COURSES OF STUDIES

For

MASTER OF SCIENCE EXAMINATION

(With Effect from the Session 2023-24 and onwards)

BOTANY

(Under Choice Based Credit System)

Maharaja Purna Chandra (Autonomous) College,
Takhatpur, Baripada 757003, Mayurbhanj

Affiliated To

MAHARAJA SRIRAM CHANDRA BHANJA DEO UNIVERSITY

Sriram Chandra Vihar, Takatpur, Baripada-757003

M.Sc. (BOTANY)

(Choice Based Credit System)

I. The course is of two years duration comprising of four semesters of theory and laboratory works.

II. There is one open elective (OE-BOT 305) in semester-III. This paper is open for other departments. Students of this department in semester –III will choose one open elective from other department.

III. Each student has to carry out project work from Semester-IV and submit a dissertation before the commencement of Semester-IV theory examination.

IV. The student can opt one elective course comprising of two papers in the 2^{nd} year of PG programme.

V. The theory examination shall be held for 80 marks (3 hours) and one Mid-Semester/ Internal Assessment Examinations (IAE) of 20 marks (1 hour). The questions shall be of unit pattern, having equal marks, with two alternatives from each unit.

VI. For IAE, question shall be asked at least from any two units of a paper covered and will be of one hour duration. The durations of the practical examination shall be 6hours.

VII. In order to pass a semester examination a candidate must have to secure a minimum of 40% marks in both practical & theory papers in each semester.

VIII. If candidate passes all the four semester examinations he/she will be declared to have passed the M.Sc. (Semester) examinations in Botany, provided further that in no case a candidate shall be allowed to appear any Semester Examination after twice the duration of course period.

IX. In order to be eligible to appear at the University examination, a student has to secure at least 75% of attendance.

Programme outcome:

- The students will acquire basic knowledge on plant diversity, conservation and utilization of phyto-resources and role of plant community in protection of environment.
- They will be able to contribute towards present day struggle for climate change, global warming, restoration and reclamation of waste land for crop production and inventorisation of plants for new phytochemicals &drugs.
- They will be equipped with adequate technical and analytical skill to pursue their further studies and to develop continuous learning throughout their professional career.
- They will be able to compete national and state level tests like UGC-CSIR NET, ICAR- NET, UPSC, OPSC and SSB etc.
- They will acquire motivational forces for higher study and research related to applied field of plant sciences.

Programme Specific Outcome:

- The student will understand both the basic and applied branches of plant sciences namely Biosystematics, Environmental Sciences, Plant Biotechnology, Plant Physiology & Biochemistry and Microbiology.
- Systematic study of selected taxa will explore the knowledge on the taxa including genetic diversity and molecular phylogeny which will be helpful for conservation & sustainable utilization of those taxa.
- They will develop creative thinking and problem solving capabilities through mentor system.
- They will able to involve in the environment programmes, launched by UNEP through inspirational and motivational ethics.
- They will understand the subject in detail through the elective courses such as Biosystematics, Environment Pollution and Management, Biochemistry and Plant Tissue culture.
- They will acquire knowledge for reintroduction and conservation of rare, endemic and threatened (RET) taxa through plant tissue culture technique.
- They will motivate towards research in plant sciences through the dissertation work in both field and laboratory based exposure.

(Effective from the academic session 2023-24 and onwards)

Semester –I

Code	Course Title	Credit	Marks
BOT 101	Plant Diversity-I	5	100 (80+20)
BOT 102	Biochemistry	5	100 (80+20)
BOT 103	Cell & Molecular Biology	5	100 (80+20)
BOT 104	Ecology &Biodiversity	5	100 (80+20)
BOT 105	Practical pertaining to papers 101, 102, 103 & 104	5	100
	Total	**25**	**500**

Semester—II

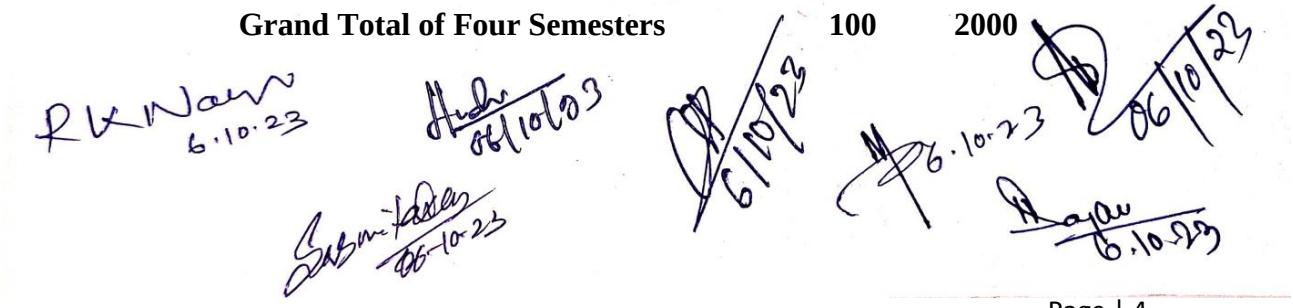
Code	Course Title	Credit	Marks
BOT 201	Plant Diversity-II	5	100 (80+20)
BOT 202	Genetics & Plant Breeding	5	100 (80+20)
BOT 203	Plant Anatomy & Embryology	5	100 (80+20)
BOT 204	Plant Systematics & economic botany	5	100 (80+20)
BOT 205	Practical pertaining to papers 201, 202, 203 & 204	5	100
	Total	**25**	**500**

Semester–III

Code	Course Title	Credit	Marks
BOT 301	Plant Physiology & Metabolism	5	100 (80+20)
BOT 302	Plant Biotechnology & Genetic Engineering	5	100 (80+20)
BOT 303	Research Methodology	5	100 (80+20)
BOT 304	Practical pertaining to papers 301, 302 & 303	5	100
OEC-BOT 305	Open Elective Course (OEC)	5	100
	Total	**25**	**500**

Semester–IV

Code	Course Title	Credit	Marks
BOT 401	Ethnobotany	5	100 (80+20)
	Discipline Specific Elective – I		
BOT 402-A	Microbes & Microbial techniques-I	5	100 (80+20)
BOT 402-B	Microbes & Microbial techniques-II	5	100 (80+20)
	Discipline Specific Elective – II		
BOT 403-A	Environmental Science-I	5	100 (80+20)
BOT 403-B	Environmental Science-II	5	100 (80+20)
BOT 404	Practical pertaining to papers 402/403	5	100
BOT 405	Dissertation pertaining to theory paper 402/403	5	100
	Total	**25**	**500**
	Grand Total of Four Semesters	**100**	**2000**



SEMESTER-I

BOT-101 Plant Diversity-I Full Mark: 100

Course objective: To acquaint the knowledge on microbes, Algae and Fungi with respect to Plant pathogenicity and human welfare.

Content:

UNIT–I (20)

- History and scope of microbiology. Bergy's manual for classification of microbes. Structure, Nutrition and Reproduction of Eubacteria. General accounts of Archaea. General features and pathogenicity of *Mycoplasma*, *Actinomycetes* & *Rickettsia*. Economic importance of Bacteria.
- General properties, structure and classification of viruses, viral multiplication. Economic importance of viruses. Viroids, Prions,

UNIT–II (20)

- General characteristics of Algae. Pigmentation in algae, Modern system of classification. salient features and life cycles in Cyanophyta, Chlorophyta, Bacillariophyta, Xanthophyta, Phaeophyta and Rhodophyta. Beneficial and harmful aspects of Algae.

