in Inorganic Chemistry." Tanaka, J. and Suib, S.L., Prentice Hall, New Jersey, 1999.

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.

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:

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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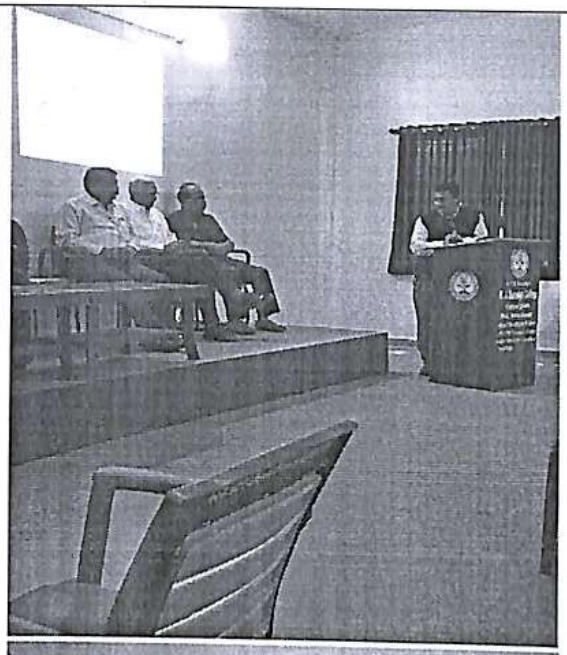
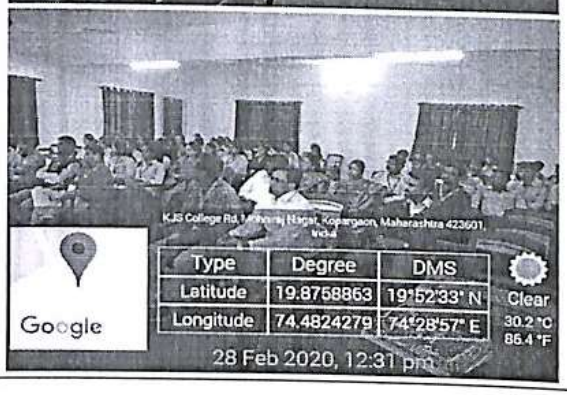
3	Department of Mathematics celebrated the 'National Science Day' on 28th February 2020. On this occasion Dr. B. D. Gavhane delivered a lecture for science stream students on the topic 'Current innovations in science and technology'	Professional Ethics, Human Values	 
4	Dr.B.D.Gavhane worked as a examiner 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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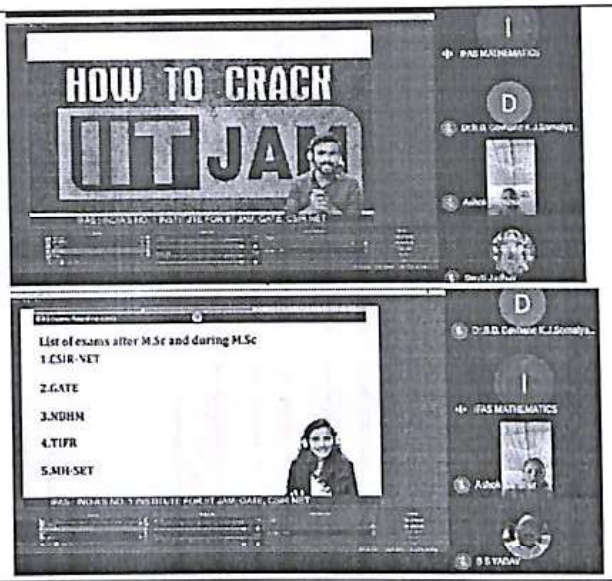
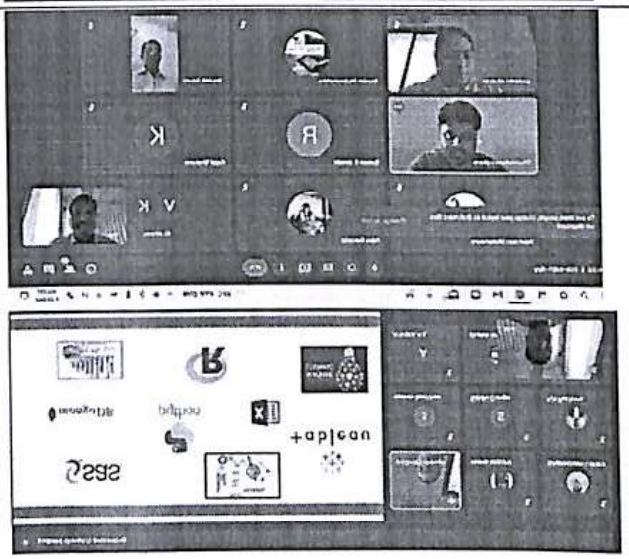
7	department of Mathematics organized one day National webinar on 'Strategies to Crack Competitive Exams in Mathematics' on 3rd February 2021. To	Professional Ethics	
8	Department of Mathematics, IQAC and EduBridge Learning organized one day National Seminar on 'Data Science with R and Python' on 28th 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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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.

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

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
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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:

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MTUT-111: LINEAR ALGEBRA

[06 Hours]

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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
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[10 Hours]

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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

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.

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i) To maintain updated curriculum.
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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

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	

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.

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

K. J. Somaiya College, Kopargaon.
Department of Physics
List of Courses addresses crosscutting issues as per **New syllabus (CBCS- 2019 Pattern)**

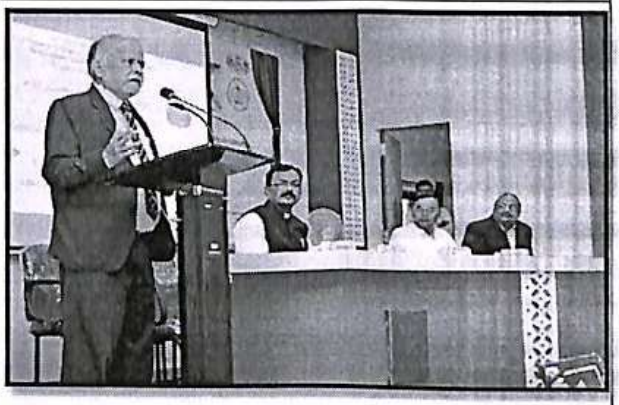
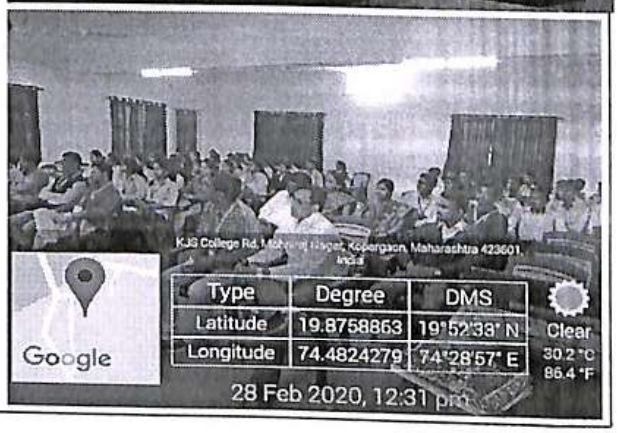
Sr. No.	Programme Name	Course code	Name of Course	Addressed issue (Professional Ethics, Environment and Sustainability)
1	B. Sc. Physics	PHY-111	Mechanics and Properties of Matter	Professional Ethics
2	B. Sc. Physics	PHY-112	Physics Principles and Applications	Professional Ethics
3	B. Sc. Physics	PHY-113	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

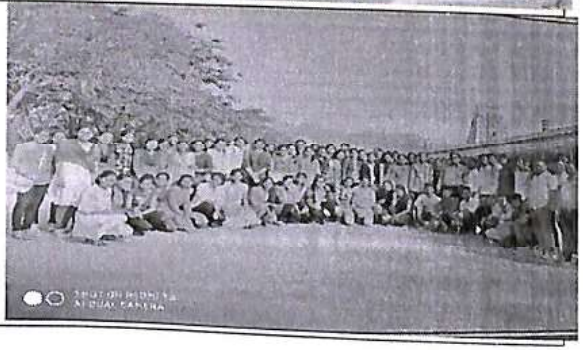
29	B. Sc. Physics	PHY-364	Nuclear Physics	Professional Ethics
30	B. Sc. Physics	PHY-365	Electronics-II	Professional & Industrial Ethics
31	B. Sc. Physics	PHY-356(D)	Laser	Professional & Industrial Ethics
32	B. Sc. Physics	PHY-357	Physics Laboratory-4A	Professional Ethics
33	B. Sc. Physics	PHY-358	Physics 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.

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

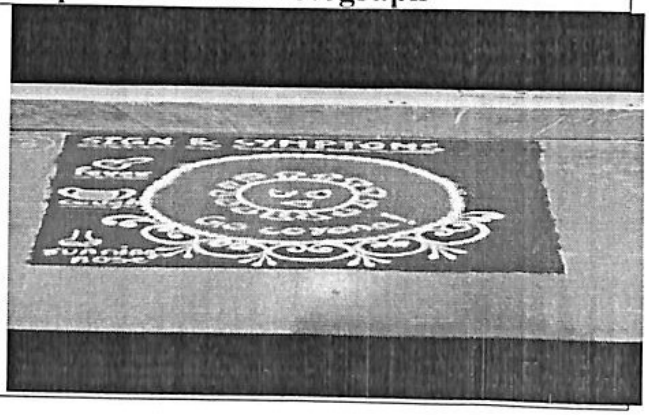
Head
Department of Microbiology
K. J. Somaiya College, Kopargaon

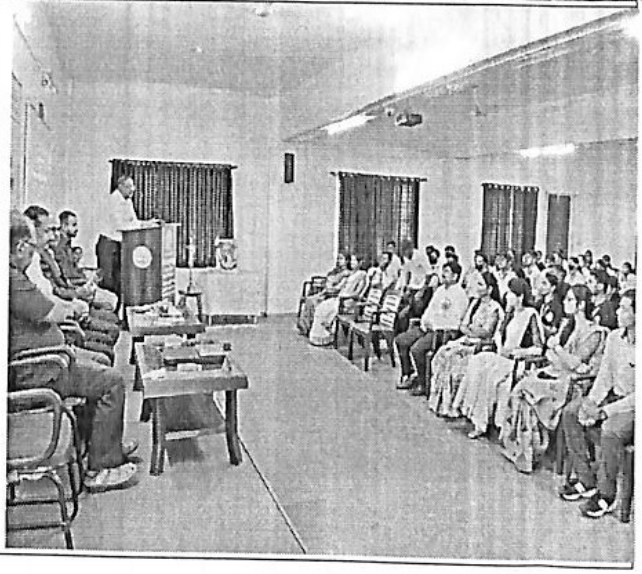
Principal
K.J.Somaiya College of Arts
Commerce & Science,Kopargaon

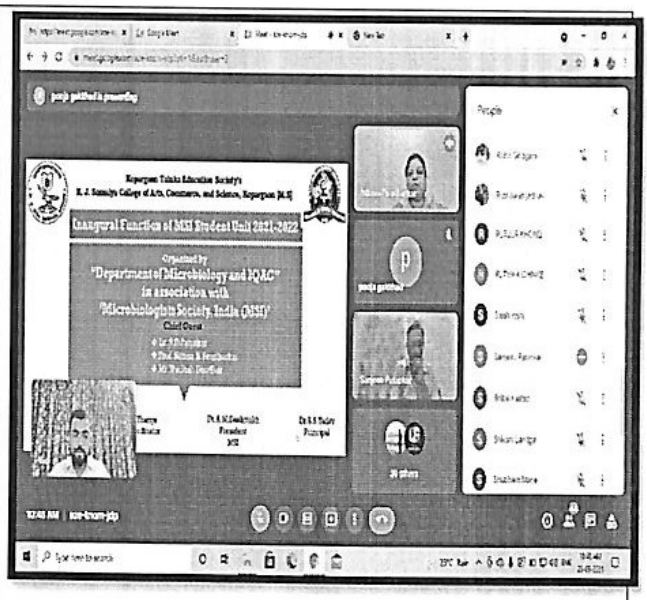
List of Add-on/Value Added/ Certificate Courses

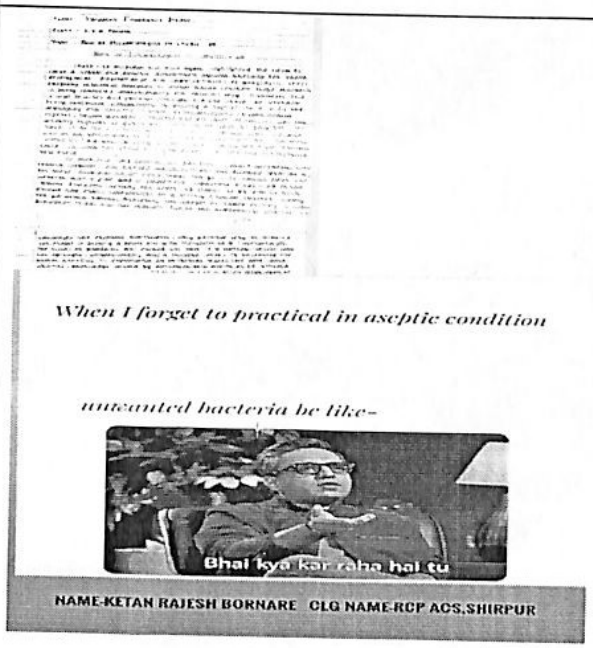
Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	Microbiology	Health and Environment Awareness	—	From 2018-19 till Current Year...	Professional Ethics

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	

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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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

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
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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

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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

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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.

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

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)
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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.	(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

SCIENCE LIBRARY

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

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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

SAVITRIBAI PHULE PUNE UNIVERSITY, PUNE.

POLITICAL SCIENCE

Syllabus for TYBA

80:20 Pattern to be implemented from 2015-16

SYLLABUS FOR TYBA POLITICAL SCIENCE (G-3)

POLITICAL IDEALOGIES

Course Rationale:

This paper studies the role of different political ideologies and their impact in politics. Each ideology is critically studied in its historical context. In course of its evolution and development, the different streams and subtle nuances within each ideology, the changes and continuities in its doctrine and its relevance to contemporary times are highlighted. The close link between an idea and its actual realization in public policy needs to be explained as well. The philosophical basis of the ideologies is emphasized with special emphasis on key thinkers and their theoretical formulations. The legacy of all the major ideologies is to be critically assessed.

SECTION-I

UNIT-I: - Ideology **08**

a) Origin, Meaning, Definition

b) Nature and Scope

UNIT-II: - Nationalism **14**

a) Meaning, Definitions and Elements

b) Progressive and Reactionary

c) Internationalism

UNIT-III: - Democratic Socialism **14**

a) Meaning, Nature and Features

b) Achievements and Limitations

c) Types : Febianism, Syndicalism, Guild Socialism

UNIT-IV: - Fascism **12**

a) Factors responsible for the rise of Fascism

b) Principles

c) Corporate State

SECTION-II

UNIT-V: - Marxism **12**

a) Historical Materialism

b) Theory of Surplus Value

c) Marxian State

UNIT-VI: - Phule-Ambekarism **12**

a) Equality

b) Religion

c) Democracy

UNIT-VII: - Gandhism **12**

a) Truth and Non-Violence

b) Theory of Satyagraha

c) Gram Swaraj

UNIT-VIII: - Feminism **12**

a) Meaning and Nature

b) Liberal Feminism

c) Feminism in India : Caste, Patriarchy, Women's Representation

SYLLABUS FOR TYBA POLITICAL SCIENCE (S-3)
PUBLIC ADMINISTRAION

Course Rationale:

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

SECTION-I

UNIT-I: - Public Administration 12

a) Meaning
b) Nature
c) Scope and Significance

UNIT-II: - New Public Administration 12

a) Evolution
b) Salient Features
c) Goals

UNIT_III:- Approaches to Public Administration. 12

a) Traditional Approach
b) Behavioral Approach
c) System Approach

UNIT-IV: - Governance 12

a) Idea of Good Governance
b) E-Governance
c) Public Private Partnership

SECTION-II

UNIT-V:- Bureaucracy 12

a) Meaning and Definitions
b) Administrative Reforms

UNIT-VI: - Personnel Administration 12

a) Recruitment
b) Training
c) Promotion

UNIT-VII: - Budget 12

a) Meaning and types
b) Budgetary Process in India

7

UNIT-VIII: - Accountability and Control 12

a) Administrative Accountability
b) Legislative Control
c) Judicial Control

SYLLABUS FOR TYBA POLITICAL SCIENCE (S-4)
INTERNATIONAL POLITICS

Course Rationale:

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 highlights various aspects of conflict and conflict resolution, collective security and in the specificity of the long period of the post Second World War phase of the Cold War, of Détente and Deterrence leading to theories of rough parity in armaments.

