**Resolution No.: AC/II(23-24).2.RPS4**

**S.P. Mandali's**

# RAMNARAIN RUIA AUTONOMOUS COLLEGE

***(Affiliated to University of Mumbai)***

RUIA COLLEGE
Explore • Experience • Excel

## Syllabus for: Semester I and II

## Program: M. Sc. I

## Program Code: Botany (RPSBOT)

## Specialization: Molecular Biology, Cytogenetics and Plant Biotechnology

(As per the guidelines of NEP 2020- Academic Year 2024-25)

# GRADUATE ATTRIBUTES

In the post graduate courses, S. P. Mandali's Ramnarain Ruia Autonomous College is committed to impart conceptual and procedural knowledge in specific subject areas that would build diverse creative abilities in the learner. The College also thrives to make its Science post graduates research/ job ready as well as adaptable to revolutionarychanges happening in this era of Industry 4.0.

| GA | GA Description<br>**A student completing Masters in Science program will be able to:** |
|---|---|
| **GA 1** | Demonstrate in-depth understanding in the relevant science discipline. Recall, explain, extrapolate and organize conceptual scientific knowledge for execution and application and also to evaluate its relevance. |
| **GA 2** | Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary. |
| **GA 3** | Access, evaluate, understand and compare digital information from various sources and apply it for scientific knowledge acquisition as well as scientific data analysis and presentation. |
| **GA 4** | Articulate scientific ideas, put forth a hypothesis, design andexecute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language. |
| **GA 5** | Demonstrate initiative, competence and tenacity at the workplace. Successfully plan and execute tasks independently as well as with team members. Effectively communicate and present complex information accurately and appropriately to different groups. |
| **GA 6** | Use an objective, unbiased and non-manipulative approach in collection and interpretation of scientific data and avoid plagiarism and violation of Intellectual Property Rights. Appreciate and be sensitive to environmental and sustainability issues and understand its scientific significance and global relevance. |
| **GA 7** | Translate academic research into innovation and creatively design scientific solutions to problems. Exemplify project plans, use management skills and lead a team for planning and execution of a task. |
| **GA 8** | Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements. |

# PROGRAM OUTCOMES

| PO | PO Description<br>A student completing Masters in Science program in the subject of Botany will be able to: |
|---|---|
| PO 1 | Gain adequate knowledge on major groups of plants -Cryptogams to Phanerogams, learn the inter-relationships, phylogeny and evolutionary concepts, biodiversity in relation to habitat correlate with climate change, land and forest degradation and Paleobotany to trace the evolution of plants |
| PO 2 | Comprehend the concepts of plant taxonomy with respect to principles of ICN, evolution, concept of characters and methods to illustrate evolutionary relationships. Familiarize with the latest classification system and role of BSI |
| PO 3 | Gain core knowledge of foundational concepts of anatomy, developmental botany, ultra-structure and function of cell membranes cyto-genetics, physiology and ecology and their application in contemporary research/biological systems |
| PO 4 | Critically evaluate the functioning of organisms at the genomic and cellular level, Relate physiological adaptations, development and reproduction of higher plants. |
| PO 5 | Outline the utilization of various plant groups, ethnobotanical aspects, active constituents and medicinal uses of plants with special reference to usage as mentioned in different Pharmacopoeia. |
| PO 6 | Apply the skills in handling scientific instruments in planning and executing biological research, demonstrate proficiency in the experimental techniques and methods of analysis appropriate for their area of specialization |
| PO 7 | Apply the principles of biostatistics and bioinformatics in biological research, evaluate the scientific content, apply the scientific methods in formulating hypothesis and data analysis. |
| PO 8 | Apply the technique of plant tissue culture for the propagation of the plants which is the need in the society /industry, apply the methods of *in vitro* techniques for product enhancement |
| PO 9 | Apply the fundamentals of Nanotechnology, Environmental biotechnology and food biotechnology in various fields |
| PO 10 | Understand and apply the techniques of plant breeding procedures for hybridization, stress tolerance and genetic engineering of plants. |
| PO 11 | Develop critical and logical thinking capacity and prepare themself to qualify various competitive exams like MPSC, UPSC, SET, GATE,CSIR and UGC NET |

# PROGRAM OUTLINE

| YEAR | SEM | COURSE CODE | COURSE TYPE | COURSE TITLE | CREDITS |
|---|---|---|---|---|---|
| FY | I | **RPSBOTO501 (Discipline Specific Core)** | **DSC-1** | **PLANT DIVERSITY- I** | **03** |
| | | **I** | | Phycology | |
| | | **II** | | Mycology | |
| | | **III** | | Bryophyta | |
| | | **RPSBOTPO501** | **Practical DSC-1** | **PLANT DIVERSITY- I** | **01** |
| | | | | | |
| | | **RPSBOTO502 (Discipline Specific Core)** | **DSC-2** | **FORM AND FUNCTION- I** | **03** |
| | | **I** | | Anatomy and Developmental Botany | |
| | | **II** | | Environmental Botany | |
| | | **III** | | Stress Physiology | |
| | | **RPSBOTPO502** | **Practical DSC-2** | **FORM AND FUNCTION- I** | **01** |
| | | | | | |
| | | **RPSBOTO503 (Discipline Specific Core)** | **DSC-3** | **BIOANALYTICAL TECHNIQUES** | **03** |
| | | **I** | | Microscopy | |
| | | **II** | | Spectroscopy and PCR | |
| | | **III** | | Chromatography and Tracer techniques | |
| | | **RPSBOTPO503** | **Practical DSC-3** | **BIOANALYTICAL TECHNIQUES** | **01** |
| | | | | | |
| | | **RPSBOTO504 (Discipline Specific Core)** | **DSC-4** | **IPR AND TRADITIONAL KNOWLEDGE** | **02** |
| | | **I** | | Intellectual Property Rights | |
| | | **II** | | Traditional Knowledge | |
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| | | **RPSRMBOTO505** | | **Research Methodology** | **04** |
| | | **I** | | **Research Methodology- I** | |
| | | **II** | | **Research Methodology- II** | |
| | | **III** | | **Research Methodology- III** | |
| | | **IV** | | **Biostatistics** | |
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| | | **RPSBOTO506 (Discipline Specific Elective)** | **DSE** | **BIOPROSPECTING FOR INDUSTRIAL MOLECULES** | **03** |
| | | **I** | | Bioprospecting for crop protection and anti-microbial products | |
| | | **II** | | Algal biomass for high-value biomolecules | |
| | | **III** | | Bioprospecting for flavours and Fragrance | |
| | | **RPSBOTPO506** | **DSE** | **BIOPROSPECTING FOR INDUSTRIAL MOLECULES** | **01** |
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| | | | | | **22** |
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| | **II** | **RPSBOTE511 (Discipline Specific Core)** | **DSC-1** | **PLANT DIVERSITY- II** | **03** |
| | | **I** | | Pteridophyta, Paleobotany and Gymnosperms | |
| | | **II** | | Angiosperms | |
| | | **III** | | Palynology | |