UNIT-III (20)

- General characteristics & classification of Fungi. Structure and reproduction of Phycomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Degeneration of sexuality in fungi, Fungal nutrition, heterothallism, heterokaryosis. Application of fungi in industries, agriculture and medicine.

UNIT-IV (20)

- Concepts of phytopathology, Disease symptoms, modes of infection and dissemination, disease resistance and defense – morphological and biochemical basis, host-parasite relationship.
- Disease-cycle, preventions & control of plant diseases: Citrus canker, Tobacco mosaic, smut of sugarcane, Blight of rice, Blight of Potato, Powdery mildew of pea.

Course Outcome: Upon successful completion of this course student will be able to acquire basic knowledge on microbial diversity, Algal diversity and Fungi diversity. A detailed knowledge can be obtained on phytopathology and applications for human benefits.

SEMESTER-I

BOT-102 Biochemistry Full Mark: 100

Course objective: The course aims to educate student on basic fundamentals of biochemistry, structure, properties and metabolism of various bio-molecules such as carbohydrates, proteins, lipids and enzymes.

Content:

UNIT–I (20)

- Amino acids: Classification and properties. Acid–base properties. The Peptide bond, ionization behavior of peptides.
- Levels of protein structure, Determination of primary structure of protein. Three dimensional structure of proteins (Secondary, tertiary and quaternary structures, structural patterns: motifs and domains), Ramchandran Plot.

UNIT–II (20)

- Carbohydrates: Classification, configuration and conformation of monosaccharides, sugar derivatives, important disaccharides. Structural and storage polysaccharides, glucosaminoglycans, proteoglycans, glycoproteins and glycolipids
- Carbohydrate metabolism: Gluconeogenesis, glycogen metabolism, regulation of carbohydrate metabolism,

UNIT-III (20)

- Enzymes: General properties, nomenclature and classification, Michaelis-Menten kinetics and its significance, Brigg's-Halden modification, determination of V_{max} and $K_{m.}$
- Mechanism of enzyme action: general acid-base catalysis, covalent catalysis, metal catalysis Mechanism of action of RNAse, Lysozyme and Chymotrypsin
- Enzyme inhibition: competitive, non-competitive, uncompetitive inhibition, determination of K_i, allosteric regulation, covalent modification

UNIT-IV (20)

- Lipids: Classification, storage lipids, structural lipids (glycerophospholipid and sphingolipids),signaling lipids, cofactors, terpenes, and pigments.Coenzymes and vitamins.
- Biosynthesis and oxidation of fatty acids, regulation of fatty acid metabolism.

Course Outcome: Students will be learning about concepts of biochemistry including metabolism and bioenergetics. Students will gain knowledge on structure and properties ofcarbohydrate,proteins,lipids and secondary metabolites. Students willl earn the basics of enzyme kinetics and regulation of enzyme activity.

SEMESTER-I

BOT-103 Cell & Molecular Biology Full Mark: 100

Course objective: The objective of the present course contentis to provide a foundation and background of cellular structure, cell organelles & Nucleic acid in relation to their functions and regulatory mechanisms.

Content:

UNIT–I (20)

- Cell Wall: Structure & functions, biogenesis, growth. Plasma membrane: Composition and dynamics. Transport across cell membrane. Cell junction, cell adhesion an extra-cellular matrix. Cytoskeleton: Microtubules, intermediate filaments and microfilaments.
- Plant Vacuole: Tonoplast membrane, ATPases, transporters as storage organelle
- Biogenesis, structure, genome organization of Chloroplast & Mitochondria.

UNIT–II (20)

- Nucleus: Structure and function of nuclear envelope, nuclear pore complex, nucleolus & Chromatin organization and its packaging. Nuclear transport.
- Cell cycle: Molecular models and events. Regulators and checkpoints in cell cycle. Molecular mechanisms of cell division: Mitosis (Behavior of chromosomes, formation of mitotic spindle, Sister chromatid separation), Cytokinesis (Role of mitotic spindle in determining cytoplasmic cleavage site), Meiosis: Events & mechanism.

UNIT-III (20)

- DNA replication: Replication in prokaryotes, replication fork, initiation, elongation, termination, Replication in eukaryotes, Various models of replication, DNA Repair: mismatch repair, base excision, nucleotide excision, direct repair, SOS repair.
- Transcription: Mechanism of Prokaryotic &Eukaryotic transcription and their regulation. RNA polymerases structure and assembly, Eukaryotic promoters and enhancers, General and specific transcription factors, transcriptional repressors, mechanism of transcription regulation (The Operon concept, lac- & trp-operon), Transcriptional and post-transcriptional gene silencing.

UNIT-IV (20)

- Modifications in RNA: 5'-capping, polyadenylation, splicing, RNA editing, Processing of t-RNA and r-RNA.
- Prokaryotic and eukaryotic translation: The translation machinery, mechanism of initiation, elongation and termination. Post translational modification of proteins..
- Cell Signaling: Signaling molecules and signal receptors, second messengers, G protein coupled receptors, activation of gene transcription by G protein coupled receptors.

Course Outcome: The students will be learning about the structure and function of cell wall and plasma membrane, cell organelles such as chloroplast, mitochondria and others. Student will be able to understand the central dogma of life through detail study of DNA, RNA & cell signaling.

SEMESTER-I

BOT-104 Ecology & Biodiversity Full Mark: 100

Course objective: To Know about the principles of ecology, ecosystem & biodiversity.

Content:

UNIT–I (20)

- Concept of Ecology, Structure and function of ecosystem; trophic organization, food chain, food web & ecological pyramid. Principles and models of Energy flow, Production and productivity, methods of measuring productivity.
- Biogeochemical cycles - Carbon, Nitrogen, Sulphur and Phosphorus.

UNIT–II (20)

- Habitat and Niche; Concept, niche width & overlap, fundamental and realize niche, resource partitioning, character displacement.
- Community ecology: nature, structure and gradient analysis, community characteristics & Raunkiaer's life forms, level of species diversity and its measurement. Ecotone and edge effect.
- Succession - models of succession (monoclimax and polyclimax theories), Mechanism of succession in natural communities - facilitation, tolerance, and inhibition.

UNIT-III (20)

- Biotic interactions: positive and negative interactions.
- Population ecology: Basic concept, population characteristics; growth curves, population regulation, life history strategies (r&k selection). Concept of metapopulation, age structured populations.
- Major terrestrial biomes, theory of island Biogeography. phytogeographical zones of India.

UNIT-IV (20)

- Biodiversity: Concepts and level (α, β, γ), importance of biodiversity, status of biodiversity in India, major causes of biodiversity loss and its impact, biodiversity hot spots of India and world, IUCN categories of threat, red data book, convention of biological diversity (CBD), salient features of biodiversity Act.
- Conservation: Strategies for *in situ* Conservation: Protected areas, wildlife sanctuaries, national parks, biosphere reserve, strategies for *ex situ* conservation: botanical gardens, field gene banks, seed banks, *in vitro* conservation, DNA banks, national and international strategies for conservation of plant genetic resources, sustainable development in biodiversity.