SECTION-I:

UNIT I :- International Politics 12

a) Nature and Scope

b) Theories of Idealism and Realism

UNIT II :- Approaches to the Study of International Relations 12

a) Power Approach

b) Decision Making Approach

c) System Approach

UNIT III :- Power 12

a) Meaning

b) Elements

c) Changing Nature of the National Power

UNIT IV :- Balance of Power 12

a) Meaning and Nature

b) Characteristics

c) Changing Nature of the Balance of Power

SECTION –II

UNIT V :- Security 12

a) Meaning and definition

b) Regional Security

c) Collective Security

UNIT VI :- Diplomacy 12

a) Meaning

b) Types of Diplomacy

c) Challenges To Diplomacy

9

UNIT VII :- Disarmament 12

a) Meaning and Nature

b) Types of Disarmament

c) Issues and Challenges

UNIT VIII :- Issues in International Politics 12

a) Human Rights –Its variations and Measures

b) Terrorism – Causes and Consciousness

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Systems Programming
Code No. : CS-331

Semester III **Total Lectures : 48**

Aim : To understand the design and implementation issues of System programs that play an important role in program development.

Objectives :

- To understand the design structure of a simple editor.
- To understand the design structure of Assembler and macro processor for an hypothetical simulated computer.
- To understand the working of linkers and loaders and other development utilities.
- To understand Complexity of Operating system as a software.

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1. Introduction **[4]**

1.1. Types of program – System program and Application program.
1.2. Difference between system programming and application programming.
1.3. Elements of Programming environment - Editor, Preprocessor, Assembler, Compiler, Interpreter, Linker and Loader, Debugger, Device drivers, Operating System.
1.4. Simulation of simple computer smac0 (hypothetical computer) -Memory, Registers, Condition Codes, Instruction format, Instruction Set, smac0 programs.

2. Editors **[2]**

2.1 Definition, need/purpose of editor.
2.2 Types of editor- Examples ed, sed, VIM & emacs
2.3 Structure of editor

3. Assembler **[10]**

3.1 Definition.
3.2 Features of assembly language, advantages
3.3 Statement format, types of statements – Imperative, Declarative, Assembler Directive.
3.4 Constants and Literals.
3.5 Advanced assembler directives (LTORG, ORIGIN, EQU),
3.6 Design of assembler – Analysis Phase and Synthesis Phase.
3.7 Overview of assembling process
3.8 Pass Structure of Assembler – One pass, Two pass assembler.
3.9 Problems of 1-pass assembler - forward reference, efficiency, Table of Incomplete Instructions.
3.10 Design of 2-pass Assembler – Pass-I and Pass-II
3.11 Data structure of 2-pass assembler.
3.12. Intermediate Code – Need, Forms-variant I and Variant II

4. Macros and Macro Processors **[10]**

4.1 Definition
4.2 Macro definition and call
4.3 Macro expansion – positional and keyword parameters
4.4 Design of Data structures to be used for Macro definition and use
4.5 Nested macro calls
4.6 Advanced macro facilities – alteration of flow of control during expansion, expansion time variable, conditional expansion, expansion time loops. (with examples)
4.7 Design of macro preprocessor – Design overview, data structure, processing of macro definition and macro expansion (Except algorithms)

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Theoretical Computer Science
Code No. : CS-332

Semester III **Total Lectures : 48**

Aim:
To have a introductory knowledge of automata, formal language theory and computability.

Objectives:
- To have an understanding of finite state and pushdown automata.
- To have a knowledge of regular languages and context free languages.
- To know the relation between regular language, context free language and corresponding recognizers.
- To study the Turing machine and classes of problems.

Prerequisite:
- Sets, Operations on sets, Finite & infinite sets Formal Language
- Relation, Equivalence Relation,(reflexive, transitive and symmetric closures)

1. Introduction [3]
1.1 Symbol, Alphabet, String, Prefix& & Suffix of Strings, Formal Language, Operations on Languages.
1.2 Regular Expressions (RE) : Definition & Example
1.3 Regular Expressions Identities.

2. Finite Automata [12]
2.1 Deterministic finite Automaton – Definition, DFA as language recognizer, DFA as a pattern recognizer.
2.2 Nondeterministic finite automaton – Definition and Examples.
2.3 NFA TO DFA : Method (From Book 4)
2.4 NFA with ε- transitions Definition and Examples.
2.5 NFA with ε-Transitions to DFA & Examples
2.6 Finite automaton with output – Mealy and Moore machine, Definition and Examples.
2.7 Minimization of DFA, Algorithm & Problem using Table Method.

3. Regular Languages [5]
3.1 Regular language-Definition and Examples.
3.2 Conversion of RE To FA-Examples.
3.3 Pumping lemma for regular languages and applications.
3.4 Closure properties of regular Languages
(Union, Concatenation, Complement, Intersection and Kleene closure)

4. Context Free Grammar and Languages [12]
4.1 Grammar - Definition and Examples.
4.2 Derivation-Reduction - Definition and Examples.
4.3 Chomsky Hierarchy.
4.4 CFG : Definition & Examples. LMD, RMD, ,Parse Tree
4.5 Ambiguous Grammar : Concept & Examples.
4.6 Simplification of CFG :
- 4.6.1 Removing Useless Symbols,
- 4.6.2 Removing unit productions
- 4.6.3 Removing ϵ productions & Nullable symbols

4.7 Normal Forms :
- 4.7.1 Chomsky Normal Form (CNF) Method & Problem

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Computer Networks -I
Code No. : CS-333

Semester III **Total Lectures : 48**

Pre-requisites: Basics of computer, Knowledge of 'C' for assignment.

Objectives: This course will prepare students in Basic networking concepts.

1. Understand different types of networks, various topologies and application of networks.
2. Understand types of addresses, data communication.
3. Understand the concept of networking models, protocols, functionality of each layer.
4. Learn basic networking hardware and tools.

Ch.No.	Name of Chapter	Reference Book
1	**Chapter 1 Introduction to Computer Networks**	**[Lectures 8]**
1.1	Computer Networks- Goals and applications – Business Application , Home Application, Mobile User, Social Issues	Book 1 CH1 (Pg. No.3 -14)
1.2	Network Hardware - Broadcast and point-to-point	Book 1 CH1 (Pg. No.14-16)
1.3	topologies – star, bus, mesh, ring etc.	Book 2 CH1 (Pg. No. 9-13)
1.4	Network Types-LAN, MAN, WAN, Wireless Networks, Home Networks, Internetwork	Book 1 CH1 (Pg. No.16-26)
1.5	Data Communication-Definition, components, data representation, Data Flow	Book 2 CH1 (Pg. No. 3-7)
1.6	Protocols &Standards De facto and De jure standard,	Book 2 CH1 (Pg. No. 19-20)
1.7	Network Software - Protocol Hierarchies -layers, protocols, peers, interfaces Network architecture, protocol stack, Design issues of the layers –addressing, error control, flow control, multiplexing and demultiplexing, routing Connection-oriented and connectionless service, Service Primitives – listen, connect, receive, send, disconnect and Berkley Socket ,the relationships of services to protocols.	Book 1 CH1 (Pg. No.26-37)
2.	Network Models	[Lectures 5]
2.1	OSI Reference Model - Functionality of each layer	Book 2 CH2 (Pg. No 29-42)

3. Page no listed above may vary according to year of publication of 4th edition but topics remain same.
4. All sub topics listed pages of respective reference books should be covered.

SAVITRIBAI PHULE PUNE UNIVERSITY

T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Internet Programming I
Code No. : CS-334

Semester III **Total Lectures: 48**

Aim: To Design dynamic and interactive Web pages.
Objective:

- Learn Core-PHP, Server Side Scripting Language
- Learn PHP-Database handling.

Prerequisite: HTML.

1. **Introduction to web techniques** [8]
1.1 HTTP basics, Introduction to Web server and Web browser
1.2 Introduction to PHP
1.3 What does PHP do?
1.4 Lexical structure
1.5 Language basics
Book 1 chapter 2

2. **Function and String** [10]
2.1Defining and calling a function
2.2 Default parameters
2.3 Variable parameters, Missing parameters
2.4 Variable function, Anonymous function
2.5 Types of strings in PHP
2.6 Printing functions
2.7 Encoding and escaping
2.8 Comparing strings
2.9 Manipulating and searching strings
2.10 Regular expressions
Book 1 chapter 3 and 4

3. **Arrays** [6]
3.1 Indexed Vs Associative arrays
3.2 Identifying elements of an array
3.3 Storing data in arrays
3.4 Multidimensional arrays
3.4Extracting multiple values
3.5 Converting between arrays and variables
3.6 Traversing arrays
3.7 Sorting
3.8 Action on entire arrays
3.9 Using arrays
Book 1 chapter 5

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B.Sc. COMPUTER SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Programming in Java-I
Code No. : CS-335

Semester IV **Total Lectures: 48**

Prerequisite:

- Knowledge of C Programming language

Objective:

- To learn Object Oriented Programming language
- To handle abnormal termination of a program using exception handling
- To create flat files
- To design User Interface using Swing and AWT

1. An Introduction to Java [4]

1.1 A Short History of Java
1.2 Features or buzzwords of Java
1.3 Comparison of Java and C++
1.4 Java Environment
1.5 Simple java program
1.6 Java Tools – jdb, javap, javadoc
1.7 Java IDE – Eclipse/NetBeans (Note: Only for Lab Demonstration)

2. An Overview of Java [4]

2.1 Types of Comments
2.2 Data Types
2.3 Final Variable
2.4 Declaring 1D, 2D array
2.5 Accepting input using Command line argument
2.6 Accepting input from console (Using BufferedReader class)

3. Objects and Classes [8]

3.1 Defining Your Own Classes
3.2 Access Specifiers (public, protected, private, default)
3.3 Array of Objects
3.4 Constructor, Overloading Constructors and use of 'this' Keyword
3.5 static block, static Fields and methods
3.6 Predefined class – Object class methods (equals(), toString(), hashcode(), getClass())
3.7 Inner class
3.8 Creating, Accessing and using Packages
3.9 Creating jar file and manifest file
3.10 Wrapper Classes
3.11 Garbage Collection (finalize() Method)
3.12 Date and time processing

4. Inheritance and Interface [7]

4.1 Inheritance Basics (extends Keyword) and Types of Inheritance
4.2 Superclass, Subclass and use of Super Keyword
4.3 Method Overriding and runtime polymorphism

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Object Oriented Software Engineering
Code No. : CS-336

Semester III **Total Lectures: 48**

Prerequisites
- Knowledge of Object Oriented Concepts
- Knowledge of Classical Software Engineering

Aim
To Understand Object Oriented Modeling techniques and their applicability.

Objectives
- Understanding importance of Object Orientation in Software engineering
- Understand the components of Unified Modeling Language
- Understand techniques and diagrams related to structural modeling
- Understand techniques and diagrams related to behavioral modeling
- Understand techniques of Object Oriented analysis, design and testing

1. Object Oriented Concepts and Principles [4]
1.1 What is Object Orientation ? - Introduction , Object , Classes and Instance , Polymorphism, Inheritance
1. 2 Object Oriented System Development- Introduction, Function/Data Methods (With Visibility), Object Oriented Analysis, Object Oriented Construction
1.3 Identifying the Elements of an Object Model
1.4 Identifying Classes and Objects
1.5 Specifying the Attributes (With Visibility)
1.6 Defining Operations
1.7 Finalizing the Object Definition

2. Introduction to UML [2]
2.1 Concept of UML
2.2 Advantages of UML

3. Basic Structural Modeling [5]
3.1 Classes
3.2 Relationship
3.3 Common Mechanism
3.4 Class Diagram (Minimum three examples should be covered)

4. Advanced Structural Modeling [7]
4.1 Advanced Classes
4.2 Advanced Relationship
4.3 Interface
4.4 Types and Roles
4.5 Packages
4.6 Object Diagram (Minimum three examples should be covered)

5. Basic Behavioral Modeling [9]

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Operating Systems
Code No. : CS-341

Semester IV **Total Lectures : 48**

Aim : To understand the design and implementation issues of Operating System.

Objectives :

- To understand design issues related to process management and various related algorithms
- To understand design issues related to memory management and various related algorithms
- To understand design issues related to File management and various related algorithms

1. Introduction [2]

1.1 Operating System Structure – Simple structure, Layered approach, Micro kernels, Modules
1.2 Virtual Machines – Introduction, Benefits
1.3 System Boot

2. Process Management [4]

2.1 Process Concept – The process, Process states, Process control block.
2.2 Process Scheduling – Scheduling queues, Schedulers, context switch
2.3 Operations on Process – Process creation with program using fork(), Process termination
2.4 Interprocess Communication – Shared memory system, Message passing systems.

3. Multithreaded Programming [2]

3.1 Overview
3.2 Multithreading Models

4. Process Scheduling [8]

4.1 Basic Concept – CPU-I/O burst cycle, CPU scheduler, Preemptive scheduling, Dispatcher
4.2 Scheduling Criteria
4.3 Scheduling Algorithms – FCFS, SJF, Priority scheduling, Round-robin scheduling, Multiple queue scheduling, Multilevel feedback queue scheduling
4.4 Thread Scheduling

5. Process Synchronization [6]

5.1 Background
5.2 Critical Section Problem
5.3 Semaphores: Usage, Implementation
5.4 Classic Problems of Synchronization – The bounded buffer problem, The reader writer problem, The dining philosopher problem

6. Deadlocks [8]

6.1 System model
6.2 Deadlock Characterization – Necessary conditions, Resource allocation graph
6.3 Deadlock Prevention
6.4 Deadlock Avoidance - Safe state, Resource allocation graph algorithm, Banker's Algorithm
6.5 Deadlock Detection
6.6 Recovery from Deadlock – Process termination, Resource preemption

7. Memory Management [11]

7.1.Background – Basic hardware, Address binding, Logical versus physical address space, Dynamic loading, Dynamic linking and shared libraries

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Compiler Construction
Code No. : CS-342

Semester IV **Total Lectures : 48**

Aim :
To understand the various phases of a compiler and to develop skills in designing a compiler

Objective :
- 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 issues related to memory allocation
- To understand and design code generation schemes

1. Introduction [5]

1.1 Definition of Compiler, Aspects of compilation.
1.2 The structure of Compiler.
1.3 Phases of Compiler – Lexical Analysis,Syntax Analysis, Semantic Analysis, Intermediate Code generation, code optimization, code generation.
1.4 Error Handling
1.5 Introduction to one pass & Multipass compilers, cross compiler, Bootstrapping.