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| | | **RPSBOTPE511** | **Practical DSC-1** | **PLANT DIVERSITY- II** | **01** |
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| | | **RPSBOTE512 (Discipline Specific Core)** | **DSC-2** | **FORM AND FUNCTION- II** | **03** |
| | | **I** | | Photosynthesis (Prokaryotes & Eukaryotes) | |
| | | **II** | | Protein structure | |
| | | **III** | | Plant Hormones | |
| | | **RPSBOTPE512** | **Practical DSC-2** | **FORM AND FUNCTION- II** | **01** |
| | | | | | |
| | | **RPSBOTE513 (Discipline Specific Core)** | **DSC-3** | **CURRENT TRENDS IN PLANT SCIENCES- I** | **03** |
| | | **I** | | Ethnobotany & Ethnopharmacology | |
| | | **II** | | Life guards of Coastal Ecosystems- Mangroves | |
| | | **III** | | Membrane Biophysics | |
| | | **RPSBOTPE513** | **Practical DSC-3** | **CURRENT TRENDS IN PLANT SCIENCES- I** | **01** |
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| | | **RPSBOTE514 (Discipline Specific Core)** | **DSC-4** | **BIOINFORMATICS AND MOLECULAR MODELING** | **02** |
| | | **I** | | Bioinformatics | |
| | | **II** | | Molecular Modeling | |
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| | | **RPSBOTE515** | | **FIELD PROJECT** | **04** |
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| | | **RPSBOTE516 (Discipline Specific Elective)** | **DSE** | **IMMUNOLOGY AND CANCER BIOLOGY** | **03** |
| | | **I** | | Immune system and Immunotechniques | |
| | | **II** | | Cancer biology and Cancer genetics | |
| | | **III** | | Genetic disorders | |
| | | **RPSBOTPE516** | **DSE** | **IMMUNOLOGY AND CANCER BIOLOGY** | **01** |
| | | | | | **22** |

## SEMESTER I

## DISCIPLINE SPECIFIC CORE COURSE- 1

## Course Code: RPSBOTO501

## Course Title: Plant Diversity- I

### Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe the morphology, structure, reproduction, classification and evolution of Algae and Fungi. |
| **CO 2** | Identify various plant diseases, based on symptoms and environmentally sustainable control measures. |
| **CO 3** | Classify Bryophytes according to the recent systems of classification. |
| **CO 4** | List the members of Bryophytes of ecological and economic value. |
| **CO 5** | Comment on the different commercial algae cultivation technologies, thereby exploring their industrial applications. |
| **CO 6** | Collect and identify Algae & Bryophyta and submit a report highlighting its characteristic features. |

## Detailed Syllabus

| RPSBOTO 501 | Title: Plant Diversity – I | Credits- 03 |
|---|---|---|
| **UNIT I** | **Phycology** | **Hours- 15** |
| | ➢ Classification of Algae upto orders as proposed by Gilbert M. Smith.<br>➢ Origin and evolution of sex in Algae.<br>➢ Techniques in commercial cultivation of Algae for protein & secondary metabolites, carbon credit, antibiotics and biofuel.<br>➢ Detrimental algae and their control.<br>➢ Toxic algae, Parasitic algae & Fossil algae<br>➢ Water blooms & red tides in India and across the world, their utility, disadvantages and control of algal blooms.<br>➢ Algae as a source of Pharmaceuticals & nutraceuticals.<br>➢ Algal collection and preservation. | |
| **UNIT II** | **Mycology** | **Hours- 15** |
| | ➢ Classification of fungi, upto orders, according to the system proposed by Alexopoulos.<br>➢ Sexuality in Fungi.<br>➢ General account of spore bearing organs and their | |

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| | arrangements in various groups of fungi; spore release and dispersal.<br>➢ History of plant pathology, Host-parasite relationship.<br>➢ Classification of plant diseases based on symptoms.<br>➢ Industrial applications of fungi with respect to agriculture, industries, food and medicine, harmful activities, fungal pigments of commercial importance.<br>➢ Mycorrhiza- type, distribution and significance with reference to agriculture and forestry. | |
| **Unit III** | **Bryophyta** | **Hours- 15** |
| | ➢ Classification of Bryophyta, up to orders, according to the system proposed by G.M. Smith, Campbell and Crandall-Stotler.<br>➢ Alternation of generation in Bryophyta.<br>➢ Origin and evolution of Bryophyta with reference to habitat and form.<br>➢ Evolution of gametophyte and sex organs in Bryophytes.<br>➢ Evolution of sporophyte in Bryophyta.<br>➢ Economic and ethnic uses of Bryophytes. | |
| **PRACTICALS** | | |
| **RPSBOTPO 501** | Practicals based on **Plant Diversity-I** | **Credit- 01** |
| 1 | **Phycology:** Study of following type with reference to their systematic position, thallus and reproductive structures:<br>*Scytonema, Lyngbya, Volvox, Scenedesmus, Oedogonium, Closterium, Nitella, Padina* and *Gracilaria*. | |
| 2 | Extraction of algal pigments and their separation by paper chromatography. | |
| 3 | Cultivation of microalgae and algal growth curve | |
| 4 | Estimation of metabolites from microalgae/ sea weeds. | |
| 5 | **Mycology:** Study of following type with reference to their systematic position, thallus and reproductive structures: *Stemonitis, Saprolegnia, Phytophthora, Peziza, Penicillium, Ganoderma,Auricularia,, Alternaria* and *Trichoderma.* | |
| 6 | **Plant diseases:** Ergot of rye, Covered smut of barley, Damping off, Early blight of Potato. | |
| 7 | **Economic Importance of fungi**: *Beauveria, Verticillium, Monascus, Mycorrhiza.* | |

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|---|---|
| 7 | **Bryophyta:** Study of following type with reference to systematic position, thallus and reproductive structures: *Targionia, Plagiochasma, Fimbraria, Pogonatum.* |
| | Collect and identify Algae/ Fungi/ Bryophytes from different habitat and prepare a key based on 5 characters. Prepare and submit a field report. |

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20. Pandey, B. P. 1999. Plant Pathology -pathogen and plant disease. S. Chand & Co.
21. Banks H.P. 1968 The early history of Land plants. In evolution and environment, ed. E.T.Drake. New Haven: Yale Univ. Press, pp, 73-107
22. Banks H.P. 1970 Evolution and plants of past. (Belmont, California, Wadsworth).
23. Lacey, W. A. 1969. Fossil Bryophytes.Biological Reviews, 44,189-205.
24. Parihar N. S. 1976. An introduction to Embryophyta, Bryophyta (Centaral Book House, Allahabad).