Course Outcome: Students will able to understand the principles of ecology, components of ecosystem and cycling of nutrients. They will able to learn the methods of assessing vegetation quantitatively and also acquire knowledge on Biodiversity and its conservation.

SEMESTER-I

[Practical pertaining to papers 101, 102, 103 & 104]

BOT-105 **PRACTICAL** **Full Mark: 100**

1. Staining techniques for microorganisms (Basic staining, Negative staining, Gram staining, Acid fast staining, Lactophenol cotton blue staining).
2. Study of microbial growth.
3. Identification of algal samples through temporary mounting.
4. Separation and identification of algae from mixed population.
5. Preparation of temporary and permanent slides and study of vegetative and reproductive structures of members of Fungi & Algae
6. Preparation of temporary and permanent slides lichen.
7. Extraction of pigment from leaves and preparation of absorption spectra for chlorophylls and carotenoids.
8. Preparation of standard curves for quantification of protein, carbohydrate and reducing sugar.
9. Quantification of soluble and total protein and total carbohydrate contents of plant samples.
10. Demonstration on pre-treatment, fixation, staining and squashing technique for cytological analysis
11. Study of different stages of Mitosis and Meiosis of *Allium cepa*
12. Determination of minimum size of the quadrat by Species Area Curve method.
13. Determination of Frequency, Density and Abundance of different species in a grassland community.
14. Museum specimen of bacterial disease (citrus canker) viral disease (tobacco mosaic), Fungal diseases (Blight of rice, powdery mildew of pea, blight of potato, Blast of rice)

SEMESTER-I

Recommended Books:

1. **Microbiology-An Introduction**: GJ Tortora,BR Funcle& CL Case: The Bejamin/Cummings Publishing Company,Inc.
2. **Microbiolgy**: Klein, Harley & Prescott: JohnWilley
3. **Microbiology: Principles & Experiments**: JG Black: Bejamin/Cummings Publishing Company,Inc.
4. **Microbiology**: TD Brock: Bejamin/Cummings Publishing Company,Inc.
5. **General Microbiology**: Stanier: Blackwell ScientificPublication
6. **Basics of Plant Virology**: HN Verma: Oxford IBH PublishingCompany
7. **Introductory Phycology**: HD Kumar: Affiliated East-West Press, NewDelhi
8. **An Introduction to the Algae**: I. Morris: Cambridge UniversityPress
9. **The Biology of Algae**: FE Round: Cambridge UniversityPress
10. **Introductory Mycology**: CJ Alexopoulus& C.W. Mims: John Willey
11. **An Intoduction to Mycology**: RS Mehrotra& RS Aneja: New Age Intermediate Press
12. **Introduction to Fungi**: J Webster: Cambridge University Press
13. **Fungi**: BR Vashistha& AK Sinha: S. Chand & Company
14. **Plant Pathology**: Mehrothra,R.S.-TataMcGrawHillPublishingCo.NewDelhi .
15. **Genes X**: Benjamin Lewin: Oxford IBH
16. **Cell & Molecular Biology**: Concepts & Experiments: G. Karp: John Willey
17. **Molecular Biology of the Cell**: Alberts, Bray, Lewis et al: Garland Publisher
18. **Essentials of Molecular Biology**: MD Freifelder: Jones &Barlet Publisher
19. **Molecular & Cellular Biology**: SL Wolfe: Wadsworth Publishing
20. **Molecular Cell Biology**: H Lodish et al: WH Freeman, New York
21. **Cell & Molecular Biology**: De Robertis&Robertis: Blackwell
22. **Cell Biology-Fundamentals**: PK Gupta: Rastogi Publication
23. **Biochemistry and Molecular Biology of Plants**: Buchanan. B.B., Guissem, W. and Jones RL., American Society of Plant Physiologist, Maryland, USA
24. **Molecular Cell Biology**:Lodish, H., Berk, A., Zipurskt S.L. Matsudaire, P. Baltimore, D and Darnell J., W.H. Freeman and Co. New York, USA
25. **Practical Application of Plant Molecular Biology**: Henry R J., Cuapmman and Hall
26. **Annual Review of Plant Physiology and Molecular Biology**: annual review of Biochemistry, Academic Press
27. **Lehninger Principles of Biochemistry**, D.Nelson and M.Cox, Macmillan Worth Publishers
28. **Biochemistry**, Stryer, W.H.Freeman & Co.
29. **Fundamentals of Ecology**: EP Odum: Saunders
30. **Concepts of Ecology**: EJ Kormondy: Prentice Hall
31. **Ecology**: Principles & Application: JL Chapman, MJ Reiss: Cambridge Univ.
32. **Text book of Biodiversity**: K V Krishnamurthy: CRC Press
33. **Measuring Biological diversity**: A.E. Magurran: Blackwell publishing
34. **Biodiversity**: An introduction: Second Edition: Kevin J Gaston and John I. Spicer: Blackwell publishing
35. **Ecology**: Ricklefs and Miller:Fourth Edition: W. H. Freeman
36. **Ecology**: Theories and Applications: Peter Stiling
37. **Ecology**: From Individuals to Ecosystems: Begon, Townsend and Harper
38. **Ecology**: E.O. Wilson

SEMESTER-II

BOT-201 Plant Diversity-II Full Mark: 100

Course objective: To acquire the basic knowledge on classification, reproduction and economic importance of Bryophytes, Pterodophytes& Gymnosperms.

Content:

UNIT–I (20)

- Bryophyta: Theories of origin (algal and pteridophytean), Ecology, Evolution and Classification, Structure and reproduction of Anthocerotales, Marchantiales, Jungermanniales, Sphagnales, and Polytrichales.
- Evolution of gametophytes and sporophytes in Bryophytes Phylogenetic relationships among Bryophytes, ecological and environmental significance.

UNIT–II (20)

- Pteridophyta: Theories of origin (algal and bryophytean), evolution and classification, Structure and reproduction of Psilophyta, Lycophyta, Sphenophyta and Pterophyta.
- Structural diversity of sori, Soral evolution in ferns, Structure, morphology, evolution and significance of sporocarp, stellar evolution; Origin of heterospery, Heterospory and seed habit.

UNIT-III (20)

- Gymnosperm: origin, evolution and classification, Structure and reproduction of Cycadales, Ginkgoales, Coniferales, Ephedrales, Welwitscilales, and Gnetales.
- Phylogenetic importance Range of reproductive structures of Cycadales, Ginkgoales, Coniferales, and Gnetales, Structural diversity of pollens in Gymnosperms, Evolution of male and female gametophytes in Gymnosperms.

UNIT-IV (20)

- Paleobotany,General account of Pteridospermales, Cycadeoidales, Pentoxyllales, fossil Ginkgoales, Cordaitales and fossil Coniferales.
- Geological time scale, Basic concepts of continental drift, Fossilization process, Types of fossil, Dating of fossil, Fundamentals and applications of paleobotany, Palynology: Spore and pollen morphology, polarity, symmetry, ornamentation **(20)**

Course Outcome: Upon completion, students will able to know the general characteristics, classification, reproduction and economic importance of bryophytes. Pteridophytes& Gymnosperms. Student will gather information about fossil and palynology.