2. Lexical Analysis(Scanner) [5]

2.1 Review of Finite automata as a lexical analyzer,
2.2 Applications of Regular Expressions and Finite Automata (lexical analyzer, searching using RE), Input buffering, Recognition of tokens
2.3 LEX: A Lexical analyzer generator (Simple Lex Program)

3. Syntax Analysis(Parser) [20]

3.1 Definition , Types of Parsers
3.2 Top-Down Parser –
- 3.2.1Top-Down Parsing with Backtracking: Method & Problems
- 3.2.2 Drawbacks of Top-Down parsing with backtracking,
- 3.2.3Elimination of Left Recursion(direct & indirect)
- 3.2.4Need for Left Factoring & examples

3.3 Recursive Descent Parsing : Definition
- 3.3.1Implementation 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
- 3.4.3 Construction of LL(1) Parsing Table
- 3.4.4Parsing of a String using LL(1) Table

3.5 Bottom-Up Parsers
3.6 Operator Precedence Parser -Basic Concepts
- 3.6.1Operator Precedence Relations form Associativity & Precedence
- 3.6.2 Operator Precedence Grammar
- 3.6.3 Algorithm for LEADING & TRAILING(with ex.)
- 3.6.4Algorithm for Operator Precedence Parsing (with ex.)
- 3.6.5Precedence Functions

3.7 Shift Reduce Parser
- 3.7.1Reduction, Handle, Handle Pruning
- 3.7.2Stack Implementation of Shift Reduce Parser (with examples)

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16

TITLE OF PAPER : Computer Networks -II

Code No. : CS-343

Semester IV **Total Lectures: 48**

Pre-requisites: Basics of computer networks covered last semester, Knowledge of 'C'.

Objectives: This course will prepare students in

1. Basic networking concepts.
2. Understand wired and wireless networks, its types, functionality of layer.
3. Understand importance of network security and cryptography.

Ch. No.	Name of Chapter	Reference Book
1.	Wired LANs	[Lectures 9]
1.1	IEEE Standards Data Link Layer, Physical Layer	Book 2 CH13 (Pg. No 395-397)
1.2	Standard Ethernet MAC Sublayer – Frame Format, Frame Length, Addressing, Access Method	Book 2 CH13 (Pg. No 397-402)
1.3	Physical Layer – Encoding and Decoding, 10Base5, 10Base2, 10Base-T, 10Base-F,	Book 2 CH13 (Pg. No 402-405)
1.4	Changes In The Standard – Bridged Ethernet, Switched Ethernet, Full Duplex Ethernet	Book 2 CH13 (Pg. No 406-409)
1.5	Fast Ethernet – Goals, MAC Sublayer,Topology, Implementation	Book 2 CH13 (Pg. No.409-410)
1.6	Gigabit Ethernet – goals, MAC Sublayer, Topology, Implementation	Book 2 CH13 (Pg. No 412-414)
1.7	Ten-Gigabit Ethernet – goals, MAC Sublayer, Physical Layer	Book 2 CH13 (Pg. No 416)
1.8	Backbone Networks Bus Backbone, Star Backbone, Connecting Remote LANs	Book 2 CH15 (Pg. No 456-458)
1.9	Virtual LANs Membership, Configuration, Communication between Switches, IEEE standards Advantages	Book 1 CH1 (Pg. No 458-463)
2.	Wireless LAN	[Lectures 2]
2.1	IEEE 802.11 Architecture – Basic Service Set, Extended Service Set, Station Types	Book 2 CH14 (Pg. No421-422)

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Internet Programming II
Code No. : CS-344

Semester IV **Total Lectures: 48**

Aim: To Design dynamic and interactive Web pages.

Objective:

- Learn different technologies used at client Side Scripting Language
- Learn XML,CSS and XML parsers.
- One PHP framework for effective design of web application.
- Learn JavaScript to program the behavior of web pages.
- Learn AJAX to make our application more dynamic.

1. Web Techniques **[10]**

1.1 Variables
1.2 Server information
1.3 Processing forms
1.4 Setting response headers
1.5 Maintaining state
1.6 SSL
Book 1 chapter 7

2. Handling email with php **[8]**

2.1 Email background
2.2 Internet mail protocol
2.3 Structure of an email message
2.4 Sending email with php
2.5 Email attachments.
2.6 Email id validation and verification
2.7 PHP error handling.
Book 2 chapter 15

3. PHP framework **[4]**

3.1 Introduction to PHP framework.
3.2 Features, Applications.
3.3 One example like JOOMLA,DRUPAL.
Book 11, https://api.drupal.org

4. XML **[8]**

4.1What is XML?
4.2 XML document Structure
4.3 PHP and XML
4.4 XML parser
4.5 The document object model
4.6 The simple XML extension
4.7 Changing a value with simple XML
Book 2 chapter 8

5. WEB DESIGNING TECHNOLOGIES(JavaScript-DHTML) **[10]**

5.1 Overview of JavaScript, DHTML
5.2 Object Orientation and JavaScript

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T.Y. B.Sc. COMPUTER SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : Programming in Java-II
Code No. : CS-345

Semester IV **Total Lectures : 48**

Prerequisite:

- Knowledge of Core Java (CS – 345)

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

1. Collection [6]

1.1 Introduction to the Collection framework
1.2 List – ArrayList, LinkedList and Vector,Stack,Queue
1.3 Set - HashSet, TreeSet, and LinkedHashSet
1.4 Map – HashMap, LinkedHashMap, Hashtable and TreeMap
1.5 Interfaces such as Comparator, Iterator, ListIterator, Enumeration

2. Database Programming [10]

2.1 The design of jdbc, jdbc configuration
2.2 Types of drivers
2.3 Executing sql statements, query execution
2.4 Scrollable and updatable result sets
2.5 Metadata – DatabaseMetadata, ResultSetMetadata
2.6 Transactions – commit(), rollback(), SavePoint
(Database : PostgreSQL)

3. Servlet [12]

3.1 Introduction to Servlet and Hierarchy of Servlet
3.2 Life cycle of servlet
3.3 Tomcat configuration (Note: Only for Lab Demonstration)
3.4 Handing get and post request (HTTP)
3.5 Handling a data from HTML to servlet
3.6 Retriving a data from database to servlet
3.7 Session tracking – User Authorization, URL rewriting, Hidden form fields, Cookies and HttpSession

4. JSP [10]

4.1 Simple first JSP program
4.2 Life cycle of JSP
4.2 Implicit Objects
4.3 Scripting elements – Declarations, Expressions, Scriplets, Comments
4.4 JSP Directives – Page Directive, include directive
4.5 Mixing Scriplets and HTML
4.6 Example of forwarding contents from database to servlet, servlet to JSP and displaying it using JSP scriplet tag

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER :Computer Graphics
Code No. : CS-346

Semester IV **Total Lectures: 48**

Pre – Requisites

- Computer programming skills in C programming language
- Basic understanding of use of data structures
- Basic Mathematical concepts related to matrices and geometry

Objectives

- To study how graphics objects are represented in Computer
- To study how graphics system in a computer supports presentation of graphics information
- To study how interaction is handled in a graphics system
- To study how to manipulate graphics object by applying different transformations
- To provide the programmer's perspective of working of computer graphics

1. Introduction to Computer graphics [4]

1. 1 Introduction to computer graphics & graphics systems
1.2 Components of Computer Graphics Representation, Presentation , Interaction and Transformations
1.3 Applications of Computer Graphics
1.3 Pixel/Point ,Raster v/s Vector ,RGB color model, intensity
1.4 Programming essentials – event driven programming. OpenGL library

2. Input devices and Interaction tasks [4]

2.1 Logical Interaction – Locator, valuator , pick and choice;
2.2 Physical devices used for interaction – keyboard, mouse, trackball,spaceball, tablets, light pen, joy stick, touch panel, data glove;
2.4 Keyboard , Mouse interaction in OpenGL
2.5 Graphical User Interfaces- cursors , radio buttons, scroll bars, menus, icons
2.6 Implementing GUI in open GL

3. Presentation and Output devices [4]

3.1 Presentation Graphics - frame buffer, display file, lookup table;
3.2 Display devices, Random and Raster scan display devices; CRT,
3.3 Hardcopy devices - Plotters and Printers

4. Raster Scan Graphics [10]

4.1 Line drawing algorithms; DDA algorithm, Bresenham's line drawing algorithm, Circle generation algorithm;
4.2 Scan conversions- Generation of the Display, Image compression
4.3 Displaying Lines and characters
4.3 Polygon filling -Scan converting polygons, fill algorithms, Boundary fill algorithm, flood fill algorithm

5. Transformations [7]

5.1 Basic transformations: translation, rotation, scaling; Matrix representations & homogeneous coordinates, Reflection, shear
5.2 Transformation of points, lines, parallel lines, intersecting lines. Viewing pipeline
5.3 Window to viewport co-ordinate transformation. Setting window and viewport in OpenGL.

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER : System Programming & Operating System
Code No. : CS-347

Aim:
To understand the process of designing and implementing System programs and operating system components.

Objective :-
1. Design and implement System programs with minimal features to understand their complexity.
2. Design and implement simulations of operating system level procedures.

Syllabus

Sr. No	Topic	Lectures
1	Line Editor	8 lectures
2	SMAC0 simulator	8 lectures
3	Assembler	12 Lectures
4	Macro processor	12 lectures
5	DFA driver	8 lectures
6	Development Utilities	8 lectures
7	Toy shell	8 Lectures
8	CPU Scheduler	12 lectures
9	Deadlock detection	8 lectures
10	Page Replacement Algorithms	12 lectures
11	File Allocation methods	12 Lectures

Examination

Internal Marks : Activity + Labbook(10+10)

External Marks : two programs(35each) oral(5) Activity(5)

SAVITRIBAI PHULE PUNE UNIVERSITY
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER :Lab Course II – Programming in Java
Code No. : CS-348

Aim:
To understand the process of designing and implementing Core and Advanced Java programs.

Objective :-
1. Implement core Java programs to solve simple problems
2. Implement Client and Server end Java programs

Syllabus

Sr. No	Topic	Lectures
Core and Advanced Java		
1	Simple Java programs	8 Lectures
2	Arrays and Packages	8 Lectures
3	Inheritance and Interfaces	8 Lectures
4	Exception Handling	8 Lectures
5	File Handling	8 Lectures
6	GUI designing & Event Handling	8 Lectures
7	Database Programming	8 Lectures
8	Multithreading	4 Lectures
9	Collection	8 Lectures
10	Servlets	8 Lectures
11	JSP	8 Lectures
12	Socket Programming	4 Lectures
Computer Graphics		
1	Simple Graphics program using OpenGL	4 Lectures
2	Using graphics primitives to display graphics	4 Lectures
3	Window to viewport transformations and other transformations	4 Lectures
4	Using simple Keyboard and Mouse interaction	4 Lectures
5	Graphics Mini project	16 Lectures

Examination

Internal Marks : Activity(CG) + Seminar(Enhanced java+ listening) (10+10)

External Marks : two programs(30each) oral(5) Activity(5)+ Labbook(10)

SAVITRIBAI PHULE PUNE UNIVERSITY
Proposed Draft of
T.Y. B. Sc. COMPUTER SCIENCE SYLLABUS
TO BE IMPLEMENTED FROM ACADEMIC YEAR 2015-16
TITLE OF PAPER :Lab Course III – Programming in PHP & Project
Code No. : CS-349

Aim:
To understand the process of designing and implementing Web applications, using PHP.

Objective :-
1. Implement Simple PHP programs to solve simple problems

Syllabus

Sr. No	Topic	Lectures
PHP		
1	String manipulation	8 Lectures
2	Arrays	8 Lectures
3	Inheritance	8 Lectures
4	File Handling	8 Lectures
5	Form designing	8 Lectures
6	Database Connectivity	8 Lectures
7	Sessions and cookies	8 Lectures
8	Java script with AJAX	
Networking		4 Lectures
1	Setting a LAN Environment	4 Lectures
2	Configuring the Server	4 Lectures
3	Use of Service Primitives	12 Lectures
4	Use of Networking Tools	
Project		
1	Choose Project topic and Prepare problem description	
2	Study of Existing System	
3	Identifying users and functionalities of proposed system	
4	Preparing the Design of the proposed system- Data Design Screen and Report Designs	
5	Implementation	

Examination

Internal Marks: Project (20) Continuous Evaluation.

External Marks: One programs (30) (large program on PHP + small program PHP), networking(10) – Internal, Lab book(10), Project(30) -20 Marks External + 10 Marks Internal for Project Demo before Final Practical Exam

Kopargaon Taluka Education Society's

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

Crosscutting Issues in Syllabus of Geography

Crosscutting Issues in 2013 Pattern:

Sr. No.	Class	Course Code	Course Name	Addressed issues
1	B. A. Geography	Gg-220(S-1)	SYBA: Economic Geography OR Tourism Geography	Professional Ethics
2	B. A. Geography	Gg-201(S-2)	SYBA: Fundamentals of Geographical Analysis	Professional Ethics
3	B. A. Geography	Gg-301(S-4)	TYBA: Techniques of Spatial Analysis	Professional Ethics
4	M.A /M.Sc Geography	Gg-105	F Y MA: Practical in Physical Geography (Sem-I)	Professional Ethics
5	M.A /M.Sc Geography	Gg-106	F Y MA: Practical in Human Geography	Professional Ethics
6	M.A /M.Sc Geography	Gg-223	Geography of Rural Settlement	Professional Ethics
7	M.A /M.Sc Geography	Gg-202	F Y MA: Practical in Cartography(Sem-II)	Professional Ethics
8	M.A /M.Sc Geography	Gg-203	F Y MA: Practical in Surveying and Field visit(Sem-II)	Professional Ethics
9	M.A /M.Sc Geography	Gg-204	F Y MA: Geography of Tourism(Sem-II)	Professional Ethics
10	M.A /M.Sc Geography	Gg-207	F Y MA: Practical in Terrain Analysis(Sem-II)	Professional Ethics
11	M.A /M.Sc Geography	Gg-333	S Y MA: Population & Settlement Geography (Sem-III)	Professional Ethics
12	M.A /M.Sc Geography	Gg-302	S Y MA: Interpretation of Topographical Maps & Village Survey / Project work	Professional Ethics
13	M.A /M.Sc Geography	Gg-303	S Y MA: Research Method in Geography(Sem-III)	Professional Ethics
14	M.A /M.Sc Geography	Gg-305	S Y MA: Practical in Watershed analysis(Sem-III)	Professional Ethics
15	M.A /M.Sc Geography	Gg-441	S Y MA: Principles of Regional Geography & Project work	Professional Ethics
16	M.A /M.Sc Geography	Gg-420	S Y MA: Regional Planning and Development(Sem-IV)	Professional Ethics
17.	B. A. Geography	Gg-320(S-3)	TYBA: Population and Settlement Geography	Gender
18.	M.A /M.Sc Geography	Gg.-104	FYMA: Principles of Population and Settlement Geography	Gender

19.	B. A. Geography	Gg-310(G-3)	TYBA: Regional Geography of India OR Human Geography	Human Values
20.	M.A /M.Sc Geography	Gg-321	SYMA: Political Geography	Human Values
21.	M.A /M.Sc Geography	Gg-304	SYMA: Social &Cultural Geography(Sem-III)	Human Values
22.	M.A /M.Sc Geography	Gg-404	SYMA: Geography of Food Security of India	Human Values
23.	M.A /M.Sc Geography	Gg-405	SYMA: Geography of Health	Human Values
24.	M.A /M. Sc Geography	Gg- 407	SYMA: Regional Geography of SAARC countries	Human Values
25.	B. A. Geography	Gg-110 (G-1)	FYBA: Elements of Geomorphology	Environment and Sustainability
26.	B. A. Geography	Gg-210(G-2)	SYBA: Elements of Climatology and Oceanography OR Geography of Disaster Management	Environment and Sustainability
27.	M.A /M.Sc Geography	Gg.-101	FYMA: Principles of Geomorphology(Sem-I)	Environment and Sustainability
28.	M.A /M.Sc Geography	Gg.-102	FYMA: Principles of Climatology(Sem-I)	Environment and Sustainability
29.	M.A /M.Sc Geography	Gg-213	FYMA: Population Geography(Sem-II)	Professional Ethics & Human Value
30.	M.A /M.Sc Geography	Gg-205	FYMA: Geography of Disaster Management (Sem-II)	Environment and Sustainability
31.	M.A /M.Sc Geography	Gg- 313	SYMA: Urban Geography	Environment, Professional Ethics, Human Value
32.	M.A /M.Sc Geography	Gg-103	FYMA: Prin. Of Economic Geography	Environment and Sustainability Professional Ethics
33.	F.Y.B. Com		FYBCOM: Commercial Geography	Professional Ethics

Dr. G. K. Chavhan
Head, Dept. of Geography

Dr. V. C. Thange
IQAC, Coordinator

Dr. B. S. Yadav
Principal

Gg- 220 : Tourism Geography (S-1)

Objective:-

1) To acquaint the student's basic concepts of Geography & Tourism
2) To aware the students with the utility and application of Tourism
3) To help the students & society to understand the interrelationship between tourism and employment generation opportunities.
4) To understand the impact of tourism on Physical and Human Environments.