## DISCIPLINE SPECIFIC CORE COURSE- 2

## Course Code: RPSBOTO502

## Course Title: Form and Function- I

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe the basic concepts in anatomy regarding the origin of tissue systems and organogenesis. |
| **CO 2** | Explain the fundamentals of the development of male and female gametophytes, embryo and fertilization. |
| **CO 3** | Explain the ecological principles, applying the same to conservation strategies. |
| **CO 4** | Interpret the theory of population ecology and biogeography. |
| **CO 5** | Comment on the responses of plants to abiotic and biotic stresses. |

**Detailed syllabus**

| RPSBOTO 502 | Title: Form and Function- I | Credits- 03 |
|---|---|---|
| **UNIT I** | **Anatomy and Developmental Botany** | **Hours- 15** |
| | ➢ Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristems; shoot and root development, Quiescent centre; Root cap, origin of lateral root.<br>➢ Leaf development and phyllotaxy; transition of flowering, floral meristems and floral development in *Arabidopsis* and *Antirrhinum.*<br>➢ Male gametophyte: Gene expression, male sterility sperm dimorphism and hybrid seed production; pollen storage; pollen embryos.<br>➢ Female gametophyte: Types of embryo sacs<br>➢ Pollen-pistil interaction and fertilization: floral characteristics.<br>➢ Sexual Incompatibility, Embryogenesis, Polyembryony, Parthenocarpy, Apomixis - Seed germination and Seedling growth, applications of Embryology.<br>➢ Seed development and fruit growth; endosperm development during Early, Maturation and Desiccation stages; embryogenesis, ultrastructure and nucellar cytology; celllineage during late embryo development; storage proteins of endosperm and embryo; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation. | |
| **UNIT II** | **Environmental Botany** | **Hours- 15** |

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|---|---|---|
| | ➢ Habitat and Niche: concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.<br>➢ Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of meta-population–demes and dispersal, interdemic extinctions, age structured population.<br>➢ Biogeography: Major terrestrial biomes, theory of island biogeography; biogeographical zones of India.<br>➢ Present concern- Conservation of genetic resources, gene pools, land races, Global warming, Depletion of forest cover, urbanization and plant cover. | |
| **UNIT III** | **Stress Physiology** | **Hours- 15** |
| | ➢ Responses of plants to biotic (pathogen and insects) andabiotic (water, temperature and salt) stresses.<br>➢ Mechanism of resistance to biotic stress and tolerance toabiotic stress.<br>➢ Role of phytoalexins in plant disease resistance. | |

| **PRACTICALS** | | |
|---|---|---|
| **RPSBOTPO502** | Practicals based on **Form and Function- I** | **Credit- 01** |
| 1 | Study of wood elements in *Michelia* and *Thuja* stem, using maceration technique | |
| 2 | Study of the following leaves wrt leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth) in *Nymphaea, Nerium, Peperomia* | |
| 3 | Photosynthetic tissue system in *Araucaria, Cyperus, Ficus*. | |
| 4 | Effect of water and salinity stress on chlorophyll content and proline content of leaves. | |
| 5 | Comparison of two populations of a species collected from two areas. (stomatal index & epidermal architecture) | |
| 6 | Determination of Nygard index of algae in a water body. | |
| 7 | Determination of dust load on leaves of roadside plant. | |

**References:**


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**DISCIPLINE SPECIFIC CORE COURSE- 3**

## Course Code: RPSBOTO503

## Course Title: Bioanalytical Techniques

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Compare and contrast between the principles, working and applications of various bioanalytical techniques. |
| **CO 2** | Illustrate the basic principles, working and applications of chromatography. |
| **CO 3** | Determine the basic principles of tracer techniques and PCR and their applications. |
| **CO 4** | Demonstrate the preparation of various buffers and their applications in various experiments. |

**Detailed Syllabus**

| RPSBOTO 503 | Title: Bioanalytical Techniques | Credits- 03 |
|---|---|---|
| **UNIT I** | **Microscopy** | **Hours- 15** |
| | ➢ Principles, instrumentation, working and applications of Fluorescence microscopy, Polarization microscopy, Phase contrast microscopy, TEM & SEM.<br>➢ Biological sample preparation for electron microscopy. | |

| UNIT II | Spectroscopy and PCR | Hours- 15 |
|---|---|---|
| | ➢ IR, GC MS, LC MS, AAS, ICP- AES, Plasma Emission spectroscopy, NMR & 2D NMR.<br>➢ PCR: Principle, Steps in PCR, Constraints in PCR, Modifications of PCR techniques and its applications. | |
| **UNIT III** | **Chromatography and Tracer techniques** | **Hours- 15** |
| | ➢ General Principle of chromatography.<br>➢ Techniques and applications of Ion exchange, Affinity Chromatography and HPLC Application / validation of herbal drugs using HPTLC.<br>➢ Radioactive isotopes and autoradiography-Principle, instrumentation & technique: Geiger-Muller counter, Liquid scintillation counters.<br>➢ Applications of isotopes in biology.<br>➢ PET scan, CT scan, Radionuclide imaging.<br>➢ Blotting techniques- Southern blotting, Western blotting and Northern blotting. | |
| **PRACTICALS** | | |
| **RPSBOTPO503** | Practicals based on **Bioanalytical techniques and IPR** | **Credit- 01** |
| 1 | Preparation of buffers (phosphate and acetate) | |
| 2 | Determination of pKa | |
| 3 | Density gradient centrifugation. | |
| 4 | Analysis of heavy metals from soil/plant sample by AAS | |
| 5 | Analysis of volatile oils by GC-MS | |
| 6 | Separations of proteins by ion exchange chromatography | |
| 7 | Separation of phytochemicals using chromatographic techniques (HPLC/HPTLC) | |
| 8 | Separation of amino acids by two-dimensional chromatography | |
| 9 | DNA amplification using PCR | |

**References:**

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2. Chang R 1971. Basic principles of spectroscopy. McGraw Hill.

3. Garry D Christian, James E O'reilvy 1986. Instrumentation analysis. Alien and Bacon, Inc.
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## DISCIPLINE SPECIFIC CORE COURSE- 4

## Course Code: RPSBOTO504

## Course Title: IPR and Traditional Knowledge

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Recall the importance of IP and basic concepts of Intellectual Property Rights. |
| **CO 2** | Learn the procedure of obtaining patents, copyrights, trade Marks & industrial design. |
| **CO 3** | Understand the statutory provisions of different forms of IPRs in simple forms. |
| **CO 4** | Identify the significance of practice and procedure of patents. |

**Detailed Syllabus**

| RPSBOTO 504 | Title: IPR and Traditional Konwledge | Credits – 2 |
|---|---|---|
| **UNIT I** | **Intellectual Property Rights** | **Hours- 15** |
| | ➢ IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO –TRIPS. TRIPS & Patent laws: Introduction and standards for patent protection.<br>➢ Different types of IPR's<br>➢ Patent Act 1970 – amendments of 1999, 2000, 2002 and 2005<br>➢ Patentable subject matter, Patentability criteria, non-patentable inventions, Drafting a patent specification.<br>➢ Prior art/ Novelty search: Free and paid databases<br>➢ Rights of patentee, Procedure for granting a patent and obtaining patents, Grounds for opposition, Working of Patents, Compulsory License Acquisition, Surrender, Revocation, restoration, Transfer of patent rights<br>➢ PCT, Types of patent applications, patent forms, guidelines, fee structure, priority date.<br>➢ Patent protection: Pharmaceutical products and process,<br>➢ Patenting life forms. Patenting biotech inventions – minimum 5 case studies<br>➢ Ethics in IPR: Public health and Intellectual Property Rights Case study—Novartis Pharmaceuticals<br>➢ Bayer Pharmaceuticals<br>➢ Meaning of Copyright : Idea Vs Expression Dichotomy, Copyright Vs Moral rights, Performer's right, Copyright in Literary, Drama, and musical works, Sound Records, Cinematograph films, computer programmes. | |