SEMESTER-II

BOT-202 Genetics & Plant Breeding Full Mark: 100

Course objective: To discern about fundamental concept of Genetics, sex chromosomes, sex determination, linkage, chromosomal aberrations and Plant breeding.

Content:

UNIT–I (20)

- Mendel's experiments and laws of inheritance, Interactions of genes, Multiple allele in human (ABO blood group); eye colour in Drosophila, Polygenic inheritance, pleiotrophy, Maternal effects and cytoplasmic inheritance, mitochondrial & chloroplast genome
- Sex chromosomes, Chromosomal sex determination: XX-XY, XX-XO and ZZ-ZW systems, Genic balance theory of sex determination, Sex determination in humans and Drosophila with special reference to SRY and sex lethal genes. Sex linkage: Sex linked genes in man, sex chromosome disorders in man, Sex influenced dominance by sex-linked gene expression. Sex determination in plants with special reference to Melandrium

UNIT–II (20)

- Linkage groups: Complete and incomplete linkage, Crossing over: Relationship between genetic and cytological crossing over, Relationship between crossing over and chaisma formation, molecular mechanism of crossing over
- Detection of linkage & Linkage maps: Test cross, test for linkage on the basis of F2 generation, LOD score, gene mapping, three point test cross in Drosophila, construction of linkage maps, identification of particular linkage groups with specific chromosome, physical distance and map distance, Interference and coincidence

UNIT-III (20)

- Chromosomal aberrations:Structural and numerical alterations/ variation in chromosomes, Mutation: Spontaneous and induced mutations, physical and chemical mutagens, Meiotic behavior of deletion, duplication, inversion and translocation.Euploids and aneuploids:classification, origin, induction,
- Population genetics: Hardy-Weinberg's Law, genetics of quantitative traits in population.

UNIT-IV (20)

- Plant breeding: Introduction and objective. Centre's of origin and domestication of crop plants, Selection and Hybridization, methods for self and cross pollinated plants:procedure, advantages and limitations. Role of mutations and polyploidy, Role of polyploidy in crop improvement
- Quantitative inheritance: Concept and mechanism with examples. Monogenic vs. polygenic inheritance. Inbreeding depression and heterosis.

Course Outcome: Upon completion, students will able to know the concept of Genetics, sex chromosomes, sex determination, linkage, chromosomal aberrations, Quantitative inheritance and Plant breeding.

SEMESTER-II

BOT-203 Plant Anatomy & Embryology Full Mark: 100

Course objective: Aim of the course is to educate students regarding differentiation of meristematic tissues, developmental biology and reproductive biology of the flowering plants.

Content:

UNIT–I (20)

- Introduction and scope of Plant Anatomy, Classification of tissues; Simple and complex tissues (with phylogeny); cyto- differentiation of tracheary elements and sieve elements; Organization of shoot apex and root apex. Secondary growth in stem, Anomalous secondary growth

UNIT–II (20)

- Mechanical tissue system: Principles governing the construction of mechanical system, arrangement or distribution of mechanical tissues in different plant organ. Wood and their elements, Wood anatomy in relation to phylogeny. Root Stem transition.Periderm: Development and composition of periderm, rhytidome and lenticels, Dendrochronology

UNIT-III (20)

- Male gametophyte: Structure of anthers, microsporogenesis, pollen development, male sterility, pollen germination, pollen tube growth and guidance, pollen storage, pollen allergy
- Female gametophyte: Ovule development, megasporogenesis, structure and organization of the embryo sac, pollination mechanisms and vectors, pollen embryos. Palynology in taxonomy.

UNIT-IV (20)

- Structure of pistil, pollen-pistil interactions, Self incompatibility in plants: cytological, biochemical and molecular aspects, Double fertilization and endosperm development & types.
- Development and maturation Embryogenesis: structure and development of monocot and dicot embryo, polyembyony and apomixes.

Course Outcome: Students will learn about plant cell development, differentiation of apical meristems &vascular tissues, flower development and its genetic regulation. Students will gain knowledge on development of fruit, senescence and its regulation, development of male and female gametophyte, pollen-stigma interactions and double fertilization.

SEMESTER-II

BOT-204 Plant Systematic & economic botany Full Mark: 100

Course objective: The course aims to add to understanding of the students about the nomenclature, classification and diversity and economic botany of flowering plants.

Content:

UNIT–I (20)

- Nomenclature: The species concept, delimitation of taxa and attribution of ranks, salient features of ICBN, herbarium methodology, important herbaria of the world. Phenetic and phylogenetic systems of classification, relative merits and demerits of major system of classification (Benthem& Hooker, Engler-Prantl, Hutchinson, APG system),

UNIT–II (20)

- Taxonomic evidence: Morphology, palyonology, anatomy, embryology, cytology and Phytochemistry, Cladistics in taxonomy, Molecular taxonomy.
- Range of floral structures in major dicot groups: Ranales, Asterales, Lamiales, and Leguminales.
- Range of floral structures in monocot groups: Poales, Scitaminae and Orchidales

UNIT-III (20)

- Economic Botany: Origin and domestication of cultivated plants, world centres of diversity of domesticated plants, plant introduction and secondary centre of origin, Evolution of new crops/varieties, Importance of germ plasma diversity, Morphology, cultivation and processing of millets and sugarcane

UNIT-IV (20)

- Morphology, processing of spices and beverages, Extraction and uses of oils, Evolution and uses of food, forage, fodder, fibre and oil-yielding crops., Uses of medicinal and aromatic plants, Important firewood and timber yielding plants and non-wood forest products, plants used as avenue trees for shade, pollution control and aesthetics

Course Outcome: Students will learn about ICBN and rules for plant nomenclature, merits and demerits of major system of classification, Taxonomic evidence and range of floral structures of different orders. Students will learn about centre of origin of plants and various economic uses of domesticated and wild plants.

SEMESTER-II

[Practical pertaining to papers 201, 202, 203 & 204]

BOT-205 PRACTICAL Full Mark: 100

1. Local field trip to acquaint the students with occurrence of Bryophyta, Pteridophytes and Gymnosperms at different habitats in nature and collection of specimens, and submission of report.
2. Study of morphological and anatomical features (vegetative and reproductive) of different classes of Bryophytes, Pteridophytes and Gymnosperms.
3. Preparation of permanent slides and study of vegetative and reproductive structures of members of Bryophytes, Pteridophytes and Gymnosperms. The students have to submit permanent slides.
4. Mendel's laws through seed ratios. Laboratory exercises in probability and chi-square analysis.
5. Pedigree analysis for dominant and recessive autosomal and sex linked traits.
6. Incomplete dominance and gene interaction through seed ratios (9:7, 9:6:1, 13:3, 15:1, 12:3:1, 9:3:4).
7. Blood Typing: ABO groups & Rh factor.
8. Preparation of permanent slides and study of anatomical features of stem and root of selected angiospermic plants.
9. Preparation of micro slides and study of anomalous secondary growth in selected angiospermic plants.
10. Study of anatomical and physiological adaptations in hydrophytes, xerophytes and epiphytes.
11. Microscopic preparation and study of embryological slides.
12. Determination of distribution and population status of taxa occurring in local flora.
13. Identification of species and assignment of correct names of selected taxa.Herbarium methodology: collection, preservation, mounting and submission of herbarium.
14. Study of vegetative and floral characters of materials of the families included in the theory syllabus.
15. Study of T.S. of Anther, Morphology of spores, Types of ovules (permanent slide & photograph), Development of dicot embryo through permanent slide/photographs.