Section-I				
No.	Unit	Sub-unit	Learning Points	Periods
1	Introduction to Tourism Geography	(A) Introduction and Definition	1.Introduction 2.Definition of Tourists and Tourism	10
		(B) Nature of Tourism Geography	1.Uniqueness 2. Diversity 3.Recreational 4. Dynamic 5.Interdisciplinary 6.Non-Productive 7.Seasonal	
		(C) Scope of Tourism Geography	1 Tourism as a Basic Need of Mankind 2 Tourism and Transportation 3 Natural environment and Tourism 4. Culture and Tourism 5. Religion and Tourism 6. Tourism Products	
		(D) Importance	1 Relation Between Geography and Tourism 2 Importance of Tourism	
2	Concepts and Classification of Tourism	(A) Concepts	1 Geo-Tourism 2 Agro- Tourism 3 Heritage Tourism 4 Adventure Tourism 5 Religious Tourism 6 Health Tourism 7 Sport Tourism 8 Disaster Tourism	15
		(B) Classification Based on a)Nationality	1. International 2. National 3. Regional 4. Local	
		b) Travel Time	1. Long Haul 2. Short Haul.	
		c)Travel Distance	1. Global 2. National 3. Regional 4. Local	

4	Basic analysis of Statistical Data	1. Population and Sample 2. Statistical Data and Frequency	1. Population, sample, Method of sampling, Characteristics of sample 2. Tally marks and frequency table. 3. Frequency distribution (histogram and polygon) 4. Cumulative Frequency and Ogive curve.	10
		SECTION II		
5	Surveying	1. Directions 2. Definition of Surveying 3. Types of Surveying 4. Measurement of Land	1. Various Methods of deciding North direction True, Magnetic and Grid North 2. Plane Table Survey. i. Radiation Method ii. Intersection methods 3. Prismatic Compass Surveying Methods: ii. Open Travers ii. Close Travers 4.GPS Survey & Plotting Finding Latitude (X), Longitude (Y) and Altitude (Z). Plotting of X and Y on graph paper 5. Dumpy Level Survey Plotting by- i. Rise and Fall Method *ii.* Collimation Plane Method 6. At least exercise involving of actual measurement of piece of a land.	40
6	Field Excursion / Village/ Urban Survey	Visit two places of geographical interest anywhere in the country.	One short tour of two days duration and Preparation of tour report. OR One long tour more than five days and preparation of tour report	20

Note : 1. Use of stencils, log tables, computer and calculator is allowed.
2. Journal should be completed and duly certified by practical in-charge and Head of the Department.
3. Int. and Ext examiner should set jointly the question paper for each batch

Reference Books :

1. Singh Lehraj, (1973) : Map Work and Practical Geography, Central Book Depot – Allahabad
2. D. Y. Ahirrao and E. K. Karanjkhele, (2002) : Pratyakshik Bhugol, Sudarshan – Nashik
3. P. G. Saptarshi and S. R. Jog, Statistical Methods
4. S. N. Karlekar, (2008) : Statistical Methods, Diamond – Pune
5. T. P. Kanetkar and S. V. Kulkarni, (1986) : Surveying and Leveling, Pune Vidyrthi Griha Prakashan – Pune
6. Arjun Kumbhare, Practical Geography
7. Pijushkanti Saha & Partha Basu. (2007), 'Advanced Practical Geography', Books and Allied (P) Ltd, Kolkata

Savitribai Phule Pune University, Pune

T.Y.B.A

Gg. 301: Techniques of Spatial Analysis (S-4)

Effective from-June-2015

Workload: Six periods per week per batch (12 students for per Batch)
(Examination for the course will be conducted at the end of academic year).

Objectives:

1. To Introduce the Students with SOI Toposheets and to acquire the Knowledge of Toposheet Reading/Interpretation.
2. To familiarize the students with the weather instruments and their applications in Geographical phenomena.
3. To acquaint the students with IMD weather maps and to gain the knowledge of weather map Reading / interpretation.
4. To train the students in elementary statistics as an essential part of geography.
5. To awareness about GIS among the students.

Section - I

nit).	Topic	Learning Points	Periods
1	Toposheets	a. Introduction to Survey of India (SOI) toposheets, Marginal Information, Grid reference, Conventional signs and symbols b. Types of toposheet/Indexing of toposheets i. 1: 1000000/Million sheet ii. 1:250000/Degree sheet/Quarter inch sheet iii. 1:100000/Half inch sheet iv. 1:50000/One inch sheet v. 1:25000 vi. 1: 5000	15
2.	Methods of Relief Representation	1. Methods of Relief Representation a. Qualitative :- Hachures, Hill shading, Layer Tint b. Quantitative:- Contours, Form lines, Bench Marks, Spot Heights, Triangulation Mark, Relative Height (r) 2. Representation of Relief features by Contours a. Concave Slope, Convex Slope, Steep Slope, Gentle Slope, Terraced / Uniform b. Conical Hill, Spur, Plateau, Ridge, Saddle, Pass, Cliff & Waterfall 3. Profile a. Drawing and Description of Cross Profile of any Region from toposheet b. Drawing and Description of Longitudinal Profile of a Road or a River	15
3.	Toposheet Reading, Interpretation & data generation	1. Reading of at least three SOI toposheets one each for Plain, Plateau and Mountainous/hilly Region 2. One day field Excursion for Orientation of toposheet, Observation and Identification of Geographical Features and Preparation of a Brief Report	15

Savitribai Phule, Pune University, Pune
T.Y.B.A
Gg-320: Population and Settlement Geography (S-3)
Effective from-June-2015

Objective:-

1. To provide an understanding of spatial and structural dimensions of population
2. To familiarizing the students with global and regional level problems.
3. To acquaint the students with the spatial, political and structural characteristics of human settlement under varied environmental conditions.

Section-A. Population Geography

nit	Topic	Sub Topic	Learning Points	Periods
1	Introduction	Nature and Scope	Definitions, Nature and Scope of Population Geography	10
		Source of Population Data	Census, National Sample Survey, Sample Registration Survey, NFHS, DLHS Data, Demographic Surveys and other Sources	
2	Population Dynamics	Spatial Pattern of Distribution	1) Determinates of Distribution and Density of Population 2) Distribution of Population – World & Indian Scenario 3) Population Growth- Global & Indian Trend	10
		Composition of Population	Population Composition: Age and Sex, Rural-Urban &Economic	
3	Demographic Attributes	Human Migration	1. Migration-Classification, Determinants and Consequences of Migration. 2.Measures – Fertility, Morbidity and Mortality, Marital Status 3.Human Development Index 4. Illegal Migrations and its Impacts Migration and its Impacts on Smarts Cities and Smart Villages	14
		Theories of Population Growth	1) Demographic Transition Model [DTM] 2) Malthus: Population Theory	
4	Population Policies	Population Policies and Programmes	1.Population Policies in the Context of Growth, Structure, Distribution &Quality Life 2. Evolution of Family Welfare Programme in India 3.National Population Policies in India [After 1991]	11

Section-B- Settlement Geography

5	Introduction of Settlement Geography	Definition, Nature and Scope	Definition, Nature and Scope of Settlement Geography	12
		Characteristics	1) Characteristics of Settlement Geography 2) Branches of Settlement Geography	
6	Man-Environment Relationship	Factors Influencing the Growth and Distribution of Settlements.	1. Physical 2. Economic 3. Social 4. Political	10
7	Settlement	Site and Structure	Site, Situation, Type, Size, Spacing and Patterns	12

5. Concepts related to Settlement	1. Various Concepts 2. Settlement Theory	1. Nodality 2. Centrality 3. Range 4. Threshold & Hierarchy 5. Rank-size distribution		08
6. Concentration of Population and Levels of Urbanization	1. Urbanization 2. Factors of Urban Growth	1. Christaller and Losch's Model	Concept of Urbanization 1.Improvement in transportation & Communication. 2.Changes in Industrial Production. 3.Industrialization 4.Food supply and Public hygiene	08
7. Population Distribution	Factors influencing the Distribution of Population	1. Physical 2. Economic 3. Social 4. Political		08
8. Theories of Population Growth	1. Thomas Malthus 2. Ricardo 3. Demographic Transition Model	1. Concept 2. Scope 3. Applications 4. Relevance		08
9. Population as a resource	Various aspects of population	1. Size 2. Growth 3. Age 4. Education		06

Savitribai Phule Pune University, Pune
T.Y.B.A
Gg.: 310 Regional Geography of India (G-3)
June 2015

Objective : -

1. To acquaint the students with geography of our Nation.
2. To make the student aware of the magnitude of problems and Prospects at National level.
3. To help the students to understand the inter relationship between the subject and the society.
4. To help the students to understand the recent trends in regional studies.

SECTION - I

Sr. No.	Topic	Sup Topic	Learning Points	Periods
1	Introduction	Location , Extent and Geopolitical Significance	1.Historical Background 2.Location and Extent 3.Relationship with Neighboring Countries 4.Geopolitical Importance of Indian Ocean.	10
2	Physiography	Major Physiographic Regions and their Importance	1. The Northern Mountains 2.The North Indian Plains 3.The Peninsular Plateau 4.The Costal low lands 5.The Islands	12
3	Drainage	Drainage System of India The Himalayan River System The Peninsular River System	1.The Indus , The Ganga , The Brahmaputra 2.East Flowing Rivers- Mahanadi, Godavari, Krishna, Kaveri. 3.West Flowing Rivers- Narmada, Tapi, Mahi 4.Rivers of the Sahyadri - Amba & Damanganga	12
4	Climate	Characteristics , Origin and Mechanism of Monsoon, Various Seasons	1. Characteristics of Indian Climate 2.Role of Various Controlling Factors on Climate of India 3.Monsoon: Origin and Mechanism 4.Various Seasons and Weather Associated with them	11
			SECTION – II	
5	Soils and Natural Vegetation	Types and Distribution	Types of Soils and its Distribution Soil Degradation and Conservation Types of Natural Vegetation and its Distribution	12

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

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
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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.

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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.
3. Eames, J. and Mc. Daniels (1994). An Introduction to Plant Anatomy. Tata McGraw Hill Publishing Comp., New Delhi.
4. Esau, K. (1993). Plant Anatomy. Wiley Eastern Ltd. New Delhi.
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16. Sutaria, R.N.A. Text Book of Systematic Botany.
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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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2. Chamberlain, C.J. (1934). Gymnosperms- Structure and Evolution. Chicago.
3. Coulter, J.M. and Chamberlain, C.J. (1917). Morphology of Gymnosperms. Chicago.
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5. Dutta, S.C. (1988). Systematic Botany. Wiley Eastern Ltd., New Delhi.
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8. Naik, V.N. (1994). Taxonomy of Angiosperms. Tata McGraw Hill Publishing Comp., New Delhi.
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10. Rashid, A. (1999). An Introduction to Pteridophyta. Vikas Publishing House Pvt. Ltd. New Delhi.
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

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. Cooper, G.M. and Hausman, R.E. (2007). The Cell: Molecular Approach 4th Edition, Sinauer Associates, USA.
3. David, Nelson and Cox, Michael (2007). Lehninger Principles of Biochemistry. W.H. Freeman and Company. New York.
4. Devlin, R.M. (1983). Fundamentals of Plant Physiology. Mc. Millan, New York.
5. Dutta, A.C. (2000). A Class Book of Botany. Oxford University Press, UK.
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7. Lewin, Benjamin (2011). Genes. X Jones and Bartlett.
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10. Pal, J.K. and Ghaskadbi, Saroj (2009). Fundamentals of Molecular Biology. Oxford University Press. India.
11. Pandey, S.N. and Sinha, B.K. (2014). Plant Physiology. Vikas Publishing House Pvt. Ltd., India.
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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:

1. Plant Anatomy, Chandurkar P J, Plant Anatomy Oxford and IBH publication Co. New Delhi 1971
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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

	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:

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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 :

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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.
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8. Watson, J. D. (2008). *Molecular Biology of the Gene* (5th ed.). Menlo Park, CA: Benjamin/Cummings.
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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.

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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
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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
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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
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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.
3. Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter (1999). Molecular Biology of the Cell.Garland Publishing, Inc., New York.
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.
6. Kleinsmith L.J and Kish V.M (1995).Principles of Cell and Molecular Biology (Second Edition).Happer Collins College Publishers, New York, USA.
7. Lodish H., Berk A., Zipursky, S.L Matsudaira P., Baltimore D. and Darnell J. (2000). Molecular Cell Biology (Fourth Edition). W.H. Freeman and Company, New USA.

8. David Freifelder (1996). Essentials of Molecular Biology, Panima Publishing Company, New Delhi.
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.
4. Moore T. C. (1989), Biochemistry and Physiology of Plant Hormones, Springer – Verlag, New York, USA.
5. Nobel P. S.(1998), Physiochemical and Environmental Plant Physiology (Second Edition), Academic Press, San Diego, USA.
6. Salisbury F.B. and Ross C. W. (1992), Plant Physiology (Fourth Edition), Wadsworth Publishing Company, California, USA.
7. Singhal G. S., Renger G., Sopory S.K., Irrgang K.D. and Govindjee (1999), Concept in Photobiology; Photosynthesis and Photomorphogenesis, Narosa Publishing House, New Delhi.
8. Taiz L. and Zeiger E. (2010), Plant Physiology (Fourth Edition), Sinauer Associates Inc. Publishers, Massachusetts, USA.
9. Thomas B. and Vince – Preu D. (1997), Photoperiodism in Plants (Second Edition), Academic Press, San Diego, USA.
10. Verma S. K. and VermaMohit (2007), A Textbook of Plant Physiology, Biochemistry and Biotechnology, S Chand Publications.
11. Lehninger A. L. (1987), Principles of Biochemistry, CBS Publishers and Distributors (Indian Reprint).
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

तृतीय वर्ष कला (T.Y.B.A)

मराठी (सामान्यस्तर पेपर —३)

प्रथम सत्र

एकूण तासिका— ४८ एकूण गुण — ६०

घटक अ — ग्रंथ परीक्षण

गुण — १५
तासिका — १२

- ग्रंथ परीक्षणाचे स्वरूप स्पष्ट करून ग्रंथ परीक्षणाच्या घटकांचे विवेचन करणे.
- विविध साहित्यप्रकारातील साहित्यकृतींचे परीक्षण कसे करावे ते विद्यार्थ्यांना समजावून सांगणे.
- ग्रंथ परीक्षणांच्या तात्त्विक विवेचनासाठी एकूण ८ गुण असतील तर प्रत्यक्ष साहित्यकृतीच्या परीक्षणासाठी एकूण ७ गुण असतील.

सूचना :—

१. विविध साहित्यप्रकारांतील पुस्तकांचे परीक्षण कसे करावे, यासंबधी सप्रमाण विवेचन वर्गात केले जावे अशी अपेक्षा आहे.

२. विद्यार्थ्यांनी पदवी पर्यंतच्या विद्यापीठीय अभ्यासक्रमात समाविष्ट असलेल्या साहित्यकृतीं व्यतिरिक्त पुस्तकाचे परीक्षण करावे.