| | | |
|---|---|---|
| | ➢ Copyright Act, 1957 – Salient features of the Act (Amendment Act 2012) - Ownership of copyright – Assignment of Copyright –Term of Copyright – Copyright Office – Copyright Board, Copyright : registration and duration. | |
| **UNIT II** | **Traditional Knowledge** | **Hours- 15** |
| | ➢ Protection of traditional knowledge– objective, concept of traditional knowledge, holders, issues concerning bio-prospecting and biopiracy; geographical indications, industrial designs, advantages of IPR, some case studies.<br>➢ Recognition and Documentation of Traditional Knowledge – Databases – Traditional Knowledge Digital Library "TKDL" – AYUSH Systems of Medicines – Biodiversity Register. Prevention of plundering TK- neem, basmati and turmeric patents.<br>➢ Traditional Knowledge as Property – Nature of Property in genetic Resources and associated traditional Knowledge - Ownership in Traditional Knowledge: Nature and Elements of Ownership – Exclusivity and Protection –Benefit Sharing.<br>➢ International Depositary authority, Gene patenting, National gene bank.<br>➢ Plant variety protection, farmer's rights, plant breeders rights. Protection of Plant Varieties and Farmers' Rights Act, 2001. Registration of Plant Varieties – Duration and effect of Registration, GM crops | |

**REFERENCES:**


1. Hamilton, C..2006. Biodiversity, Biopiracy and Benefits: What allegations of Biopiracy tell us about intellectual property. Blackwell publishing Ltd., Oxford.
2. Heink, U and Kowarik,I. 2010. What criteria should be used to select biodiversity indicators . Biodiversity Conservation 19:3769-3797.
3. Ram Reddy,S. Surekha ,M. and Krishna Reddy,V 2016. Biodiversity Traditional Knowledge Intellectual Property Rights .Scientific Publishers.
4. Unnikrishna,P and Suneetha,M. 2012. Biodiversity ,traditional knowledge and community health : strengthening linkages .Institute for Advanced Studies, United Nations University ,Tokyo.
5. Wood ,A., Pamela, S.E.and Johanna, M.2000. The root causes of biodiversity loss. United Kingdom: Early –Scan Publications.

# RESEARCH METHODOLOGY

## Course Code: RPSRMBOTO505

## Course Title: Research Methodology

## Academic year 2024-2025

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Enlist the resources for accessing scholarly articles, published papers, abstract writing and bibliographic management. |
| **CO 2** | Illustrate the skills to design good research hypotheses and select an appropriate data analysis method. |
| **CO 3** | Make use of methods of data collection, tools for data analysis and ethical issues in educational research. |
| **CO 4** | Apply basic computer skills and required numerical skills necessary for the conduct of research. |

**Detailed Syllabus**

| RPSRMBOTO505 | Title: Research Methodology | Credits- 04 |
|---|---|---|
| **UNIT I** | **Research Methodology- I** | **Hours- 15** |
| | ➢ Introduction: Research design principles, execution of work, interpretation of results.<br>➢ Review of literature<br>• Library: Types of sources, Structure of a scientific library, journals, books, Digital library and E books<br>• Catalogue: Classification of books (Universal Decimal System)<br>• Journals: Indexing journals, H-index, abstracting journals, research journals, review journals, e-journals.<br>• Impact factor of journals, NCBI-Pub Med.<br>• Reprints, Secondary storage devices, Internet, open access initiative for biological sciences, INFLIBNET, INSDOC, Google Scholar, Ruia Library OPAC, OATD, Shodhganga, Shodhgangotri & N-LIST.<br>• Research Metrics – Impact factor of journals, H-index, Indexing databases – Web of Science, Scimago, Indian Citation Index etc. | |

| UNIT II | Research Methodology- II | Hours- 15 |
|---|---|---|
| | ➢ Introduction to scientific writing: Meaning of Scientific and non-scientific writing; Scientific Vocabulary and grammar. Synopsis, Dissertations, Thesis, Posters.<br>➢ Correspondence: Formal letters, cover letters, drafting emails, replying to reviewers.<br>➢ Writing a Research paper: Title, Abstract, Introduction, Review of literature, Methodology, Observations, Results, Discussions, Summary, Conclusion, and Bibliography (Referencing and citation styles). Supplementary data.<br>➢ Writing a Research Grant Proposal: Funding agencies, guidelines, structure of research proposals – Setting a budget (Manpower, Consumables, Equipment, Travel, Contingencies, Overheads) with justifications, Expected outcomes, Cost benefit analysis, Work plan, and Time schedule of activities.<br>➢ Bioethics: Definition – moral, values, ethics and ethics in biology; Role and importance of ethics in biology; Legal and regulatory issues; Bioethics in healthcare, agriculture, modern biology, biotechnology, animal welfare & right / animals in research, wildlife conservation and management, commercialism in scientific research.<br>➢ **Scientific misconduct:** Plagiarism, Fabrication, Authorship conflicts, Salami and Imalas publication. | |
| **UNIT III** | **Research Methodology- III** | **Hours- 15** |
| | ➢ **Literature Search:** Query formulation and organization of review.<br>➢ **Referencing:** Using Mendeley/ EndNote/ Zotero.<br>➢ **Word Processing systems:** Microsoft Word, Google Docs, LATEX**.**<br>➢ **Image Editors:** Guidelines for publishing images, Inkscape, GIMP, Image J. Creating a multi-panel vector and raster image for research paper publishing.<br>➢ **Graphing & Statistics:** Using Microsoft Excel, Google Sheets, GraphPad Prism, MaxStat, IBM SPSS and R.<br>➢ **Presentation and Design:** Microsoft PowerPoint, Google Slides, Microsoft Publisher. Presenting numerical data - Graphical, Tabular, Animations, Slides, etc.<br>➢ **Creating a website for scientific communication:** Google sites, Wix website design and publishing.<br>➢ **Miscellaneous Tools and AI**. | |
| **UNIT IV** | **Biostatistics** | **Hours- 15** |
| | ➢ Hypothesis testing: Theory of errors – Type I and Type II errors<br>➢ Null Hypothesis & Alternate Hypothesis<br>➢ Z-test<br>➢ Test of significance | |

| | | |
|---|---|---|
| | ➢ Introduction to ANOVA, One-way & Two-way ANOVA<br>➢ Randomized Block Design and Latin Square. (5 problems to be solved in each category)<br>➢ Dunett's test | |

**References:**

1. Anderson J, Durston B H, Poole 1970. Thesis and assignment writing. Wiley eastern.
2. Bedekar V. H.1982. How to write assignment and research papers, dissertations and thesis. Kanak publications.
3. Kothari– C.R. 2004. Research Methodology –Methods and Techniques, New Age InternationalLtd. Publishers, New Delhi
4. S. C. Gupta and V.K. Kapoor; 3rd Edition; Sultan Chand and Sons (2001): Fundamentals of Applied Statistics and Fundamentals of Mathematical Statistics.
5. Introduction to Biostatistics (Second Edition-2005) N. Gurumani M J Publishers.
6. Biostatistics: A foundation For Analysis In Health Sciences ( 7th Edition 1999) Wayne W. Daniel John Wiley & Sons Inc.