SEMESTER-II

Recommended Books:

1. **Bryophytes**: Prem Puri: Atma Ram & Sons
2. **Bryophyta**: NS Parihar: Central Book Depot, Allahabad
3. **Biology & Morphology of Pteridophytes**: Central Book Depot,Allahabad
4. **The Morphology of Pteridophytes**: KK Sporne, BI Publishing Pvt. Ltd.Mumbai
5. **Gymnosperms**: SP Bhatnagar& A. Moitra: New AgeInternational
6. **Gymnosperm**: Structure & Evolution: CJ Chamberlain: CBS Publication, NewDelhi
7. **The Gymnosperms**: C. Biswas& BM Johri: Narosa PublishingHouse
8. **The Science of Genetics**: Atherly, Girton, Mc Donald: Saunders College Publication
9. **Genetics**: PJ Russel: The Benjamin/ Cummings Publisher
10. **Principles of Genetics**: DP Snustad& MJ Simmers: John Willey
11. **Genetics**: MW Strickberger: McMillan
12. **Genetics**: PK Gupta: Rastogi Publication
13. **Cytogenetics**: PK Gupta: Rastogi Publication
14. **Principles & Practice of Plant Breeding**: JR Sharma: Tata McGraw Hill
15. **Principles of Crop Improvement**: NW Simmonds: Longman, London
16. **Cytology& Genetics**: S Sen& DK Kar: Narosa Publishing House
17. **Hybrid Cultivar Development**: SS Banga& SK Banga: Narosa Publishing House
18. **Breeding Field Crops**: JM Poehlman& DR Sleeper: Panima Publishing
19. **Microbial Genetics**: D. Freifelder: Narosa Publishing House
20. **Principles & Procedures of Plant Breeding**: GS Chahal& SS Ghosal: Narosa Publishing House
21. **The Embryology of Angiosperms**: SS Bhojwani, SP Bhatnagar: Vikash Publishing
22. **An Introduction to Plant Cell Development**: J Burgess: Cambridge Univ. Press
23. **Plant Science**: Growth, Development, and Utilization of Cultivated Plants, Margaret E. McMahon , Anton M. Kofranek, Vincent E. Rubatzky - Prentice Hall
24. **Mechanisms in Plant Development**:OttolineLeyser, Stephen Day (Author) - Blackwell Science Ltd.;
25. **Taxonomy of Angiosperms**: VN Naik, Tata McGrawHill
26. **Flora of Orissa** : Saxena&Brahmam, OFDC, Bhubaneswar
27. **The Botany of Bihar & Orissa**: HH Haines, Bishen Singh &MahinderPalsing
28. **Handbook of Palynology**: G Erdtman , Hafner, New York
29. **An Aid to ICBN**:Henry& Chandra Bose, Today & Tomorrow Publication
30. **A Textbook of Economic Botany**: A Sambamurthy and Subramaniam, Willey Eastern
31. **Economic Botany in the Tropics**: SL Kochar, Mac Millan
32. **Taxonomy**: O P Sharma, McGraw Hill Book Company,NY
33. **Current Concepts in Plant Taxonomy**: PH Davis & VH Heywood,VH Heywood & DM Moore, Robert E Kreiger Publishing Co Academic Press, London
34. **Plant Systematics**: SB Jones & AE Luchsinge, McGraw Hill Book Company,NY

SEMESTER-III

BOT-301 Plant Physiology & Metabolism Full Mark: 100

Course objective: To acquaint with various physiological & metabolic pathways, nature and mode of action of enzymes and nitrogen fixation of plant.

Content:

UNIT–I (20)

- Water balance in plants, water absorption and transport through xylem, Mechanisms of transpiration and stomatal movement, Transport of ions across membrane ,water channels, H^+ - ATPase and H^+- pyrophosphatase, solute accumulation in vacuoles through ABC transporters, Translocation in phloem with special reference to pressure flow model, Phloem loading & unloading

UNIT–II (20)

- Photosynthesis: Photosynthetic pigments and light harvesting complexes, mechanism of electron transport, photo protective mechanisms; CO2 fixation: C3, C4 and CAM pathways, Photorespiration and it's significance.
- Respiration: Glycolysis, TCA cycle, pentose-phosphate pathway, Oxidative phosphorylation, Electron transport and ATP synthesis, alternate oxidase system.

UNIT-III (20)

- Plant Growth regulators: Biosynthesis, storage, breakdown and transport of plant hormones, Mechanism of action, physiological effects and applications of plant growth regulators auxins, gibberellins, cytokinins, ethylene and abscisic acid;
- Flowering and Senescence: Mechanism of flowering and photoperiodism and vernalization, biological clocks. Molecular mechanism of senescence and aging in plants

UNIT-IV (20)

- Nitrogen metabolism: Biological nitrogen fixation, mechanism of nitrate uptake and reduction, nitrate and ammonium assimilation,
- Sensory Photobiology: Pigments as photoreceptors, structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins,
- Stress Physiology: Responses of plants to biotic (pathogen and insects) and abiotic (water temperature and salt) stresses. Metal toxicity, oxidative stress.

Course Outcome: Student will be able to understand the mechanism of plant metabolism, enzyme kinetics and nitrogen fixation.

SEMESTER-III

BOT-302 Plant Biotechnology & Genetic Engineering Full Mark: 100

Course objective: The paper will deal plant cell, tissue & organ culture, somatic hybridization and cybridization, recombinant DNA technology and genetic engineering of plants. Students will be taught about various instruments and techniques used in biological experiments.

Content:

UNIT–I

- Plant cell, tissue & organ culture: History, scope and concept of cellular differentiations, totipotency, Fundamental aspects of morphogenesis: organogenesis and somatic embryogenesis, Clonal propagation, Artificial seeds. Androgenesis and production of haploids, Callus and cell suspension culture, Production of somaclonal variants, production of secondary metabolites in cultures, Cryopreservation. **(20)**

UNIT–II

- Somatic hybridization and cybridization: Factors affecting protoplast isolation, culture and plant regeneration, Protoplast fusion-chemical fusion & electrofusion mechanism & techniques, Selection of heterokaryotic fusion products, biochemical selection and physical selection (micromanipulation, flow cytometric characterization and cell sorting), Analysis of hybrids, Somatic hybrids and cybrids for crop improvement. **(20)**

UNIT-III **(20)**

- Recombinant DNA technology: Gene cloning-principles, Cloning vectors-plasmids, phages, cosmids & phagemids; Artificial chromosomes, Polymerase Chain Reaction-principles, types and applications, RT-PCR; Genomic and c-DNA libraries; Construction of recombinant DNA molecules and their mobilization into bacteria; Analysis of recombinant clones, DNA sequencing.