घटक ब — निबंध : तात्त्विक विवेचन

गुण — १५
तासिका — १२

- निबंध या साहित्यप्रकाराचे स्वरूप व व्याख्या
- मराठीतील इतर साहित्यप्रकारांच्या तुलनेत निबंधाचे वेगळेपण
- निबंधाचे प्रकार
- निबंध या साहित्यप्रकारामागील प्रेरणा व प्रयोजने

घटक क — निबंधसंग्रह

गुण — ३०
तासिका — २४

'विचारधारा' — संपा— डॉ. स्नेहल तावरे
डॉ. भास्कर शेळके

तृतीय वर्ष कला (T.Y.B.A)

मराठी (सामान्यस्तर पेपर — ३)

द्वितीय सत्र

एकूण तासिका— ४८

घटक अ — प्रवासवर्णन : तात्त्विक विवेचन

गुण — १५
तासिका — १२

- प्रवासवर्णन या साहित्यप्रकाराचे स्वरूप व व्याख्या
- इतर साहित्यप्रकारांच्या तुलनेत प्रवासवर्णनाचे वेगळेपण
- प्रवासवर्णन या साहित्य प्रकारामागील प्रेरणा व प्रयोजने

घटक ब — प्रवासवर्णन साहित्यप्रकाराची वैशिष्टये, व्याप्ती आणि वाटचाल

गुण — १५
तासिका — १२

घटक क — प्रवासवर्णनसंग्रह

गुण — ३०
तासिका — २४

'देशविदेश' — संपा— डॉ. स्नेहल तावरे
डॉ. अशोक शिंदे
डॉ. अरुण कोळेकर

तृतीय वर्ष कला (T.Y.B.A.)
मराठी (विशेषान्तर पेपर - ३) (S-३)
पुनर्रचित अभ्यासक्रम अमलात
२०१५-१६ पासून

साहित्यविचार S-३

प्रथम सत्र

एकूण तासिका— ४८

१. साहित्याचे स्वरूप:—

१) शास्त्रीय साहित्य आणि ललित साहित्य यांमधील भेद

२) साहित्याचे शब्दरूप

३) साहित्यातून व्यक्त होणाऱ्या अनुभवांचे विशेष — वास्तव आणि कल्पित यांचा संबंध, संवेदनात्मकता — भावनात्मकता — वैचारिकता, सेंद्रियत्व, सूचकता, विशिष्ट आणि विश्वात्मकता.

२. साहित्याचे प्रयोजन:—

१) प्रयोजन म्हणजे काय?

२) प्रयोजन आणि परिणाम यांमधील भेद.

३) साहित्याची प्रयोजने —

अ) मम्मटाची प्रयोजने

ब)पाश्चात्यांचीप्रयोजने:— इच्छापूर्ती — जिज्ञासातृप्ती — विरेचन — आत्माविष्कार अनुभवविश्वाची समृद्धी — स्वप्नरंजन—उद्‌बोधन—प्रचार—मनोरंजन—आनंद.

४) या प्रयोजनांचा लेखक व वाचक तसेच कलावादी, जीवनवादी या दृष्टीने विचार.

३. साहित्याची निर्मितीप्रक्रिया:—

१) साहित्याच्या निर्मितीचे स्वरूप

२) साहित्यनिर्मितीच्या शक्ती—१) प्रतिभा २) कल्पनाशक्ती ३) स्फूर्ती

३) प्रतिभाव्यापार व स्वप्नव्यापार

४) साहित्याची निर्मिती प्रक्रिया आणि साहित्यिकाचे व्यक्तिमत्त्व — १) संवेदनक्षमता

२) शैशववृत्ती ३) अनुभव समृद्धी ४) विद्वत्ता ५)लेखकाचा जीवनविषयक दृष्टिकोण. ६) लेखकाचा साहित्यविषयक दृष्टिकोण.

४. साहित्याची भाषा:—

१) व्यवहारभाषा, शास्त्रीय साहित्याची भाषा व साहित्याची भाषा यांच्यातील भेद.

२) शब्दार्थांचा वक्रव्यापार

३) भाषेचे नादरूप

४) अलंकार

५) रूपक

६) प्रतिमा

७) प्रतीक

८) प्राक्कथा

९) शैली विचार — १) लेखक तशी शैली २) आशय तशी शैली ३) साहित्यप्रकार तशी शैली.

द्वितीय सत्र

एकूण तासिका— ४८

५. साहित्याचा आस्वाद:—

१) आस्वाद म्हणजे काय ?

२) आस्वाद प्रक्रिया

३) आस्वादकाला आवश्यक असणारे गुण

४) आस्वादातील अडथळे

६. साहित्याची सामाजिकता:—

१) साहित्य आणि समाज यांचे परस्परसंबंध

२) लेखकाची सामाजिकता

३) भाषेची सामाजिकता

४) कलात्मक अनुभवातील सामाजिकता

५) वाचकाची सामाजिकता

६) साहित्यातील सामाजिकतेला वैश्विक रूप प्राप्त होते काय?

७) बांधीलकीची संकल्पना व साहित्यिकाची बांधीलकी.

७. साहित्यिक अभिरुची

१) अभिरुची म्हणजे काय?

२) अभिरुची आणि सौदर्यदृष्टी.

३) अभिरुची आणि औचित्य.

४) अभिरुची भिन्नतेची कारणे.

५) अभिरुची नियत करणारे घटक — सांस्कृतिक पर्यावरण, आर्थिक पर्यावरण, वाङ्मयीन पर्यावरण.

८. साहित्यप्रकाराची संकल्पना:—

१) साहित्याच्या वर्गीकरणाची शक्याशक्यता

२) साहित्याच्या वर्गीकरणाची आवश्यकता

३) साहित्याच्या वर्गीकरणाची तत्त्वे— माध्यमभिन्नता, प्रस्तुतीकरणाची पद्धती, प्रस्तुतीकर्त्यांचा दृष्टिकोण व प्रस्तुतीकरणाचा काळ

४) साहित्याचे ठळक प्रकार — कथा, कादंबरी, काव्य, नाटक.

संदर्भ साहित्य

१) साहित्यविचार — डॉ. अ. वा कुलकर्णी

२) साहित्यविचार (संपा.) डॉ. द.दि.पुंडे, डॉ.स्नेहल तावरे

३) काव्यशास्त्र प्रदीप — डॉ. स.रा.गाडगीळ

४) वाङ्मयीन शैली आणि तंत्र — म.द.हातकणंगलेकर,

५) साहित्यविचार — भालचंद्र खांडेकर

तृतीय वर्ष कला (T.Y.B.A)

मराठी (विशेषस्तर पेपर —४)

भाषाविज्ञान — S_4

पुनर्रचित अभ्यासक्रम आराखडा

सन २०१५—२०१६ पासून

भाषाविज्ञान— वर्णनात्मक आणि ऐतिहासिक

❖ **अभ्यासक्रमाची उद्दिष्टये:—**

१) भाषेचे स्वरूप व कार्य, भाषेच्या अभ्यासाचे महत्त्व, भाषेच्या अभ्यासाची प्रमुख अंगे जाणून घेणे.

२) भाषा म्हणजे काय व तिचे मानवी जीवनातील कार्य व महत्त्व जाणून घेणे.

३) वेगवेगळ्या भाषाअभ्यासपद्धतींचे वेगळेपण व महत्त्व जाणून घेणे.

४) स्वननिर्मितीची प्रक्रिया समजावून घेणे.

५) वागिंद्रियांची रचना व कार्ये समजावून घेणे.

६) स्वनविज्ञान, स्वनिम संकल्पना आणि मराठीची स्वनिम व्यवस्था जाणून घेणे.

७) मराठीची रूपिमव्यवस्था समजावून घेणे.

८) वाक्यविन्यास व अर्थविन्यास या भाषावैज्ञानिक संकल्पनांचा मराठीच्या संदर्भात स्थूल परिचय.

९) ऐतिहासिक भाषाभ्यासपद्धतीचे स्वरूप व महत्त्व लक्षात घेणे.

१०) भाषाकुलाची संकल्पना जाणून घेवून मराठी भाषेच्या उत्पत्तीचा अभ्यास करणे.

११) मराठी भाषेचा उत्पत्तीकाळ जाणून घेवून तत्कालीन भाषिक स्थित्यंतरांचा आढावा घेणे.

१२) टप्याटप्याने भाषा म्हणून मराठीच्या वाटचालीचा ऐतिहासिक आढावा घेणे.

प्रथम सत्र

एकूण तासिका– ४८

१. **भाषेचे स्वरूप व कार्य :–**भाषा एक सहज क्रिया – भाषा : एक अर्जित वस्तू – संज्ञापन : भाषेचे मुख्य कार्य – संकेत : भाषेचा आधार – शारीरिक आणि मानसिक क्रियांचा संयोग – ध्वनिसंकेत : चिन्ह आणि चिन्हित – संज्ञापनाची अन्य साधने: शरीरस्थित – संज्ञापनाची साधने: शरीरबाहय – भाषा हे सर्वश्रेष्ठ संज्ञापन साधन – संज्ञापनातील क्रिया प्रतिक्रिया – मानवेतर प्राण्यांची भाषा – भाषा : एक सामाजिक संस्था – भाषा आणि व्यक्तिस्वातंत्र्य – भाषेच्या अभ्यासाची आवश्यकता. भाषाअभ्यासाची अंगे, भाषाभ्यास पद्धती –वर्णनात्मक भाषाभ्यासपद्धती, **ऐतिहासिक** भाषाभ्यासपद्धती, तौलनिक भाषाभ्यासपद्धती, समाजभाषाभ्यासपद्धती.

२. **स्वनविज्ञान आणि स्वननिर्मिती :–** वागिंद्रियाची रचना व कार्ये स्वनविज्ञानाचे स्वरूप–स्वन निर्माण करणारी इंद्रिये–जिभेचे महत्त्व–स्वननिर्मितीची प्रक्रिया–मुखमार्ग, नासिकामार्ग आणि पडजीभ– दात आणि ओठ यांचे कार्य–तालुपटाची रचना व कार्य–स्वरांचे स्वरूप, लक्षणे व प्रकार–व्यंजनांचे स्वरूप लक्षणे व प्रकार–स्वरांच्या वर्गीकरणाची तत्त्वे– स्वननिर्मितीमधील 'प्रयत्ना'चे स्वरूप.

३. **स्वनिम विचार :–** स्वनिम निश्चितीचे तत्त्वे, विनियोग संकल्पनेचा स्थूल परिचय, स्वन, स्वनिम व स्वनांतर यामधील परस्परसंबंध, मराठी स्वनिमव्यवस्थेची रूपरेषा, स्वरस्वनिम, अर्धस्वरस्वनिम, व्यंजनस्वनिम यांचे वर्गीकरण.

४. **रूपिम विचार :–** रूपिमचे तत्त्व, रूपिका–रूपिम आणि रूपिकांतर यांमधील परस्परसंबंध, रूपिकांचे प्रकार प्रकृति (धातू) आणि प्रत्यय यांचे वर्गीकरण (आशयबोधक रूपिम व कार्यकारी रूपिम)

द्वितीय सत्र

एकूण तासिका— ४८

५. **वाक्य**विचार — वाक्यविन्यास संकल्पना आणि मराठीतील वाक्यविन्यास व्यवस्था, वाक्याचे घटक

६. **अर्थविचार** — अर्थविन्यास व मराठीतील त्याचे स्वरूप, अर्थ ही संकल्पना, अर्थाचे विविध प्रकार

७. **ऐतिहासिक भाषाभ्यासपध्दती** — सर विल्यम जोन्स यांचा सिद्धांत — ऐतिहासिक भाषाविज्ञानाचे स्वरूप — कार्य, **भाषाकुलाची संकल्पना** — भाषांचे वर्गीकरण — जगातील प्रमुख भाषाकुले — इंडो युरोपियन भाषाकुल — आर्य भाषाकुल व मराठी भाषा — होर्न्ले यांचा अंतर् बहिर् वर्तुळ सिध्दांत.

८. **मराठी भाषेची उत्पत्ती** :— मराठी भाषेची उत्पत्ती व त्यासंबंधीची साधने — मराठी भाषेच्या उत्पत्ती संबंधी विविध सिध्दांत — वैद्य—गुणे वाद, मराठीचे कालिक भेद

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

दुसरे सत्र

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

द्वितीय वर्ष कला (S. Y. B. A.)

कौशल्याधिष्ठित अभ्यासक्रम

पहिले सत्र

विषयाचे नाव

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

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.

Proposed Syllabus from 2015-2016 in Botany
T. Y. B. Sc. Semester III
Paper- I: BO : 331 Cryptogamic Botany
(Algae, Fungi, Bryophytes and Pteridophytes)

1. Introduction: Cryptogams- meaning. Types- Lower Cryptogams and Higher Cryptogams, brief review with examples. **02L.**

Algae: **(11L)**

2. Algae: General characters, economic importance and Classification (Chapman and Chapman, 1973) up to classes. **03L.**

3. Study of life cycle of algae with reference to taxonomic position, occurrence, thallus structure, and reproduction of *Nostoc, Chara, Sargassum* and *Batrachospermum*. **08 L.**

Fungi:

(11L)

4. Fungi: General characters, economic importance and Classification. (Alexopoulos, 1979) up to classes.

5. Study of life cycle of fungi with reference to taxonomic position, thallus structure, and reproduction of *Rhizopus, Saccharomyces, Puccinia* and *Cercospora*. **03L.**

Bryophytes: **08 L.**

6. Bryophytes: General characters, economic importance and Classification. (G.M. Smith, 1955) up to classes. **(12L)**

03L.

7. Study of life cycle of Bryophytes with reference to taxonomic position, thallus structure (Morphology and anatomy), reproduction and sporophyte structure of *Marchantia, Anthoceros* and *Polytrichum*. **09 L.**

Pteridophytes:

8. Pteridophytes: General characters and economic importance and Classification. (K.R. Sporne, 1975) up to classes. **(12L)**

9. Study of life cycle of Pteridophytes with reference to taxonomic position, Morphology, anatomy, reproduction, gametophytes and sporophyte of *Psilotum, Selaginella* and *Marsilea*. **03L**

(Development of sex organs and sporophyte is not expected.) **09 L.**

Reference Books :

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. **Vashishta B.R. et al.,** Botany for degree students- Fungi
5. **Sharma, P.D.**-The Fungi
6. **Sharma, O.P.**-Fungi
7. **Chopra G.L. and Yadav D.L.** A Text book of Bryophytes.
8. **Parihar, N.S.** An introduction to Embryophyta: Bryophyte-I
9. **Puri Prem.** Brayophytes, Atmaram and Sons. Delhi.
10. **Vashishta B.R.** Botany for degree students Bryophytes- Vol-III
11. **Parihar N.S.** 1991. Bryophyta. Central Book Depot, Allahabad.
12. **Puri P.** 1980. Bryophytes. Atma Ram and Sons, Delhi.
13. **Alexopoulus C.J , Mims C.W. and Blacwel M.I** 1996. Introductory Mycology. John Wiley and Sons Inc.
14. **Kumar H.D.** 1988. Introductory Phycology. Affiliated East-West Press Ltd., New Delhi.
15. **Sporne K.R.** 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.

Practicals - 06

(Finalize the practicals after discussion in workshop).

1. Study of **Algae** with respect to systematic position thallus structure and reproduction of *Nosotc, Chara, Sargassum and Batrachospermum.*
2. Study of **Fungi** respect to systematic position thallus structure and reproduction of *Rhizopus, Saccharomyces* and *Puccinia.*
3. Study of **Bryophytes** with respect to systematic position thallus structure and reproduction of of *Marchantia, Anthoceros and Polytrichum.*
4. Study of **Pteridophytes** with respect to systematic position, sporophyte - morphology and anatomy, reproductive structures of *Psilotum, Selaginella* and *Marsilea.*
5. Excursion tour.