## DISCIPLINE SPECIFIC ELECTIVE

## Course Code: RPSBOTO506

## Course Title: Bioprospecting for Industrial Molecules

## Academic year 2024-25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Describe the role of entomotoxic proteins in crop protection. |
| **CO 2** | Enumerate the different extraction methods of natural sources for flavours and fragrances. |
| **CO 3** | Interpret the role of algae and plant products in bioprospecting. |
| **CO 4** | Comment on the economic potential of biological resources for obtaining industrial Molecules of pharmaceutical, bioceutical & agricultural value. |
| **CO 5** | Elaborate on the plant resources as antimicrobials by testing their antimicrobial activity. |

**Detailed Syllabus**

| RPSBOTO 506 | Title: Bioprospecting for Industrial Molecules | Credits- 03 |
|---|---|---|
| **UNIT I** | **Bioprospecting for crop protection and anti-microbial products** | **Hours- 15** |
| | ➢ Introduction to Bioprospecting, its significance and recent trends in bioprospecting.<br>➢ Entomotoxic proteins to control the crop insect pests and mechanism of insecticidal activity:<br>➢ Lectins, Ribosome-Inactivating Proteins (RIPs), Arcelins, Defensins, Cyclotides (two examples of each)<br>➢ Use of plant products as antimicrobials: Historical perspective.<br>➢ Major groups of Plant-derived antimicrobial compounds:<br>• Phenols and Phenolic acids, Terpenes and Essential oils,<br>• Alkaloids (any two examples of each) | |

| | | |
|---|---|---|
| | ➢ Mechanisms of Antimicrobial activity:<br>• Plant extracts with efflux Pump Inhibitory Activity, Bacterial Quorum Sensing InhibitoryActivity, Biofilm Inhibitory Activity | |
| **UNIT II** | **Algal Biomass for high-value biomolecules** | **Hours- 15** |
| | ➢ Algae as a source of high-value biomolecule production:<br>• Polyphenols<br>• Polysaccharides<br>• Fatty acids<br>• Pigments | |
| **UNIT III** | **Bioprospecting for flavours and fragrances** | **Hours- 15** |
| | • Physiological mechanism of biosynthesis of essential oils: Metabolic cycles of biosynthesis of Phenolic compounds.<br>• Methods of extraction of natural sources for flavours and fragrances.<br>• Designing of flavours and fragrances and sensory evaluation. | |
| **PRACTICALS** | | |
| **RPSBOTPO506** | Practicals based on **Bioprospecting for Industrial Molecules** | **Credit- 01** |
| 1 | Anti-microbial activity of plant extracts by disc diffusion method/ well diffusion method/ MIC method. | |
| 2 | Protein profiling by PAGE (seed proteins). | |
| 3 | Applications of proteins to control insect pests. | |
| 4 | Fractional distillation of essential oils (mint/citronella/Chafa). | |
| 5 | Creation of flavours & fragrances and practical demonstration. | |
| 6 | Estimation of fragrance / flavours | |
| 7 | Application of fragrances in cosmetics, food Agarbatti, Soap, Cream, Talcum Powder etc.<br>Application of flavours in soft drink, tooth powder, jam, ketchup etc. | |
| 8 | Synthesis of nanoparticles | |
| 9 | Characterization of nanoparticles by UV spectroscopy. | |

**References:**

1. Ramya Krishnan, Sudhir P. Singh, and Santosh Kumar Upadhyay. 2021. An introductionto Plant Biodiversity and Bioprospecting. Wiley Publications.

2. Surjeet Kumar Arya, Shatrughan Shiva, Santosh Kumar Upadhyay. 2021. Entomotoxic Proteins from Plant Biodiversity to Control the Crop Insect Pests. Wiley Publications.

3. Pankaj Kumar Verma, Shikha Verma, Nalini Pandey, and Debasis Chakrabarty. 2021. Antimicrobial products from plant Biodiversity. Wiley Publications.

4. Dinesh Kumar Yadav, Ananya Singh, Variyata Agrawal, Neelam Yadav. 2021. AlgalBiomass: A Natural Resource of High-Value Biomolecules. Wiley Publications.

5. Monica Butnariu. 2021. Plants as Source of Essential Oils and Perfumery Applications.Wiley Publication.

# Modality of Assessment-DSC/DSE

**Theory Examination Pattern:**

**A) Internal Assessment- 40%- 30 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Class Test | 20 |
| 2 | Assignment | 10 |
| | **TOTAL** | **30** |

**B) External Examination (Semester End)- 60%- 45 Marks**

**Semester End Theory Examination:**

1. Duration – The duration for these examinations shall be of **two hours**.
2. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q.1 | Any 3 out of 4. | 15 | Unit- I |
| Q.2 | Any 3 out of 4. | 15 | Unit- II |
| Q.3 | Any 3 out of 4. | 15 | Unit- III |
| | **TOTAL** | **45** | |

**Practical Examination Pattern:**

**External (Semester end practical examination):**

| Particulars | Practical 1 |
|---|---|
| Laboratory work /Viva | 25 |
| **Total** | **25** |

**PRACTICAL BOOK/JOURNAL**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examinations.**

# Modality of Assessment- Research Methodology

**Theory Examination Pattern:**

**C) Internal Assessment- 40%- 40 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Scientific Writing assignment (Abstract /Research Article) | 20 |
| 2 | Research Review/ Research Proposal Writing | 20 |
| | **TOTAL** | **40** |

**D) External Examination (Semester End)- 60%- 60 Marks**

**Semester End Theory Examination:**

3. Duration – The duration for these examinations shall be of **two Hours**.
4. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| 1 | Any 3 out of 4 | 15 | Unit I |
| 2 | Any 3 out of 4 | 15 | Unit II |
| 3 | Any 3 out of 4 | 15 | Unit III |
| 4 | Any 3 out of 4 | 15 | Unit IV |
| | **TOTAL** | **60** | |

# Modality of Assessment- Traditional knowledge and Intellectual Property Rights

**External Examination (Semester End)- 60%- 50 Marks**

**Semester End Theory Examination:**

5. Duration – The duration for this examination shall be of **two hours**.
6. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q.1 | Any 2 out of 3. | 20 | Unit- I |
| Q.2 | Any 2 out of 3. | 20 | Unit- II |
| Q.3 | Any 2 out of 3. | 10 | Unit- I and II |
| | **TOTAL** | **50** | |

## Overall Examination and Marks Distribution Pattern

### Semester- I

| Course | RPSBOTO501<br>RPSBOTO502<br>RPSBOTO503<br>RPSBOTO506 | | Total of 4 courses | | RPSBOTO504 | RPSBOTO505 | | Grand Total |
|---|---|---|---|---|---|---|---|---|
| | Internal | External | Internal | External | External | Internal | External | |
| Theory | 30 | 45 | 120 | 180 | 50 | 40 | 60 | 450 |
| Practicals | 25 | | 100 | | - | - | | 100 |

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## SEMESTER II

## DISCIPLINE SPECIFIC CORE COURSE- 1

## Course Code: RPSBOTE511

## Course Title: Plant Diversity- II

## Academic year 2024– 25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Explain the structures of fossil forms highlighting their role in evolutionary studies. |
| **CO 2** | Classify Pteridophytes and Gymnosperms and comprehend the affinities and interrelationships between various orders. |
| **CO 3** | Summarize the rules of nomenclature according to the ICN. |
| **CO 4** | Interpret the evolutionary relationships among angiosperms. |
| **CO 5** | Comment on the palynological information for plant systematics, agriculture and horticulture. |
| **CO 6** | Elaborate the structure of angiosperm pollen and the special relationships between pollen grains in pollen tetrad. |