UNIT-IV

- Genetic Engineering of plants: Methods for gene transfer to plants, Agrobacterium mediated and direct gene delivery, Gene tagging, detection of foreign gene and gene products; Southern blotting, Northern blotting and Western blotting; Chloroplast transformation, Gene targeting, Transgenic plants for crop improvement, possible ecological risks and ethical concerns. **(20)**

Course Outcome: Students will learn about clonal propagation, production of haploids, somaclonal variants, development of somatic hybrids and cybrids for crop improvement. Students will gain knowledge on recombinant DNA technology and agrobacterium mediated gene transfer for development of transgenic plants.

SEMESTER-III

BOT-303 Research Methodology Full Mark: 100

Course objective: To acquaint the knowledge on research methodology basically on microscopy, computer and information methods. The students will be able to learn, how to study scientific literature, research ethics, writing research proposal & dissertation Content

UNIT–I **(20)**

- Biometry: Graphical Representation of Statistical Data, Measures of Central Tendency, Variance and Standard Deviation, Correlation and Regression Analysis, Test of Significance based on small samples, X^2 (Chi-Square), t-test, Analysis of Variance (ANOVA).
- Computer and Information Methods: MS Word, MS Excel, MS Power Point, Internet Latex, Bibliography tools, checking similarity using Plagiarism Detection Software

UNIT–II **(20)**

- Basic Methods in Biology: Microscopy-Principles and Working of light and Compound Microscopes, Phase Contrast, Fluorescent microscope
- Electron Microscopes (SEM & TEM), Fixation and Staining Techniques. Cryofixation,negative staining, shadow casting, freeze fracture, freeze etching.

UNIT-III **(20)**

- Analytical Techniques: Principles and Application of Spectrophotometer and Centrifugation
- Principles and Application of Chromatography, Electrophoresis and Tracer Techniques in biological research

UNIT-IV **(20)**

- Research Theory: Meaning and Objective of Research, Types of Research, Significance of Research, Research Methods, Research Process, Criteria of Good Research.
- Basics of Research Practice: Writing of Research Papers, Abstracts and Review Papers, Dissertations and Thesis Writing, Preparation and Presentation of Posters. Research Ethics: Introduction and Objective of Research Ethics,

Course Outcome: Upon successful completion of the course, students will be able to acquire knowledge on research methodology basically on microscopy, computer and information methods. The students will be able to learn, how to study scientific literature, research ethics, writing research proposal & dissertation. They can also know the better way of scientific communication

SEMESTER-III

[Practical pertaining to papers 301, 302 & 303]

BOT-304 PRACTICAL Full Mark: 100

1. To study the induction of amylase activity in germinating barley grains.
2. Measurement of relation between transpiration and transpiring surface.
3. To measure size of stomata using ocular and stage micrometer.
4. To determine the total chlorophyll pigment content of supplied leaf samples by spectrophotometer.
5. To compare the chlorophyll-a & chlorophyll-b ratio in C3 and C4 plants.
6. Preparation of plant tissue culture medium, sterilization and disinfection, Callus proliferation, shoot and root regeneration and transfer of axenically grown plants to soil,
7. Preparation of artificial seeds.
8. Study of Bt cotton, golden rice, flavr-savr tomato..
9. Isolation of plasmid DNA.
10. Demonstration of Gel electrophoresis.
11. Determine the effect of different wavelength of light on photosynrthesis.
12. Determine the rate of photosynthesis under different CO_2 concentration.
13. Determine the effect of light intensity on photosynthesis.
14. Determination of the osmotic potential of plant cell-sap by plasmolytic method.
15. Study of the effect of wind velocity, light on the rate of transpiration in the exised twig.

SEMESTER-III

OEC-BOT-305 Open Elective Course (OEC) Full Mark: 100

Course objective: The course aims to educate students on types, risks of Disaster & it's management with special reference to various recent case studies of disaster management.

Content: Disaster Management

UNIT–I **(20)**

- Disaster Management: Types of Disasters (Natural and Man-made and their cause and effect)
- Vulnerability Assessment and Risk Analysis: Vulnerability to various disasters (Flood, Cyclone, Earthquake, Heat waves and Lightning)

UNIT–II **(20)**

- Institutional Framework: Institutional arrangements for disaster management (National Disaster Management Authority (NDMA), State Disaster Management Authority (SDMA),
- District Disaster Management Authority (DDMA), National Disaster Response Force (NDRF) and Odisha Disaster Rapid Action Force (ODRAF)

UNIT-III **(20)**

- Preparedness Measure: Disaster Management Cycle, Early Warning System, Pre-Disaster and Post Disaster Preparedness,
- Strengthening of SDMA and DDMA, Community Preparedness, Stakeholder Participation, Corporate Social Responsibility (CSR)

UNIT-IV **(20)**

- Case Studies in Disaster Management in Odisha:
  1.1999 Odisha super cyclone
  2. Cyclone Phailin
  3. Cyclone Hudhud
- Survival Skills: Survival skills adopted during and after disaster Flood, Cyclone, Earthquake, Heat waves and Lightning.

(20)

Course Outcome: Students will learn about types and risks of disasters and how to manage with various management authorities.

SEMESTER-III

Recommended Books:

1. **Introduction to Plant Physiology**.Hopkins, W.G. and Huner, A. (2008).John Wileyand Sons. U.S.A. 4th edition.
2. **Plant Physiology andDevelopment**Taiz, L., Zeiger, E., MØller, I.M. and Murphy, A (2015). Sinauer Associates Inc. USA. 6th edition.
3. **Experiments in Plant Physiology-A Laboratory Manual**Bajracharya D. (1999).Narosa Publishing House, New Delhi.
4. **Plant Physiology** : Salisbury, F. B. and Ross, C. W. Wadsworth Publishing Company, California
5. **Outlines of Plant Physiology**Sahoo, A. C. (2018). Kalynai Publishers, New Delhi.
6. **Plant Physiology**:Srivastava, N. K.. (2017),Rastogi Publications, Meerut.
7. **Plant Physiology**:Pandey and Sinha (2011), Vikash Publishing House, New Delhi.
8. **Phytochemical Methods**: Harborne, J.B. (1973). John Wiley & Sons. New York.
9. **Advanced Plant Physiology**, Wilkins M.B., ELBS
10. **Biochemistry and Molecular Biology of Plant Hormones**:HooyKaas P.J.J., Hall M.A and Libbenga KR (EDS), Elsevier, Amsterdam, The Netherlands.
11. **Biochemistry and Plant Physiology of Plant Hormones**: Moore T.C., Springer-Verlag New York, USA
12. **Photoperiodism in Plant**: Thomas B. and Vince-Prrune, D., Academic Press, San Diego, USA
13. **Plant Biotechnology, the genetic manipulation of plants**. Adrian Slater, Nigel Scott and Mark Fowler. Oxford University Press.
14. **Plant Cell, Tissue and Organ Culture, Fundamental Methods**. Gamborg O.L. and Phillips G.e. (Editors). Narosa PublishingHouse.
15. **Introduction to Plant Biotechnology.**Chawla H.S. Oxford &mH Publishing Co. Pvt.Ltd.
16. **From Genes to Genomes, Concepts and Applications of DNA technology**. Dale IW. And Von Schantz M. John Wiley and SonsLtd.
17. **Plant Tissue Culture**: Theory and Practice..Bhojwani S.S and Razdan M.K.,Elsevier.
18. **Introduction to Bioinformatics**. Lesk M., Oxford UniversityPress.
19. **Biochemistry and Molecular Biology of Plants**, Buchanan. B.B., Guissem, W. and Jones RL., American Society of Plant Physiologist, Maryland,USA
20. **Molecular Cell Biology**, Lodish, H., Berk, A., Zipurskt S.L. Matsudaire, P. Baltimore, D and Darnell J., W.H. Freeman and Co. New York, USA
21. **Practical Application of Plant Molecular Biology**, Henry R J., Cuapmman andHall
22. **Annual Review of Plant Physiology and Molecular Biology**, annual review of Biochemistry, AcademicPress

SEMESTER-IV

BOT-401 Ethnobotany Full Mark: 100

Course objective: To acquaint the knowledge on Ethnobotany & its role in modern science, conservation of plant genetic resources.