Paper II: BO.332: CELL AND MOLECULAR BIOLOGY

Chapter 1 Cell Biology: An Introduction **2L**

1. Definition and brief history
2. Units of measurement of cell
3. Prokaryotic and Eukaryotic Cell
4. Cell biology and other Biological Sciences

Chapter 2 Cytoplasmic Matrix **2L**

1. Physical nature of cytoplasmic matrix
2. Chemical organisation- organic and inorganic compounds of cytoplasmic matrix

Chapter 3 Plant Cell- Cytoplasmic Constituents

15L

Morphology, Ultrastructure, Chemical composition, Functions of Cell wall, Plasma membrane, Endoplasmic Reticulum, Golgi apparatus, Lysosomes, Microbodies, Mitochondria, Plastids, Vacuoles, Ribosomes

Chapter 4 Plant Cell- Nucleus and Chromosomes

5L

Nucleus- Morphology, Ultrastructure, Nucleoplasm, Nucleolus, Functions

Chromosome- Number, Morphology, Structure, Karyotype and ideogram, Chemical composition, Euchromatin and Heterochromatin, Giant chromosomes

Chapter 5 Molecular Biology

1L

Definition, History, Scope and Importance, Central Dogma of Molecular Biology

Chapter 6 Nature of Genetic Material

5L

Characteristics of genetic material, Physical and Biological evidences to prove DNA as genetic material, Chargoff's Law, Franklin and Wilkion's Work, Watson and Cricks Model of DNA, Forms of DNA- A, B and Z, C-Value Parodox, RNA as genetic material-TMV

Chapter 7 DNA Replication

3L

Introduction and types, Messelson and Stahl's Experiment, Molecular mechanism of DNA replication

Chapter 8 DNA Damage and Repair

2L

Introduction, Causes and types, DNA repair system- Photoreactivation, Dark excision repair,

Chapter 9 Gene Organization

3L

Promoter-structure and function in prokaryotes and eukaryotes, Terminators, Units of Gene, Enhancers, Split genes, jumping genes

Chapter 10 Transcription

3L

Structure and role of m-RNA, r-RNA, t-RNA, Transcription apparatus, Mechanism of Transcription in Prokaryotes,

Chapter 11 Genetic Code and Translation

4L

Genetic Code- Definition, Concept, Work of Nirenburg and Khorana, Properties of Genetic code, Translation- Definition, Mechanism of translation- Initiation, Elongation and Termination

Chapter 12 Gene Action and Regulation

3L

Relation of Gene and Enzymes- One gene one enzyme hypothesis, regulation of metabolism, Inducible and Repressible enzymes, Gene regulation- in prokaryotes (Lac Operon Model) and eukaryotes (Britten and Davidson's Model)

Practicals:

1. Cytological techniques-preparation of Fixatives, preparation of stains (Aceto-carmine and Aceto-orcein).
2. Study of various stages of mitosis and meiosis
3. Study of Chromosomes Morphology (from colchicines pretreated Onion root tip cells)
4. Maceration technique for study of plant tissues
5. Study of polytene chromosome from Chironomus larvae
6. Plant Genomic DNA extraction from Cauliflower
7. Estimation of Plant DNA by DPA Method
8. Extraction and estimation of RNA by Orcinol Method

References:

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.

Paper III: BO: 333: Genetics and Evolution

1. **Genetics- Introduction**

Definition, Concept of heredity and variations, Branches and Applications of Genetics **1L**

2. **Mendelism**

Genetical terminology, Selection of experimental material , Monohybrid cross, Law of dominance, Incomplete dominance, Law of segregation/law of purity of gametes, Dihybrid cross, Law of independent assortment, Back cross and Test cross **4L**

3. **Interactions of genes**

Non-epistatic genetic interactions- complementary genes (9:7), Duplicate Genes (15:1), Epistatic genetic interactions- Masking genes (12:3:1), Supplementary genes (Recessive epistasis) (9:3:4), Inhibitory genes(13:3), Lethal genes (2:1)-Concept, Inheritance of coat colour in mice, Inheritance of sickle cell anemia **6L**

4. **Multiple alleles**

Definition, Concept, Characters of multiple alleles, Examples of multiple alleles – inheritance of blood group in human, self-incompatibility in **Nicotiana and** eye colour in **Drosophila** **2L**

5. **Linkage 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 **4L**

6. **Quantitative and Cytoplasmic Inheritance**

Concept of quantitative inheritance, Difference between qualitative and quantitative traits, 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 **5L**

7. **Sex linked inheritance**

Concept of Sex chromosomes and autosomes, Inheritance of X- linked genes - eye colour in **Drosophila**, Inheritance of colour blindness in humans, Inheritance of Y-linked genes - Holandric genes in humans, Sex influenced genes – baldness in humans Sex-limited genes - feathering in domestic fowl **5L**

8. **Euploidy and Aneuploidy**

Numerical changes in chromosomes- Euploidy and Aneuploidy, Euploidy- Monoploidy, Origin and production, morphology and uses. Polyploidy -Concept and Characteristics of polyploids, Autopolyploidy- Origin and production, effects of autopolyploidy, uses. Allopolyploidy- Concept, synthesized allopolyploidy (wheat and cotton) Evolutionary significance of polyploidy –Aneuploidy, Monosomy and nullisomy- origin and cytology, Trisomy in **Datura** and humans **5L**

9. **Chromosomal Abberations**

Types of structural changes in chromosomes, Deletion: types, cytology and genetic effects, Duplication: types and cytology, position effect and bar eye phenotype in **Drosophila**, Inversion: types and their cytology, Translocation: types, translocation complexes, Variation in chromosome morphology: Isochromosomes, ring chromosomes and Robertsonian translocation

10. **Evolution – Introduction and Theories of Evolution** **4L**

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

11. Evidences of Evolution **3L**

Direct evidences and conclusions from fossil records, Indirect evidences, Evidences from Genetics, Evidences from bio-geographical relations

12. Population Genetics and Evolution **5L**

Concept of Mendelian population, Gene pool and its models, Hardy-Weinberg law of gene frequencies, Factors affecting allelic frequency, Genetic polymorphism

Practicals based on Genetics

1. Study of structural heterozygotes (multiple translocations) in **Rhoeo** 1P
2. Induction of tetraploidy in onion root cells and preparation of squash for observation of tetraploid cells 1P
3. Preparation of salivary gland chromosomes in **Chironomous** larvae 1P
4. Estimation of frequency of PTC taste sensitivity, earlobe and rolling tongue in known population 1P
5. Genetic problems on gene mapping using three point test cross data 1P

Paper IV: BO.334: SPERMATOPHYTA AND PALAEOBOTANY)

GYMNOSPERMS: (12L)

1. Introduction, general characters, economic importance and classification according to Chamberlain (1934). **(2L)**
2. Study of life cycle of *Pinus* and *Gnetum* with reference to distribution, morphology, anatomy, reproduction, gametophyte, sporophyte, seed structure and alternation of generations. **(10 L)**

(Developmental stages of sex organs are not expected)

ANGIOSPERMS (24L)

1) Origin of angiosperms:

Origin with reference to time, place and ancestry-

1) Pteridosperms theory 2) Bennettitalean theory 3) Gnetalean theory **(3 L)**

2. Classification

Review of artificial, natural and phylogenetic systems (general account), **(4 L)** Hutchinson systems with reference to outline and assumptions, merits and limitations, Advanced Phylogenetic Group system-III (APG-III).

3) Study of following families according to Bentham and Hooker's System: (14 L)

With reference to systematic position, distinguishing characters, economic importance, general floral formula, floral diagram of following families: Magnoliaceae, Capparidaceae, Rhamnaceae, Leguminosae (Fabaceae), Asteraceae, Acanthaceae, Apocynaceae, Lamiaceae, Nyctaginaceae, Orchidaceae and Cannaceae

4) Plant identification **(3 L)**

Latin diagnosis and recent trends, use of flora, Practicing indented and bracketed keys, Preparation of artificial keys, Plant authentication.

PALAEOBOTANY : (12 L)

1. Geological time scale, Form genera concept. **(1L)**
2. **Fossil-** Definition, process of fossil formation, types of fossils.-Impression, Compression, Petrifaction, Pith cast and Coal ball. **(3L)**
3. **Study of following fossil groups.** **(08 L)**

a) **Psilopsida-** Salient features of order Psilophytales, external and internal morphology of *Rhynia*.

b) **Lycopsida-** Salient features of order Lepidodendrales, external and internal morphology of *Lepidodendron*,

c) **Sphenopsida-** Salient features of Calamitales, external and internal morphology of *Calamites*

d) **Pteridosperms-** External and internal morphology of *Lyginopteris oldhamia*.

e) **Pentoxylae-** Salient feature, external and internal morphology of stem [*Pentoxylon*], Leaf [*Nipaniophyllum*].

References:-

1. **Sporne K.R.** 1991. The Morphology of Pteridophytes. B.I Publishing Pvt. Ltd. Bombay.
2. **Stewart W.N. and Rathwell** G.W. 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
3. **Bhatnagar S.P and Moitra Alok** 1996. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi, 470 pp.
4. **Biswas C and Johari B.M** 2004. The Gymnosperms Narosa Publishing House, New Delhi. 497 pp.
5. **Sporne K.R** 1965. The Morphology of Gymnosperms London, pp. 216.
6. **Bierhorst D.W.** 1971. Morphology of Vascular Plants. New York and London.
7. **Chamberlain C.J** 1934. Gymnosperms-Structure and Evolution, Chicago.
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9. **Foster A.S and Gifford E.M** 1959. Comparative Morphology of Vascular Plants. San Francisco.
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12. **Bor N.L** 1943. Manual of Indian Forest Botany. London.
13. **Vashishta P.C., A.R. Sinha, Anil Kumar.** 2006. Gymnosperms. S.Chand.
14. **Vashishta P.C.** 2006. Pteridophytes. S. Chand.
15. **Parihar N.S.** 1996. Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
16. **Arnold C.R.**-An Introduction to Palaeobotany
17. **E.H.N.Andrews**-Studies in Palaeobotany (Botany for Degree Students Vol.-V)
18. **Shukla A.C.** and **Mishra S.P.**- Essentials of Palaeobotany.

19. **Stewart W.N. and Rathwell G.W.** 1993. Paleobotany and the Evolution of plants. Cambridge University Press.
20. **Cronquist, A.** 1968. The Evolution and Classification of Flowering Plants. Thomas Nel and Sons, Ltd. London.
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22. **Heywood V.H** 1967. Plant Taxonomy, London.
23. **Lawrence, G.H.M** 1951. Taxonomy of Vascular Plants.
24. **Lawrence G. H. M** 1955. An Introduction to Plant Taxonomy
25. **Rendle A.B.** 1925. The Classification of flowering plants. 2 Vols. London.
26. **Santapau H.** 1953. The Flora of Khandala on the Western Ghats of India.
27. **Singh V. and D.K Jain,** 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
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29. **Takhtajan A.** 1969. Flowering Plants; Origin and Disposal.
30. **Pande B.P** 1997. Taxonomy of Angiosperms. S.Chand.
31. **Gurucharan Singh 2005-** Plant systematics
32. **Naik V.N. -** Taxonomy of Angiosperms.
33. **Yadav S.R. and Sardesai M.R.-** Flora of Kolhapur District.
34. **Bhagat R.B., Shimpale V.B. and Deshmukh R.B.** Flora of Baramati
35. **Shivrajan V.V.** -Introduction to Principles plant taxonomy
36. **V. V. Sivarajan, N. K. P. Robson** 1991. Introduction to the Principles of Plant Taxonomy IInd Edi.
37. **Theodore Cooke (1903)-** The flora of The Presidency of Bombay Vol. I, II, III
38. **Chopra G.L.-** Angiosperms
39. **Datta S.C.-** A Hand Book of Systematic Botany
40. **Priti Shukla** and **Shital Mishra-** An introduction to Taxonomy of angiosperms.
41. **Sharma O.P.** Plant Taxonomy Tata McGraw-Hill Education
42. **Singh, N.P. and S.Karthikeyn** (2000) B.S.I. Calcutta. Flora of Maharashtra State, Dicotyledons. Vol. I and II
43. **Sharma B.D.. Karthikeyan. S. and N P. Singh** (1996) B.S.I., Calcutta Flora of Maharashtra State, Monocotyledons -
44. *Botanical Journal of the Linnean Society*, 2009, 161, 105–121.
45. http://www.mobot.org/MOBOT/research/APweb/

Practical based Gymnosperm Paper IV: BO.334 (1P)

1. Study of *Pinus* with the help of permanent slides and plant material.
i) External morphology, ii) T. S. of stem(Temporary double stained preparation), iii) T. S. of needle(Temporary double stained preparation), iv) Morphology of male cone – T. S. & L. S. Permanent slide, mounting of pollen grains.
v) Morphology of female cone – T. S. & L. S. Permanent slide, vi) Mounting of pollen grains.
vii) V. S. of mature ovule(Permanent slide)
2. Study of *Gnetum* with the help of permanent slides and plant material.
i) External morphology, ii) T. S. of stem
iii) T. S. of leaf (permanent slide), iv) Morphology of male cone
vi) Morphology of female cone
vii) V. S. of mature ovule
3. Study of at least any eight families as per theory course (3P)
4. Identification of plants with the help of regional/local/suitable flora. (1 P)
5. Preparation of an artificial key based on multiple characters/ androecium/gynoecium/ vegetative characters (at least two keys) (1P)
6. Study of the following with the help of slides and/ or specimens.
i) Impression ii) Compression iii) Petrifaction iv) Coal ball v) *Rhynia*
vii)*Lyginopteris viii*) *Pentoxylon* ix) *Nipaniophyllum* x) *Lepidodendron*

Paper –IV BO.335: HORTICULTURE AND FLORICULTURE

Chapter 1 Horticulture- Introduction 4L

Definition, branches, scope and economic importance of horticultural crops, export and import potential of horticultural crops, Horticultural zones of India and Maharashtra, Global and national scenario of horticulture

Chapter 2 Horticultural Plants 4L

Nutritive value of fruits and vegetables, Classification of horticultural crops, Classification of Vegetables, Fruits, Ornamental plants, Spices and Flowers

Chapter 3 Horticulture- Methods of Plant Propagation 6L

A. Sexual propagation- importance, seed viability and treatments
B. Artificial Vegetative Propagation – Importance, Methods- cutting. Layering, grafting and budding.
C. Physiological and Anatomical basis of rooting
D. Role of growth regulators in horticulture

Chapter 4 Special Practices in Horticulture 6L

Training and Pruning- objectives, types, systems of trainings
Fruit crops- Special practices like Bahar treatment, Girdling, Notching, Ringing, Bending, Vegetable crops special practices- Earthing up, Staking, Blanching

Chapter 5 Fruits and Vegetables Production Technology 8L

Introduction, soil and climate requirements, commercial varieties, special practices- harvesting and post harvest management, plant protection methods of following

Fruits- Banana, Mango, Vegetables- Tomato, peas, Beans

Chapter 6 Ornamental Horticulture **5L**

Introduction, Origin and History of Gardens, Famous Indian Gardens, Gardening styles- English garden, Italian Garden, Mughal Garden, Japanese garden, Landscape gardening

Chapter 7 Floriculture **8L**

Introduction, Concept, Definition, Scope and Importance of floriculture, Important floriculture crops and methods of cultivation for cultivation of Aster, Gladiolus, Orchids, Tagetus

Chapter 8 Flower Industry **7L**

A- **Dry Flowers** - Introduction, Indian market of dry flowers, Selection of material, Techniques of drying- Air drying, sun drying, press drying, dessicants, oven and microwave drying methods. Preservation methods, bleaching, dyeing and painting, storage , care of dried flowers, etc.