**Detailed Syllabus**

| RPSBOTE511 | Title: Plant Diversity – II | Credits- 03 |
|---|---|---|
| **UNIT I** | **Pteridophyta, Paleobotany and Gymnosperms** | **Hours- 15** |
| | ➢ Classification of Pteridophyta up to orders, according to the system proposed by G.M. Smith, Bold, Benson & Zimmermann.<br>➢ Cultivation and maintenance of ornamental ferns.<br>➢ Ethnomedicinal and ecological importance of Pteridophytes.<br>➢ The geological time scale and a study of fossil Pteridophytes. (*Horneophyton*, *Sphenophyllum*).<br>➢ Classification of gymnosperms upto orders according to the system proposed by C. J. Chamberlain & recent classification systems by Raizada and Sahni, Sporne and Christenhusz *et al.*<br>➢ General characters; affinities and interrelationships of Cycadofilicales, Bennettitales and Cordaitales.<br>➢ A study of fossil Gymnosperms- *Glossopteris*, *Medullosa*. | |
| **UNIT II** | **Angiosperms** | **Hours- 15** |

| | | |
|---|---|---|
| | ➢ Origin and evolution of Angiosperms., the primitive Angiosperm flower; primitive and advancedcharacters in Angiosperms.<br>➢ An International Code of Nomenclature (I.C.N.), History and basic principles.<br>➢ Principles for assessment of relationships, delimitation of taxa and attribution of rank: a. criteria b. guidelines c. practical considerations, d. use of categories.<br>➢ APG system of classification.<br>➢ Evolution, Variation and speciation, Biosystematic categories, Biotypes and Ecotypes.<br>➢ Concept of characters: Introduction, type function values of taxonomic importance.<br>➢ Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences), methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). | |
| **UNIT III** | **Palynology** | **Hours- 15** |
| | ➢ Special relationships of pollen grain in pollen tetrads:<br>• Young Microspores: their arrangement and number in tetrads.<br>• Pollen Wall: Ultrastructure, Morphogenesis: Formation of Aperture Pattern, Primexine formation, Exine and Intine development, Pollen attaching vehicles.<br>➢ Phylogeny of Angiosperm Pollen:<br>• Evolutionary Trends among pollen grains based on Palynotaxonomic work: Evolutionary trends in Aperture, Ornamentation and Stratification.<br>• Phylogenetic Considerations:<br>o Pollen Evolution in Early Angiosperms,<br>o Phylogeny of Dicotyledons, and Monocotyledons<br>o Role of Pollen Morphology in Phylogeny and Plant Taxonomy.<br>➢ Applications of Palynology in Agriculture and Horticulture. | |

| **PRACTICALS** | | |
|---|---|---|
| **RPSBOTPE511** | Practicals based on **Plant Diversity – II** | **Credit- 01** |
| 1 | **Pteridophyta:** Study of following type with reference to their systematic position, thallus and reproductive structures: *Isoetes, Ophioglossum, Pteris, Angiopteris, Lygodium* and *Azolla.* | |
| 2 | **Ethnomedicinal and ecological importance of Pteridophytes :** *Lycopodium*,*Azolla.* | |
| 3 | **Gymnosperms:** Study of following type with reference to their systematic position, vegetative and reproductive structures: *Auraucaria, Cupressus , Podocarpus* and *Juniperus.* | |
| 4 | **Study of fossils:** *Horneophyton, Sphenophyllum*, *Glossopteris*, *Medullosa,* | |
| 5 | **Angiosperms:** A study of the following plant families their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae,Meliaceae, Lythraceae, Boraginaceae, Bignoniaceae, Chenopodiaceae, Scitaminae, Cyperaceae. | |

| | |
|---|---|
| 6 | Identification of genus and species with the help of flora volumes. (In addition to the above mentioned families, all families studied in undergraduate classes are included). |
| 7 | Effect of temperature on pollen viability. |
| 8 | Study of the morphology of the pollen using NPC chart (using Chitale's method) from the families; Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Gramineae. |

**References:**

1. Bhatnagar S.P. and Moitra A. 1997 Gymnosperms. New Age India publishers, New Delhi.
2. Biswas C. and Johri B.M. 1997 The Gymnosperms. Narosa Publishing House, New Delhi.
3. Chamberlain C.J. 1998. Gymnosperms: Structure and evolution. CBS Publishers, New Delhi
4. Coulter J.M. and Chamberlain C.J. 1991. Morphology of Gymnosperms. Central Books,Allahabad.
5. Singh V.P. 2006. Gymnosperms. Sarup and Sons, New Delhi.
6. Sporne K.R. 1994. The morphology of gymnosperms. BI Publications Pvt. Ltd. New Delhi
7. Vasishta P.C. 2004. Gymnosperms. S. Chand & Company, New Delhi.
8. Biswas, C and Johri, B.N. 2004. The Gymnosperms, Narosa Publishing House, New Delhi.
9. Kakkar, R.K.and Kakkar, B.R. 1995. The Gymnosperms (Fossils and Living), CentralPublishing House, Allahabad.
10. Sharma O.P. 2002. Gymnosperms, Pragati Prakashan, Meerut.
11. Bhatnagar, S.P. and Moitra A. 1996. Gymnosperms, New Age International Pvt. Ltd., New
12. DelhPat, D.D. 2003. Cycas and allied Cycadophytes, BSIP, Publications.
13. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw -Hill Book Co., New York.
14. Nordentam, B. El Gazaly, G. and kassas, M. 2000.Plant systematic for 21st century.Portland press.Ltd, London.
15. Radford, A. E. 1986. Fundamentals of plant systematics.Harper and Raw publication, USA
16. Bhattacharya, K., Majumdar, M.R. and Bhattacharya, S.G. 2006. A Textbook of Palynology. New Central Book Agency (P) Ltd. New Delhi. .
17. Nair, P.K.K.1985. Essentials of Palynology. Today & Tomorrow Printers and Publishers , New Delhi.
18. Shivanna, K.R. and Rangaswamy, N.S. 1992. Pollen Biology –A Laboratory Manual. Narosa Publishing House, New Delhi
19. Shivanna, K.R. and Sawhney, V.K. (eds) 1997. Pollen Biotechnology for Crop Production and Improvement, Cambridge University Press, Cambridge.
20. Shivana, K.R. and Rangaswamy, N.S. 1992. Pollen Biology: A Laboratory Manual. Springer-Verlag, Berlin.
21. Shivana, K.R. and Johri, B.M. 1985. The Angiosperm Pollen: Structure and Function. Wiley Eastern Ltd., New York. Grant, V. 1971.Plant Speciation, Columbia University press, London.Grant W. F. 1984. Plant Systematics. Academic press, London.
22. Harisson, H.J. 1971. New concept in flowering plant Taxonomy. Hickman educational booksLtd. London.
23. Heywood, V. H. and Moore, D. M. 1984. Current concepts in Plant Taxonomy. Academic Press, London.
24. Jones, S. B., Jr.and Luchsinger, A. E. 1986. Plant Systematics (gd edition). McGraw -Hill Book Co., New York.
25. Nordentam, B. El Gazaly, G. and kassas, M. 2000.Plant systematic for 21st century.Portland press.Ltd, London.
26. Arnold C. A. 1947. An Introduction to Paleobotany. McGraw Hill Book company, New York.