Content:

UNIT–I (20)

- Introduction, concept, scope and objectives; Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context; Major and minor ethnic groups or Tribals of India, Odisha and their life styles. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses

UNIT–II (20)

- Role of ethnobotany in modern Medicine, Medico-ethnobotanical sources in India and Odisha; Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* (c) *Vitex negundo*. d) *Glorios asuperba* e) *Tribulus terrestris* f) *Pongamia pinnata* g) *Cassia auriculata* h) *Indigofera tinctoria*.

UNIT-III (20)

- Role of ethnic groups in conservation of plant genetic resources.Endangered taxa and forest management (participatory forest management). Role of ethnobotany in modern medicine with special example *Rauvolfia sepentina*, *Trichopus zeylanicus*, *Artemisia, Withania*.

UNIT-IV (20)

- Ethnobotany and legal aspects .Ethnobotany as a tool to protect interests of ethnic groups.Sharing of wealth concept with few examples from India and Odisha.Biopiracy, Intellectual Property Rights and Traditional Knowledge.

Course Outcome: Upon successful completion of this course student will be able to acquire basic knowledge on Ethnobotany & its role in modern science, conservation of plant genetic resources.

SEMESTER-IV

BOT-402-A Microbes & Microbial techniques-I Full Mark: 100

Course objective: To acquaint the knowledge on microbes, their physiology, concept and scope of industrial microbiology & microbial taxonomy.

Content:

UNIT–I (20)

- History and milestones in the development of microbiology, classification of microorganisms, Microbial culture methods: isolation, purification, growth, maintenance and preservation of microbes, axenic and synchronous culture, batch and continuous culture. Metabolic groups of bacteria, ultra-structure and composition of bacterial cell wall, cell inclusions and nucleic acids, reproduction, bacterial metabolism.

UNIT–II (20)

- Microbial Physiology: Bacterial photosynthesis (photosynthetic pigments and their location in the cell, anoxygenic photosynthesis, oxygenic photosynthesis, CO2 fixation), microbial nutrition (photoautotrophs, photoorganotrophs, chemolithotrophs and chemo-organotrophs), nitrate reduction and denitrification process, sulphate reduction.

UNIT-III (20)

- Microbial techniques: Different types of culture media, pure culture methods (isolation and maintenance), enrichment culture, and isolation of DNA.
- Microbial enzymes: Sources of enzymes, selection of microorganisms, mechanism of enzyme biosynthesis, large scale production and enzyme recovery, enzyme assay, enzyme production by microbes (α-amylase, Cellulases, Proteases and Lipases), enzyme immobilization.

UNIT-IV (20)

- General concept and scope of industrial microbiology; Isolation, preservation and maintenance of important industrial microorganisms. Strain improvement: Strain improvement strategies, strain selection and strain stability; Microbial taxonomy: microbial phylogeny derived from ribosomal RNA sequences, classical taxonomy, chemotaxonomy (DNA -DNA hybridization, ribotyping, and lipid profiling).

Course Outcome: Upon successful completion of this course student will be able to acquire basic knowledge on microbial diversity, various techniques of microbial culture, control and measurement of microbial growth, Microbial physiology, concept and scope of industrial microbiology & microbial taxonomy.

SEMESTER-IV

BOT-402-B Microbes & Microbial techniques-II Full Mark: 80

Course objective: To acquaint the knowledge on microbes fermentation techniques, soil microbiology, immunology & Microbes in soil fertility.

Content:

UNIT–I **(20)**

- Fermentor, design of bio-reactor, batch and continuous fermentation, downstream processing, industrial production of organic acids, alcohol, enzymes and antibiotics. Microbes in food: Principles of food preservation, contamination and food spoilage, microbiology of milk, processing and milk products, single cell protein-yeast, *Chlorella*, *Spirulina*, mushroom cultivation, microbial technology for pigments; bio hydrogen and biodiesel.

UNIT–II **(20)**

- Soil microbiology: surface and deep surface microbes, water microbiology: microbes of freshwater and marine habitats; aero microbiology: microbes in atmosphere, microbial activity and biogeochemical cycle. Wastewater microbes, microbial aspects of waste water treatment, biofilm structure and development, microbial interaction in biofilm, degradation of industrial pollutants and organic carbon, pesticide, hydrocarbon removal by microbes.

UNIT-III **(20)**

- Immune system, Lymphocytes and accessory cells, Immunoglobulins, mechanism of immune response and generation of antibody diversity, Effectors, complements, auto-immunity, AIDS and other immunodeficiency, Hybridoma and Mabs, Immunological techniques: detection of molecules using ELISA, RIA, western blot, flow-cytometry

UNIT-IV **(20)**

- Microbes in soil fertility: Nutrient metabolism, organic nitrogen transformation, phosphate solubilization, microbial association in soil. Lignocellulotytic and cellulolytic microbes, catabolic degradation. Biofertilisers: Types, methods of production, stain improvement, application and economics of *Rhizobium*, *Azotobactor*, *Azospirllum*, Mycorrhiza, Cyanobactria.

Course Outcome: Upon successful completion of this course student will be able to acquire basic knowledge on microbial diversity, various techniques of microbes fermentation techniques, soil microbiology, immunology & Microbes in soil fertility.

SEMESTER-IV

BOT-403-A Environmental Science-I Full Mark: 100

Course objective: Aim of the course is to educate students regarding fundamentals of environmental studies and ecology, natural resources and management, environmental hazards, risk and disaster management, environmental laws and awareness

Content:

UNIT–I (20)

- Foundation courses of environmental studies and fundamentals of ecology: Definition, concept and scope of Environmental studies. Different components of the environment: Atmosphere, Hydrosphere, Lithosphere and Biosphere. Concept of ecosystem, its biotic and abiotic components, anthropogenic activities and ecosystem degradation. Environmental protection and sustainable development**.**

UNIT–II (20)

- Natural resources and management: concept of natural resources, renewable and nonrenewable resources, mineral and water resources in India with special reference to Odisha and their exploitation, bioenergy resources, energy from biomass and biogas, energy plantation, petro plants, bioethanol and methane production, energy from solar and wind sources, rain water harvesting technology

UNIT-III (20)

- Environmental hazards, risk and disaster management: Environmental hazards: definition of hazard and disaster, environmental hazards: natural and technological hazards. Management of hazardous wastes, Risk analysis: concept of risk analysis types of models for risk analysis, their characteristics and salient features, guidelines for conducting risk analysis, Disaster management: concept of disaster management plan and the guidelines, disaster assistance.