B- **Cut Flowers** – Introduction, Species and cultivars of Orchids, **Anthuriums** and **Heliconias**, Harvesting - Techniques, mode of harvesting, post harvest handling- conditioning , precooling, pulsing and impregnation, grading, bunching, wrapping packing and cold storage of cut flowers, Indian market of Cut flowers

Practicals

1. Phenology of any two of each: fruit, vegetables and flowering crops
2. Study of garden tools and implements- Sprayer, Duster, Pruning knife, Sprinkler, Micro-irrigation system,
3. Study of garden containers and filling of pots and pits and plantation any one plants of each fruit, vegetable and flowering crops
4. Study of cutting, layering, budding and grafting
5. Study of technique of training and pruning
6. Methods of harvesting of cut flowers and their preservation methods
7. Methods of making dry flowers

- **Visit to any one Nursery unit, Commercial Orchards, fruit market, floriculture Industry and submission of report in Practical Examination**

Reference Books-

1. Horticulture: V. L Sheela, MJP Publications
2. Plant Propagation, Principles and Practices: Hartmann and Koster's
3. Principles of Horticulture and Fruit Growing by Y. N Kunte, M.P Kawathalkar and K.S Yawalkar (Agri- Horticultural Publication House, Nagpur)
4. Arora J. S *Introductory Ornamental Horticulture* Kalyani Publications
5. Bose T. K & Yadav L. P *Commercial Flowers* Naya Prokash
6. Singh B. D *Plant Breeding* Kalyani Publications
7. Chadha K. L & Pareek O. P *Advances in Horticulture* Vol. IV Malhotra Publications
8. Sudheer K. P and Indira V *Post Harvest Technology of Horticultural Crops* New Delhi Publications
9. Adams C. R. Principles of Horticulture, 4th Edt. Elsevier Publication, 2004

PAPER V: BO 336 - COMPUTATIONAL BOTANY

13. Introduction to Biostatistics **3L**

a. Definition
b. Statistical terms : Population, sample, primary and secondary data, qualitative and quantitative data, parameter and statistics, attributes, variables, discrete and continuous variables, statistical error, linear and non-linear functions of statistics, frequency, and its distribution
c. Scope, applications and uses of biostatistics

14. Sample and sampling **4L**

a. Definition
b. Sampling unit, sample and population
c. Types of sampling
   i. Random sampling – with replicates, without replicates, systematic sampling, stratified sampling
   ii. Non-random sampling- Purpose, quota sampling
d. Need of randomness
e. Achieving randomness
   i. Lottery methods
   ii. Use of random number table
f. Merits and limitations of sampling

15. Collection and representation of data **5L**

a. Classification of data
   i. Meaning and need of classification
   ii. Objectives of classification

iii. Classification according to class interval
iv. Overlapping and non-overlapping frequency table

b. Methods of representation of statistical data
   i. Essential features of tabular presentation
   ii. Advantages of tabular presentation
   iii. Graphic representation of data and its advantages
   iv. Types of graphic representation
      1. Histogram
      2. Frequency polygon
      3. Frequency curve
      4. Scatter or dot diagram
   v. Merits and limitations of graphic representation
   vi. Diagrammatic representation of data
      1. Line diagram
      2. Bar diagram
      3. Pie diagram

16. Measures of central tendency of grouped and ungrouped data **4L**

a. Simple arithmetic mean, its merits and limitations
b. Averages of position: Median and mode, their merits and limitations

17. Measures of dispersion

a. Meaning of dispersion **4L**
   i. Range: Computation in individual, discrete and continuous series, coefficient of range, merits and limitations
   ii. Mean deviation and standard deviation: computation for grouped and ungrouped data, merits and limitation
   iii. Variance: Definition, coefficient of variance

18. Correlation and regression

a. Definition and types of correlation **4L**
b. Coefficient of correlation and its properties
c. Methods of studying correlation: Scatter diagram and Karl Pearson's coefficient of correlation
d. Coefficient of determination (r^2)
e. Regression analysis
   i. Definition and types of regression
   ii. Linear regression

19. Probability and types of theoretical probability distribution **4L**

a. Concept of probability
b. Binomial distribution
c. Poisson distribution
d. Normal distribution
   i. Normal distribution curve
   ii. Relationship between normal curve area and standard deviation
   iii. Properties of normal distribution curve

20. Tests of significance of mean **4L**

a. Introduction
b. Statistic and its standard error
c. Meaning of statistical hypothesis, level of significance, null hypothesis and alternative hypothesis
d. Student's 't' test: unpaired and paired test
e. χ^2 test as a test of goodness of fit and its significance

21. Computation of seed testing and plant growth indices **10L**

a. Seed germination and early seedling growth.
   i. Germination percentage
   ii. Mean germination time (MGT)
   iii. Germination index (GI)
   iv. Germination speed (GS)
   v. Vigor index (VI)

b. Seed germination and early seedling growth under stress
   i. Promptness index (PI)
   ii. Germination stress tolerance index (GSI),
   iii. Plant height stress tolerance index (PHSI)
   iv. Root length stress tolerance index (RLSI)
   v. Dry matter stress tolerance index (DMSI)

c. Plant growth indices
   i. Absolute Growth Rate (AGR)
   ii. Crop Growth Rate (CGR)
   iii. Relative Growth Rate (RGR)
   iv. Leaf Area Index (LAI)

10. Analysis of data on vegetation studies **6L**

a. Data obtained from quadrates and transects methods
   i. Frequency
   ii. Percent frequency
   iii. Relative frequency

iv. Density
v. Relative density
vi. Abundance
vii. Dominance

b. Computation of crop/vegetation biomass using satellite data
i. Simple Ratio (SR) or Ratio Vegetation Index (RVI)
ii. Difference Vegetation Index (DVI),
iii. Normalised Difference Vegetation index (NDVI) or greenness index

NOTE – For Biostatistics, emphasis be given on methodology and numerical problem solving rather than derivations and proofs.

Practicals

1. Computation of mean, mode, median, variance and standard deviation from the given data
2. Representation of data by various graphical methods 1P
3. Statistical problem solving based on Student's 't' test and χ^2 test 1P
4. Statistical problem solving based on data for correlation and regression 2P
5. Germination of various seed lots and analysis of data with various seed germination indices 2P
6. Analysis of vegetation data obtained from list count quadrat method for frequency, density, abundance, relative dominance and importance value index. 1P
7. Analysis of satellite data collected on biomass for RVI, DVI, NDVI, TNDVI, and PVI. 1P

OR

Projects (Equivalent to 6 practicals)

1. Study effect of agrochemicals/ mutagens/ plant extracts/ fertilizers/etc/ on seed germination and early seedling growth, analyze data statistically. **OR**
2. Study varietal variation to abiotic stress based on seed germination and early seedling growth analyze data statistically. **OR**
3. Study vegetation by list count quadrat / line/belt transect method and analyze data statistically. **OR**
4. Collect satellite data on vegetation/biomass and compute RVI, DVI, NDVI, TNDVI, and PVI.

References:

1. Introduction to biostatistics, Pranab Kumar Banerjee.
2. Fundamentals of biostatistics, Khan and Khanum
3. Methods in Biostatistics for medical students and research workers, B K Mahajan
4. ABC of Research Methodology and Applied Biostatistics, M N Parikh and Nithya Gogtay
5. Biostatistics in brief, K Viswesara Rao
6. Introduction to Biometry, S G Purohit, V D Ranade and A V Dusane
7. Biostatistics-Basic Concepts and Methodology for the Health Sciences, Wayne W Daniel
8. Basic statistics, B L Agarwal
9. Biostatistics – Principle and Practice, B Antonisamy, Soloman Chrostopher and P Prasanna Samuel
10. Introduction to biostatistics and research methods, PSS Sundar Rao and J Richards
11. Drought stress in peanut, Lambert Publication , Laware And Shinde

SEMESTER IV

Paper I: BO. 341: PLANT PHYSIOLOGY AND BIOCHEMISTRY

Plant Physiology

1) **Photosynthesis:** Structure of a chloroplast, photosynthetic pigments and their role, Photosystems, Light reaction, electron transport chain, Cyclic and Non-cyclic photophosphorylation, Path of carbon in photosynthesis - Calvin cycle, HSK pathway: Salient features of C4 plants, metabolic pathway, CAM pathway, Photo-respiration, Significance of photosynthesis. **(10)**

2) **Respiration:** Structure of a mitochondrion, Respiratory substrates, Types of respiration, Mechanism of aerobic respiration – Glycolysis, TCA cycle. Electron transport system, Chemi-osmotic hypothesis of ATP synthesis, Balance sheet of ATP generation in respiration. Significance of respiration. **(7)**

3) **Translocation of organic solutes:** Definition, Path of translocation, Evidences for phloem transport, Mechanism of translocation – Pressure flow theory, Diffusion, Source to sink relationship, Phloem loading and unloading. **(4)**

4) **Stress Physiology :** Concept of abiotic , biotic and xenobiotic stresses. Types of stresses – Salinity, drought. Effect of stresses on the plant growth. **(3)**

Biochemistry

1) **Carbohydrates:** Definition and classification Properties and functions of carbohydrates. Synthesis and breakdown of starch. **(4)**

2) **Amino acids and proteins:** Definition, synthesis and properties of amino acids. Role of amino acids. Classification of proteins on the basis of structure, properties and functions of proteins. **(5)**

3) **Lipids:** Definition , classification, properties and functions of lipids. Synthesis of lipids, β-oxidation. **(4)**

4) **Enzymology:** Definition and nature of enzymes, active site, Classification (IUB) and properties of enzymes, Co-enzymes. Mechanism of enzyme action- Lock and key hypothesis, Induced fit theory. Factors affecting enzyme activity – pH, temperature, substrate concentration, enzyme concentration. Enzyme inhibitors – Competitive, uncompitative, non-competitive. **(6)**

5) **Secondary Metabolites:** Definition, Types, Metabolic pool and biosynthesis of secondary metabolites through – malonic, mevalonic and shikkimic acid pathways. Role of secondary metabolites. **(5)**

References: -

S. N. Pandey and B. K. Sinha (2014). Plant Physiology, Vikas Publishing House Pvt. Ltd., India.

Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists Maryland, USA.

Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.

William G. Hopkins (1995) Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.

Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by – Panima Publishing Corporation

R. G. S. Bidwell (revised edn.)-Plant Physiology

Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.

Leninger A.C (1987). Principles of Biochmistry, CBS Publishers and Distributers (Indian Reprint)

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..

Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.

Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House, New Delhi

Taiz L. and Zeiger E. 1998. Plant Physiology (Second Edition). Sinauer Associates, Inc. Publishes, Massachusetts, USA.

Verma S.K. and Mohit Verma 2007. A.T.B of Plant Physiology, Biochemistry and Biotechnology, S.Chand Publications.

Practicals based on Paper I: BO. 341: Plant Physiology and Biochemistry:-

1. Estimation of chlorophyll-a and chlorophyll-b by spectrometric or colorimetric method.
2. Separation of photosynthetic pigments by TLC/Paper chromatography.
3. To determine diurnal fluctuation in TAN values of CAM plants.
4. Estimation of soluble proteins by Lowery *et. al.* method.
5. Separation of amino acids by paper chromatography.
6. Demonstration of
   a. Ringing experiment for path of solute translocation.
   b. Hill reaction

c. Qualitative tests for alkaloids, tannins, glycosides, starch, lipids and proteins.

d. Enzyme activity: catalase

Paper II: BO.342: PLANT ECOLOGY AND BIODIVERSITY

Plant Ecology (24L)

1. Ecology

Introduction, Interrelationship between the living world and the environment, components and dynamism of Ecosystem, homeostasis. **(8L)**

Impact of human activities on environment – Causes, Prevention and control of – Air, water and Soil Pollution

Brief account of environmental toxicology – Eutrophication, bioaccumulation and biomagnifications

2. Environmental Crisis

Desertification, Ozone depletion and Global warming **(3L)**

3. Environmental Impact Assessment

Process, objectives of EIA, Hierarchy in EIA, Historical Review of EIA, Concepts related to EIA, Basic data collection for EIA **(3L)**

4. Environmental Audit

Meaning, need, Audit Protocol, Proccessing, Certification, personnel environmental Audit. **(3L)**

5. Ecology and Economics

Man and Biosphere concept.

Relation between ecology and economics **(3L)**

6. Remote Sensing

Definition, basic principles,

Process of data acquisition and interpretation, **(4L)**

Global positioning System

Application of Remote Sensing in ecology.

Biodiversity (24L)

Introduction to Biodiversity **(02 L)**

Introduction, Concept, Aims and objectives,

Scope and values of Biodiversity. **(05 L)**

Characterization of Biodiversity:

Introduction, need for characterization, various disciplines of Biodiversity- Genetics, Species and Ecosystem. Concept of endemism and phytogeography. **(03 L)**

Biodiversity Loss:

Loss of Species and Genetic Diversity: Introduction, Factors causing loss of species and genetic diversity, Founder Effects, Genetic Drift, Inbreeding Depression, IUCN Categories (RET plants) **03 L)**

Inventorying and Monitoring of Biodiversity:

Introduction, Necessity, planning and approaches to inventorying and monitoring, capacity building. **(11L)**

Conservation of Biodiversity:

Current Practices in Conservation,

In-situ Conservation: International efforts and Indian initiatives; protected areas in India, Concept of Biosphere Reserves and National Parks.

Ex-situ Conservation: Germplasm Collections, Botanical Gardens, Seed Banks, Gene Banks, Pollen Banks, DNA Banks, Wetlands, mangroves and coral reefs.Enlist national agencies playing role in conservation (BSI, NBPGR, ICAR, CSIR, DBT),

Social Approach to Biodiversity Conservation: Sacred Groves, Sthalavrikshas, Chipko Movement, Role of Universities and other Educational Institutions in Biodiversity Conservation

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7. **Uma Shaanker, R. Ganeshiah, KN. and Bawa KS** (2001), (Eds). Forest Genetic Resources: Status, Threats and Conservation Strategies Oxford and IBH, New Delhi
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9. **Global Biodiversity: Status of the Worlds Living Resources** (1992); WCMC; Chapman and Hall,London
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11. **Handbook of the Convention on Biological Diversity** (2001), Secretariat of the Convention onBiological Diversity. Earthscan publ., London
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15. **John E.Weaver and F.E. Clement** (1938). Plant Ecology McGraw-Hill.
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17. **Bowles M.L. and Whelan C.J** (1996) edt. Restoration of Endangered Species - Cambridge Univ. Press.
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19. **Gadgil M. and Guha R** (1992). This Fissured Land: An Ecological History of India Oxford UniversityPress, New Delhi
20. **Ashish Kothari** (1997)Understanding Biodiversity- Life, sustainability and Equity; Orient Longman

Practicals-Plant Ecology

1. Study of polluted water body with ref. to BOD.
2. Study of physicochemical properties of water body by using Sacchi disc, pH meter and electric conductivity meter.
3. Acquisition of ecological data of particular locality by using GPS/ altimeter/geographicloa maps etc
4. Study of suitable ecosystem by line/belt transect method/ nested quadrate method.
5. Visit to near by locality to study biodiversity and submission of report

Practicals-Biodiversity

1. Study and application of diversity indices to suitable ecosystem/ area.
2. To measure the latitude, longitude and altitude by using GPS

3. Visit to near by conservation institutes/sacred groove and report writing.

PAPER III BO.343:: PLANT PATHOLOGY

1 Fundamentals of plant pathology **5 L**

Introduction, Important terminology- Incitants, Host, Parasite, Pathogen, Inoculum, Penetration, Infection, Incubation, Disease, Disease development, Symptoms, Sign, Endophyte, Predisposition, Suscept, Resistance, Epidemic, Etiology. Economic importance of plant diseases, History of plant pathology, Introduction to Indian Agricultural Research Institute (IARI), International Crop Research Institute for Semi Arid Tropics (ICRISAT), Contribution of Anton DeBary and Prof. B.B. Mundkur.

2 Disease Development **6 L**

Concept of disease cycle, Inoculation, Prepenetration, Penetration, Infection, Dissemination. Epidemics- Forms, Decline,, Exponential model. Disease forecasting, Measurement of plant disease and yield loss.

3 Defence Mechanisms **3 L**

Concept and Definition, Types- Preexisting- Structural and chemical, Induced- Structural and Biochemical

4 Methods of Studying Plant Diseases **5 L**

Macroscopic study, Microscopic study, Koch"s postulates. Culture technique, Media Types and Preparation, Pure culture methods- streak plate, Pour plate, spread plate, Serial dilution.

5 Fungal Plant Diseases **5**
L

Introduction to fungi as plant pathogens. Study of Diseases- Club root of Crucifers, Downy mildew of Grapes, Head smut of Jowar, Leaf spot of Turmeric, Tikka disease of Groundnut with reference to causal organism, symptoms and signs, disease cycle and control measures.

6 Bacterial Plant Diseases **3**
L

Introduction to bacteria as plant pathogens, Study of Diseases- Citrus Canker, Black arm of Cotton with reference to causal organism, symptoms and signs, control measures.