Siddiqui, K.A. (2002) Elements of Palaeobotany, KitabMahal, Allahabad.

## DISCIPLINE SPECIFIC CORE COURSE- 2

## Course Code: RPSBOTE512

## Course Title: Form and Function- II

## Academic year 2024- 25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Compare and contrast photosynthetic pathways involved in Eukaryotes and Prokaryotes. |
| **CO 2** | Discuss the physiological processes of plants in other research fields. |
| **CO 3** | Illustrate the phenomenon of protein dynamics. |
| **CO 4** | Interpret the production, utilization and destruction of phytohormones. |

**Detailed Syllabus**

| RPSBOTE512 | Title: Form and Function- II | Credits- 03 |
|---|---|---|
| **UNIT I** | **Photosynthesis (Prokaryotes & Eukaryotes)** | **Hours- 15** |
| | ➢ Regulation of C3, C4 and CAM pathways of photosynthesis: Role of light in the activation of dark phase enzymes, regulation of RUBISCO, PEPcase, light effect, modulators and coordination of light , dark phase.<br>➢ C4 Photosynthesis: inter and intra-cellular transport of metabolites, carbonic anhydrase, PEPcase, NADP-MDH and PPDK.<br>➢ Regulation of CAM through transport of metabolites.<br>➢ Pentose Phosphate Pathway and its importance.<br>➢ Artificial photosynthesis<br>➢ Photosynthesis of prokaryotes: Pigment systems in bacteria and Cyanobacteria, light harvesting mechanisms, reductive TCA cycle. | |
| **UNIT II** | **Protein structure** | **Hours- 15** |

| | | |
|---|---|---|
| | Primary, secondary, tertiary and quaternary structural features and their analysis – Theoretical and experimental<br>➢ Classification of Proteins<br>➢ Bonds involved in protein structure- Polypeptide backbone, covalent and non-covalent interactions.<br>➢ Configuration details of primary, secondary, tertiary and quaternary structures.<br>➢ Ramachandran plot<br>➢ structure-function relation of protein eg. Hemoglobin<br>➢ Denaturation of proteins<br>Protein folding- Chaperones in protein folding. | |
| **UNIT III** | **Plant hormones** | **Hours- 15** |
| | Biosynthesis, storage, breakdown, transport and bioassay techniques of:<br>➢ Auxins<br>➢ Gibberellins<br>➢ Cytokinins<br>➢ Ethylene<br>➢ Abscisic acid<br>➢ Inositol, Jasmonic acid, Brassinosteroids | |
| **PRACTICALS** | | |
| **RPSBOTPE512** | Practical based on **Form and Function- II** | **Credit- 01** |
| 1 | Enzyme kinetics : Determination of Km and Vmax of the enzyme amylase purified amylase) | |
| 2 | Immobilization of yeast cells and study of invertase activity. | |
| 3 | Quantitative study of diurnal fluctuation in titratable acid number (TAN) in a CAM plant. | |
| 4 | Extraction and estimation of GOT and GPT from suitable plant material. | |
| 5 | Separation of organic acids by paper chromatography. | |
| 6 | A study of the enzyme polyphenol oxidase, from potato peels. | |
| 7 | Solvent extraction of chlorophyll a/b, xanthophylls and study of absorption pattern | |
| 8 | Plant hormones TLC -Auxins, GA-amylase activity | |

**References:**

1. William G. Hopkins, 1999. Introduction to Plant Physiology, 2nd edition, John Wiley A Sons, Inc.

2. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
3. Frank B. Salisbury and Cleon W.Ross, 2002. Plant physiology 3 rd edition CBS publishers and distributors.
4. Noggle G.R. and Fritz G. J., 1986 Introductory Plant Physiology Prentice Hall.
5. Goodwin Y.W. and Mercer E.I., 2003 Introduction to Plant Biochemistry, 2nd edition. CBS Publishers and distributors.
6. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
7. Cooper, T.G. 1977. Tools in Biochemistry.John Wiley, New York, USA.
8. Copeland, R.A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism andData Analysis. VCH Publishers, New York.
9. Dennison C. 1999.A guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht,The Netherland.
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11. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nded). SpringerVerlag, New York, USA.

## DISCIPLINE SPECIFIC CORE COURSE- 3

## Course Code: RPSBOTE513

## Course Title: Current Trends in Plant Sciences- I

## Academic year 2024- 25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Recall the general ethnobotanical techniques. |
| **CO 2** | Justify the role of ethnobotany in modern medicine and sustainable development. |
| **CO 3** | Comment on the role of mangroves in mitigating climate change effects and strategies to help manage mangroves in the future. |
| **CO 4** | Elaborate on the physical mangrove environment and the processes underlying them. |
| **CO 5** | Describe the conformational properties, isolation and characterization of plant membranes. |
| **CO 6** | Comment on the effect of microgravity in plant research. |

| RPSBOTE 513 | Title: Current Trends in Plant Sciences- I | Credits- 03 |
|---|---|---|
| **UNIT I** | **Ethnobotany and Ethnopharmacology** | **Hours- 15** |
| | ➢ Classification - International, National and Regional<br>➢ Centres of Ethnobotanical studies in India<br>➢ Role of ethnomedicine and its scope in modern times.<br>➢ Role of Ethnobotany in conservation and sustainable development,<br>➢ General ethnobotanical techniques-Anthropological field methods.<br>➢ A brief account of Phytochemistry, pharmacodynamics and pharmacokinetics | |

| | | |
|---|---|---|
| | ➢ Difference between herbal/botanicals and pharmaceutical medicine.<br>➢ Classification and sources of crude drugs. Regulatory guidelines for conducting toxicity studies as per OECD<br>➢ Quality, safety and efficacy of herbal medicines/ nutraceuticals. Role of ethnopharmacology in drug development.<br>➢ Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development. | |
| **UNIT II** | **Life Guards of Coastal Ecosystems- Mangroves** | **Hours- 15** |
| | ➢ Adaptations in Mangroves<br>➢ Six zones of Mangrove forest i.e. the landward fringe, *Ceriops* thickets, *Bruguiera* forests, *Rhizophora* forests, the seaward *Avicennia* zone, and the *Sonneratia* zone at the lowest level)<br>➢ Key mangrove species of India<br>➢ Mangroves of Maharashtra, India and the Mangrove reserve forests<br>➢ Ecological significance of Mangrove<br>➢ Threats to Mangroves<br>➢ Conservation and Management strategies<br>➢ GIS systems | |
| **UNIT III** | **Membrane Biophysics** | **Hours- 15** |
| | ➢ Cell membrane and permeability: Molecular models of cell membrane, cell permeability.<br>➢ Conformational properties of membranes, lipid composition ofthe membranes, lipid rafts, role of lipid rafts, diseases associated with rafts.<br>➢ Modification of cell membrane and Biophysical importance.<br>➢ Isolation and characterization of plant membranes.<br>➢ Effect of microgravity on plant growth. | |

| PRACTICALS | | |
|---|---|---|
| **RPSBOTPE513** | Practicals based on **Current Trends in Plant Sciences- I** | **Credit- 01** |
| 1 | Field trip to tribal settlement to survey, collect, preserve and document ethnobotanical specimens and frame hypothesis on the people-plant relationship. | |
| 2 | Identify and document plant parts used in the preparation of crude drugs/herbal formulations | |
| 3 | Testing of Antimicrobial activity of herbal drugs by disc diffusion method. | |
| 4 | Estimation of antioxidant activity of the herbal drug. | |
| 5 | Field visit to Godrej Mangroves/ conduct a survey on mangrove conservation strategies. | |
| 6 | Isolation of mitochondrial membrane and estimation of SDH activity. | |