UNIT-IV (20)

- Environmental laws and awareness: Environmental laws: Environmental protection act, water act., air act., land requisition policies and acts, forest laws and wild life protection act, rehabilitation and resettlement policies, biomedical waste disposal act and municipality solid waste disposal act, Environmental education and awareness: environmental ethics and global imperatives

Course Outcomes: Students will learn about components of the environment, Concept of ecosystem, Environmental protection and sustainable development, renewable and nonrenewable resources, environmental hazards and disaster management, environmental laws, environmental education and awareness.

SEMESTER-IV

BOT-403-B Environmental Science-II Full Mark: 80

Course objectives: To acquire knowledge on different environmental pollution and their management strategies

Content:

UNIT–I **(20)**

- Environment & Pollution: Definition of environmental pollution and pollutant, classification of pollution and pollutant, pollution and its effects on plants, animals, human beings and on materials, synergism and antagonism, Entry of pollutant into the environment, transfer of pollutant , abiotic transformation of pollutant, entry of pollutant into biosphere, bio-accumulation and bio-magnification, biodegradation of pollutants

UNIT–II **(20)**

- Air Pollution & Management: Normal composition of clean air, air pollution sources, deforestation, burning of fossil fuels, vehicular emission, rapid industrialization, agricultural activities and wars, effects of air pollution on biota, manufactured goods, aesthetic loss, global warming or green house effect, acid rain, ozone layer depletion, control of air pollution

UNIT-III **(20)**

- Water pollution & Management: Major water pollutant, sources of water pollution, point sources, non-point sources, industrial discharge, domestic sewage, agricultural waste, surface runoff, oil discharge, hot water discharge, radio-active wastes. Effects of water pollution on biota, Eutrophication, marine pollution, preservation and control of water pollution

UNIT-IV **(20)**

- Sources, effects and control of Soil pollution, Noise pollution, Radiation/Radio-active pollution, Importance of Environmental Impact Assessment; Role of Pollution Control Board to control environmental pollution
- Climate change: Evidences, impacts, Earth summit. UNFCCC, Kyoto protocol, Doha Amendment, Paris agreement.

Course Outcome: Students will understand and acquire knowledge on environmental pollution and their management strategies.

SEMESTER-IV

[Practical pertaining to papers 402]

BOT-404 **PRACTICAL** **Full Mark: 100**

1. Local field trip to nearby industries to acquaint the students with fermentation, food processing industries/environmental institute/research institute/various ecosystem & submission of the report.
2. Learning about safety rules, basic requirements, methods of sterilization preparation of culture media; Study of microscope and micrometry.
3. Demonstration and study of techniques for pure culture of microorganisms.
4. Techniques for isolation and enumeration of microorganisms from different habitats.
5. Study of maintenance and preservation of microorganisms.
6. Staining techniques (simple and differential) for identification of microorganisms.
7. Bacterial growth curve studies by turbidometric and cell count method.
8. Study of effect of environmental factors on bacterial growth.
9. Biochemical techniques for identification of selected bacteria.
10. Microbial examination of water for potability.
11. Isolation, cultivation and identification of Rhizobium, Azotobacter ,and Azospirillum from soil and associated host.
12. Antibiotic sensitivity test for bacteria and fungi on agar plate by disc diffusion method.
13. Study of antibiotic assay techniques.
14. Determination of Minimum Inhibitory Concentration (MIC) of antimicrobial compounds.
15. Microbiological examination of milk and milk products.
16. Isolation, culture and identification of microbes from contaminated food sample.
17. Screening of microbes (Bacteria and Fungi) for different industrial enzymes.
18. Study of production of alcohol and organic acids by microorganisms.

SEMESTER-IV

[Practical pertaining to papers 403]

BOT-404 **PRACTICAL** **Full Mark: 100**

1. Local field trip to nearby sewage treatment site, pollution management centres/environmental institute/research institute/various ecosystem & submission of the report.
2. Determination of total dissolved solids of water
3. Determination of dissolved oxygen concentration of water sample.
4. Determination of free carbon dioxide content of water of different water bodies.
5. Determination of Biological Oxygen Demand (BOD) of sewage sample.
6. Determination of Chemical Oxygen Demand (COD) of sewage sample.
7. Determine the efficiency of removal of air pollutant using fibrous air filter.
8. Effect of Sulphur dioxide on crop plants
9. Estimation of heavy metals in water/soil by Atomic Absortion Spectrophotometry.
10. Estimation of nitrate in drinking water.
11. Study of soil profile with respect to pH, moisture content, porosity and organic carbon content.
12. Study of water bodies and its pollution loads taking parameters like pH, DO content, free CO_2, BOD, COD, Acidity, Alkalinity and phosphate and nitrate content.

SEMESTER-IV

BOT-405 DISSERTATION Full Mark: 100

Course Objectives: The course aims to develop the skill of experimental design, critical thinking and scientific writing.

Content:

Each student is required to carry out a dissertation work involving either experimental research work or a review work under the supervision of a faculty member and submit a dissertation. The student has to start the project work from beginning of Semester- IV and submit the dissertation before the commencement of Semester IV theory examination. The project will be evaluated in Semester IV .The student has to give a Power Point Presentation in the presence of an external examiner and an internal examiner (the Supervisor). The project will be evaluated by the examiners based on the dissertation (50 marks), Power Point Presentation (25 marks) and viva-voce (25 marks).

Skill development with long term hands - on -training on various bio-techniques i.e. Microbes & Microbial techniques, Environmental Science along with data analysis software training for further research and development in Industries, Institutes and Academics

Course Learning Outcomes: Students will learn how to design experiments, think critically and write dissertation. The course will be a preliminary training to do research.

SEMESTER-IV

Recommended Books:

1. **Understanding Environmental Pollution**: Hill, M. K. (1997).. Cambridge University Press,
2. **Biology of Freshwater Pollution**. Mason, C. F. (1991).. Longman, New York.
3. **Fundamentals of Ecology**: EP Odum: Saunders
4. **Basic Ecology**: EP Odum: Saunders
5. **Ecology and Field Biology**: RL Smith: Harper Collins, New York
6. **Ecology:** M. Begon, J Harper & Townsend: Blackwell Scientific
7. **Fundamentals of Ecology**: EP Odum: Saunders
8. **Basic Ecology**: EP Odum: Saunders
9. **Terrestrial Plant Ecology**: MG Barnbaur, Bark, Bills: Benjamin/Cummings
10. **Concepts of Ecology**: EJ Kormondy: Prentice Hall
11. **Ecology:** Principles & Application: JL Chapman, MJ Reiss: Cambridge Univ.
12. **Sustainability Indicators**: B Moldan et al. John Willey
13. **Understanding Environmental Pollution**- MK Hill: Cambridge Univ. Press
14. **Microbiology**-An Introduction: GJ Tortora, BR Funcle& CL Case: The Bejamin/Cummings Publishing Company, Inc.
15. **Microbiolgy:** Klein, Harley & Prescott: John Willey
16. **Microbiology: Principles & Experiments**: JG Black: Bejamin/Cummings Publishing Company, Inc.
17. **General Microbiology**: Stanier: Blackwell Scientific Publication
18. **Kuby Immunology**: RA Goldsby, J Thomas: Freeman
19. **Immunology**: Roitt: John Willey