7 Mycoplasma Plant Diseases **3**
L

Introduction to Mycoplasma as plant pathogens, Study of Diseases- Grassy shoot disease of sugarcane, Little leaf of brinjal with reference to symptoms and signs, control measures.

8 Nematodal Plant Diseases **2**
L

Introduction to Nematodes as plant pathogens. Study of Diseases- Root knot disease of vegetables, Ear cockle of Wheat with reference to causal organism, symptoms and signs, control measures.

9 Viral Plant Diseases **3**
L

Introduction to Viruses as plant pathogens. Study of Diseases- Tobacco Mosaic Disease, Bunchy top of Banana with reference to causal organism, symptoms and signs, control measures.

10 Non Parasitic Diseases **4**
L

The impact and abiotic causes- Temperature, Soil moisture and relative humidity, Poor oxygen, Poor light, Air pollutants, mineral deficiencies. Herbicide injury, Study of Tip burn of Paddy, Mango necrosis, Black Heart of Potato, Khaira disease of rice.

11 Principles of Plant Disease Control **5**
L

General account, Quarantine, Eradication, cultural control practices, Biological control, Curative measures, Chemical control, Use of Effective Microorganism Solution (EMS), Microbial Pesticides, IPM

12 Molecular Diagnostics and Transgenic in Crop Protection
4 L

Introduction, Classical approaches, Use of antibodies, Pathogen derived resistance against bacterial and fungal diseases, Expression of vaccines in plants.

Practicals

1. Preparation of any one culture media for isolation of plant pathogens.
2. Study of Koch's Postulates
3. Culture technique - Streak plate methods, Pour plate methods, Spread plate and Serial dilution method for preparation of pure culture.

4. Study of any two of each fungal, bacterial and mycoplasma diseases.
5. Study of any two viral and non-parasitic diseases of plants.
6. Study of any two of each fungicides and microbial pesticides

- Visit to any Agricultural Research Institute and Plant Pathology Laboratory and submission of report

References:

1. Fungi and Plant Diseases by B. B. Mundkur
2. Plant Pathology, R. S. Mehrotra
3. Principles of Plant Pathology, R. S. Singh
4. Plant Pathology, P. D. Sharma
5. Plant Disease, R. S. Singh
6. Plant Pathology, Mandal and Dasgupta
7. Plant Pathology, G. N. Agrios
8. Agricultural Microbiology, Rangaswamy and Bhagyaraj
9. Fundamentals of Plant Pathology by Ravi Chandra
10. Methods of Microbial and Plant Biotechnology, L. N. Nair
11. Molecular Plant Pathology, 2003. Dickinson, Bios Scientific Publication, London, New York

Paper IV: BO.344: MEDICINAL AND ECONOMIC BOTANY

Medicinal Botany (36L)

1. Introduction to Pharmacognosy

1.1. Origin, history, definition and scope of Pharmacognosy, **(3L)**

1.2. Methods of classification and their significance in the study of drugs of natural origin (alphabetical, biological, chemical, taxonomical, chemotaxonomical and pharmacological)

2. Ayurvedic Pharmacy

2.1 Introduction

2.2 Tridosha concept, Humoral, Indigenous Systems of medicine (Ayurveda, Siddha, Unani,Tibi, Chinese etc.) **(8L)**

2.3 Ayurvedic principles- Ras. Guna, Vipaka, Virya, Prabhava,

2.4 Ayurvedic formulations –Asava, Arishta, Kvatha, Churna, Ksharas, Leha, Vatika, Taila, Bhasma,

3. Analytical Medicinal botany **(6L)**

3.1 Drug adulteration

3.2 Methods of extraction (percolation, maceration, soxchlet extraction etc.) of different classes of phytochemicals from crude drugs.

3.3 Methods of drug evaluation- Morphological, Microscopic, Chemical and Physical methods.

4. Cultivation, collection and processing of herbal drugs from Mentha and Eucalyptus. **(3L)**

4.1 Cultivation- Methods, Factors affecting cultivation

4.2 Collection and Processing- Collection, harvesting, drying, garbling, packing, storage of crude drugs. **(6L)**

5. Study of medicinally important drugs

Study of drugs w.r.t. occurrence, distribution cultivation, microscopic characters, constituents and uses of the following.

Root Rhizome drugs :- *Glycyrrhiza,*
Stem drugs: - *Ephedra,*
Leaf drugs: - *Adhatod,*
Flower drugs: - Clove,
Fruit drugs: - Amla,
Unorganized drugs :- Shilajit and *Acacia* gum,
Contraceptive drugs: - *Dioscorea.* **(8L)**

6. Applied Medicinal Botany

6.1 Study of drugs with respect to Biological source, Geographical distribution, common varieties, macro and microscopic characters, chemical constituents and therapeutic uses, adulterants of the following plants/drugs *Strychnosnux vomica*-Seeds, *Tinospora cordifolia*-Stem

6.2 Concept of active principle, and major metabolic Pathway (Carbohydrates and Proteins) leading to the Production of therapeutically active Chemical Constituents

6.3 Concept, definition and introduction to Biopharmaceutics, Pharmacodynamics and clinical Pharmacokinetics with applications **(2L)**

7. Ethnobotany : Definition, principles, scope and ethnic societies in India. **(2L)**

Economic Botany (12L)

1. Introduction to economic botany and its scope

2. Important Botanical resources- meaning and Mention of only botanical resources any five for non-wood forest products (NWFPs) such as **(4L)**

2.1Paper making and 2.2 Gums

3. Origin, evolution, source & uses of Rice, *Curcma longa,* Safflower, Sugarcane, *Butea monosperma/Samanea saman/ Scleichera oleosa and* Rose. **(6L)**

References:-

1. A Pharmacognosy and Pharmacobiotechnology. New Age international (P)Limited, Publishers (formerly wileyEasterm Limited)
2. **Bruncton J.**: Pharmacognosy, Phytochemistry, Medicinal Plants: Intercept Limited.

3. **Harborne, J. B.** (1973): Phytochemical Methods: A guide to Modern Techniques of plant Analysis. Chapman A ad Hal, London
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1. **Kokate C.K. (2014)**Practical Pharmacognosy, Vallabhprakashan, New Delhi, 5th edition
2. **Kokate C.K. Purohit A.P. and Gokhale S.B.** Pharmacognosy, NiraliPrakashanpune
3. **Trease G.E. and Evans. W.C.** Pharmacognosy ELBS Twelfth Edition
4. **Tyler V.E Brady L. R and Robbers J.E. (1976).**Pharmacognosy Lea and Febiger. Philadelphia.8th edition KM Varghese and Co.Mumbai,
5. **Vaidya S.S. and Dole.V.A.** Bhaishyajakalpana, AnmolPrakashan, pune
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9. **P.L. Kochhar(1987)** Tropical Crops: A Textbook of Economic Botany (Macmillan international college edition)
10. **Albert F. Hill. (1952)** Economic Botany: A Textbook of Useful Plants and Plant Products McGraw-Hill
11. **Vernma V (2009)**. Textbook of Economic botany
12. **N.D. Prajapati (2010)**A Handbook of Medicinal Plants: A Complete Source Book
13. **Himadri Panda(2002)** The Complete Technology Book On Natural Products (Forest Based)
14. **Pharmacognosy and Phytochemistry** -- Vinod Rangari.

Practicals based Paper VI: BO:346: Medicinal and Economic Botany

1. Study of any six drug plants from theory syllabus (Macroscopic and Microscopic). (2P)
2. Demonstration of Plant extraction methods -Cold and Soxhlet extraction and TLC of any one drug studied in theory. (1P)
3. Study and preparation of ayurvedic formulations - Asav, Arishtha, Churna (1P)
4. Qualitative analysis of Alkaloid, Glycoside and Tannin (1P)
5. Study of stomatal index and vein islet number using suitable plant material using micrometer and camera Lucida. (1P)
6. Survey of local flora with respect their medicinal and economic importance and submission of 10 dry specimens.

Paper V: BO. 345 PLANT BIOTECHNOLOGY

1. Introduction to Biotechnology **5L**

Introduction and History of plant Biotechnology

Pioneering work and significant achievements in Indian plant Biotechnology

Global Impact and Current excitements of plant Biotechnology - Plant Health care and plant protection. **15L**

2. Plant Tissue Culture

Brief History, Importance of plant tissue culture

Types of culture, basic technique of plant tissue culture, Concept, technique and applications of callus culture, cell suspension culture, protoplast culture, somatic hybridization and cybrids, Haploid production, Micropropagation, embryo culture-and embryo rescue **4L**

3. Germplasm and Cryopreservation

In situ and **Ex situ** conservation, techniques of cryopreservation, cold storage, low pressure and low oxygen storage, applications **6L**

4. Transgenic Plants as Bioreactors

Metabolic engineering of starch, cyclodextrins, fructans, Bioplastics, Genetically engineered plants as protein factories, Production of therapeutic proteins from plants. **6L**

5. Biotechnology of Biological Nitrogen Fixation

Non symbiotic Nitrogen Fixation-Diazotrophs and their ecology, special features,

Mechanism of N_2 Fixation

Nitrogenase and Hydrogenase

Symbiotic N2 Fixation- establishment of symbiosis,

Factors affecting and mechanism of symbiotic N2 Fixation

Genetics of Diazotrophs- Nod genes, Nif gene

Biofertilizers- algal, fungal, phosphate solubilising and organic fertilizers

6. Biotechnology and Society **4L**

Biotechnology- Benefits, GM foods and its safety, patenting of biotechnological inventions, Biotechnology and developing countries, Recombinant foods and religious beliefs, recombinant therapeutic product for human health care, Intellectual property rights

7. Bioinformatics

Introduction, Database and its classification, NCBI, Data retrieval tools, INTREZ, OMIN, BLAST, FASTA, Applications of Bioinformatics **4L**

8. Genomics and Proteomics

Genomics- methods, types and applications, Proteomics- Concept, types and importance **4L**

Practicals

1. Preparation of MS Medium
2. Callus Induction using maize embryo
3. Study of application of biofertilizers- Algal, Fungal, Bacterial, Phosphate Solubilizers and Organic Fertilizers
4. Estimation of Nitrate Reductase enzyme from Legume nodules
5. Study of Transgenic plants- Bt Cotton, Bt Brinjal, Bt Tomato, Golden Rice

- Visit to NCBI and Report preparation

Reference Books:

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.

Paper VI: BO346: PLANT BREEDING AND SEED TECHNOLOGY **(24 L)**

PLANT BREEDING **(2 L)**

1. Introduction, scope and importance **(10 L)**

2. Conventional techniques, methods and practices of breeding

(a) Plant introduction and acclimatization

i. Concept, objectives
ii. Types of plant introduction
iii. Advantage, limitations/ Disadvantages and achievements.

(b) Selection methods

i. Concept,
ii. Types of selections –mass selection, pure line selection and clonal selection.
iii. Advantage and disadvantages/limitations, achievements.

(c) Hybridization
i. Definition and Concept,
ii. Difficulties in crop hybridization and precaution to be taken during hybridization
iii. General procedure of hybridization
iv. Parent selection in a breeding program
v. Criteria for selecting parents

Breeding Methodology
i. Pedigree method
ii. Bulk method
iii. Single-seed descent method
iv. Backcross method, Achievements

(d) Heterosis and hybrid vigour
i. Concept
ii. Causes of heterosis- dominance hypothesis
iii. Applications

3. Alternative breeding techniques

(a) Mutation breeding **(08 L)**
Introduction and concept
Types of Mutation
induced mutagenesis
mutagens used -Chemical and physical mutagens
methods of working
Gamma gardens, concept and design
Applications

(b) **Importance of Polyploidy and aneuploidy in crop improvement**
Properties of polyploids,
Methods of obtaining polyploids
Methods used in obtaining haploids
Production of triploids in plant breeding
Applications and achievements

4. **Breeding for stress tolerance**
Mechanisms and genetic bases of resistance/tolerance to biotic and abiotic stresses in plants, **(4L)**
Breeding for resistance/tolerance.
Molecular Approaches
Characteristics evaluated for drought tolerance
Characteristics evaluated for insect/pest tolerance
Achievements

SEED TECHNOLOGY **(24L)**

1. Introduction: **(2 L)**
Definition of seed,
Stages of Seed Production,
Classes of Seed (nucleus seed, breeders seed, foundation seed, certified seed and truthful seed),
Role of seed technology.

2. Seed certification: **(2 L)**
General procedure of seed certification,
field inspection,
observation during inspection,
field count,
Duties of seed inspector.

3. Seed processing: **(2 L)**
Concept
Principle and techniques of processing of seeds

4. Seed sampling, storage and packaging **(6 L)**
Seed sampling,
Types of seed samples,
Sampling equipments.
Factor affecting seed storage and need of seed storage,
Methods of protection and control,
Air conditioning and dehumidification,
Sanitation and fumigation of seed stores.
Seed sorting and bagging, bag weighing, bag closing, type of bag closer,
Labelling and maintaining lot identify, lot numbers, seed pellets,
Handling and stacking,
Maintenance of seed processing record.

5. Physical purity analysis **(3L)**
Definition of purity components
Procedure
ODV test
Reporting and results.

6. Seed Testing

A. Moisture Testing

By air oven method (3L)
Moisture meters.

B. Germination testing

Definition and objectives, (3L)
General principles and requirements,
Procedure and methods (Paper, Sand and Soil)
Seedling evaluation.

7. Seed Marketing:

(3L)

Marketing- Basic concepts, supply & demand, price equilibrium, seed transportation, storage, cost & returns, cost processing, packing and marketing, Organization for seed marketing, seed markets in India, structure & working.

Practicals based on Plant Breeding and Seed technology

1. Demonstration of Hybridization Techniques.
2. Effect of chemical mutagens on seed germination and seedling growth.
3. Demonstration of chlorophyll mutation in M2 generation. (Photographs)
4. Polypolidy induction in *Allium cepa* by colchicine.
5. Seed moisture testing by hot air oven method.
6. Demonstration of seed sampling equipments with the help of photographs.
7. Visit to seed processing unit / Seed marketing organization.

References:-

1. **Sadova David** – 2004 (First Indian Edition). Cell Biology, New Delhi.
2. **Giese Arthur** 1979 (Fifth Edition). Cell Physiology, Toppan company Ltd., Tokyo, Japan.
3. **Roy S.C and KKDe** 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
4. **Verma P.S and Agarwal V.K** 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
5. **Gerald Karp** 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and Scne Ine., USA.
6. **Verma and Agarwal** – Seed Technology Demand forecasting, Seed pricing, projection of supply and demand for different kind of seeds
7. **Gardner and Simmons Snustad** 2005 (Eighth Edition). Principles of Genetics, John Wiley and Sons, Singapore.

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
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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

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	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.

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	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

1)Computer Networks – Andrew S.Tenenbaum
https://books.google.co.in/books?id=b2HyGSu46IQC&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.

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.

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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	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.

40
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.

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

HOD
Dept.of Computer Science
K.J.Somaiya College Kopargaon

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

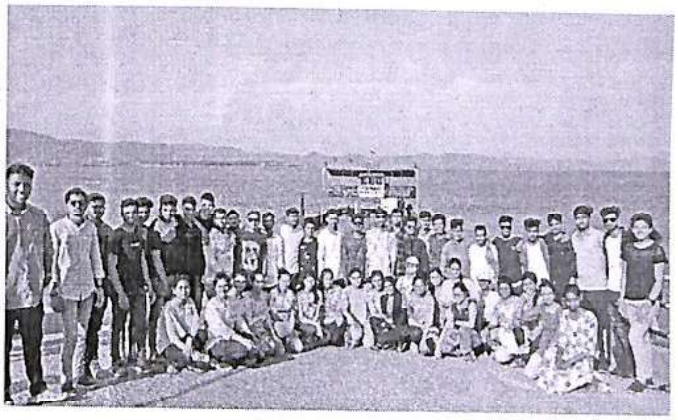
List of Add-on/Value Added/ Certificate Courses

Sr. No.	Department	Name of Certificate Course	Course Code	Year of Offering	Addressed issue (Professional Ethics, Gender, Human Values, Environment and Sustainability)
1	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

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

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.