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## DISCIPLINE SPECIFIC CORE COURSE- 4

## Course Code: RPSBOTE514

## Course Title: Bioinformatics and Molecular Modeling

## Academic year 2024 - 25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Apply the tools of bioinformatics to derive sequence properties, elucidate structures and for biological pathway analysis. |
| **CO 2** | Apply the tools of bioinformatics in retrieving, aligning sequences, in order to derive sequence properties, elucidate structures and relate it with function. |
| **CO 3** | Explain the concept of molecular modeling and molecular dynamics simulation. |
| **CO 4** | Recall the structure of biomolecules and more importantly link the structure and dynamics together. |

**Detailed Syllabus**

| RPSBOTE514 | Title: Bioinformatics and Molecular Modeling | Credits- 02 |
|---|---|---|
| **Unit I** | **Bioinformatics** | **Hours- 15** |
| | ➢ Specialized databases: EST, GSS, KEGG, OMIM<br>➢ System biology and Bioinformatics, Biological pathway analysis- System biology database and tools: Reactome, Plant Reactome, Pathway commons.<br>➢ Conserved regions in nucleotide and protein sequences- Gene finding and motif finding<br>➢ Prediction of Secondary and tertiary structure of protein- Tertiary structure prediction methods: Homology modeling, Threading,Ab-initio methods. • Introduction to Markov chain and Hidden Markov Model. • Use of Hidden Markov model in Protein structure prediction. | |

| UNIT II | **Molecular modeling and Molecular Dynamics simulations** | **Hours- 15** |
|---|---|---|
| | ➢ Concept of molecular modeling, chirality & stereochemistry.<br>➢ Theory and practice of energy minimization, Monte Carlo. Definition of the potential energy surface of a molecule, force field and generic form of a forcefield.<br>➢ Differences between molecular mechanics energy and the quantum mechanical energy of a system.<br>➢ Differences between Class I, Class II and Class III forcefields.<br>➢ Parametrization of a forcefield.<br>➢ Molecular dynamics simulation: Major steps, simulation models such as coarse grained, bead rod and bead spring models, Ensembles- microcanonical, canonical, isobaric-isothermal & grand canonical ensembles. | |

## FIELD PROJECT

### Course Code: RPSBOTE515

### Course Title: FIELD PROJECT- 04 credits

### Academic year 2024 – 25

**Course Outcomes:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Demonstrate the ability to apply theoretical concepts and methodologies to the problems encountered in the field. |
| **CO 2** | Execute a research plan and obtain conclusions from the results. |
| **CO 3** | Develop communication skills through the presentation of project findings and reports. |
| **CO 4** | Apply project management skills such as planning, time management and resource allocation. |

## DISCIPLINE SPECIFIC ELECTIVE COURSE

## Course Code: RPSBOTE516

## Course Title: Immunology and Cancer Biology

## Academic year 2024 - 25

**COURSE OUTCOMES:**

| COURSE OUTCOME | DESCRIPTION<br>A student completing this course will be able to: |
|---|---|
| **CO 1** | Comment on the various components of immune system and their applications in health care. |
| **CO 2** | Recall the various genes involved in oncogenesis. |
| **CO 3** | Elaborate on the nature, development and causes of cancer. |
| **CO 4** | Enlist the different cancer diagnostic tools and imaging techniques in the field of research. |
| **CO 5** | Enumerate various genetic disorders for genetic counseling and therapy. |

**Detailed Syllabus**

| RPSBOTE516 | Title: Immunology and Cancer Biology | Credits- 03 |
|---|---|---|
| **Unit I** | **Immune system and Immunotechniques** | **Hours- 15** |
| | ➢ Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibilitycomplex cells of immune system, regulation of immune responses.<br>➢ Production of antibodies by plant cells and organs.<br>➢ Immunity in Health and Disease: Immunodeficiency and AIDS<br>➢ Immunotechniques- Antigen-antibody reactions: agglutination, precipitation, Immuno-electrophoresis, Coomb's test, ELISA, Radioimmunoassay. | |

| UNIT II | Cancer Biology and Cancer Genetics | Hours- 15 |
|---|---|---|
| | Cancer cells: Characteristics, division, spread, treatment.<br>➢ Characteristics of Cancer: Course of Cancer formation, Division and Spread (Metastasis)<br>➢ Causes of cancer, classification and latency period<br>• Types of carcinogens: chemical, radiation, Internal factors (hormonal and genetic factors), Biological carcinogens (Bacteria, Helminths, Oncovirus); Other factors (Dietary andLifestyle, Pollution, Occupational, Medical Carcinogens)<br>➢ Diagnosis and Treatments: Diagnostic tools and Imaging techniques; Staging of Cancers; Treatments (Neoadjuvant and Adjuvant Therapies; Surgery, Radiation, Chemotherapy, Hormonal Therapy, Targeted Therapy, Immunotherapy, Stem cell and Regenerative Therapy).<br>➢ Characteristics of Cancer cells: Telomerase activity, Genome Instability, Anaplasia, Cell surface proteins and Immune reaction<br>➢ Mutations and Cancers<br>➢ Two-hit mutation theory; Familial and Sporadic Cancers<br>➢ Genes involved in Oncogenesis: Proto- oncogenes/ Oncogenes, Tumor suppressor genes, MicroRNA (miRNA) genes, and Mutator genes, Oncogenes and Growth Factors. | |
| **UNIT III** | **Genetic disorders** | **Hours- 15** |
| | ➢ X linked Dominant disorders: X-linked hypophosphatemia, Focal dermal hypoplasia, Coffin-Lowry syndrome (CLS), Alport syndrome<br>➢ X linked Recessive disorders: Red Green Color Blindness, Royal Hemophilia, Duchenne Muscular Dystrophy (DMD), Barr bodies in Klinefelter syndrome<br>➢ Autosomal Dominant disorders: Familial hypercholesteremia, Huntington's disorder, Neurofibromatosis, Marfan Syndrome<br>➢ Autosomal Recessive disorders: Lysosomal Diseases, Peroxisomal Diseases, Cytoskeletal Diseases, Diseases due to Protein misfolding<br>➢ Biochemical disorders: Albinism, Phenylketonuria, Alkaptonuria<br>➢ Cardiovascular disorders: Coronary heart disease, Strokes and TIAs, Peripheral arterial disease, Aortic disease<br>➢ Need for Genetic counseling and its applications | |
| **PRACTICALS** | | |
| **RPSBOTPE516** | **Immunology and Cancer Biology** | **Credit – 1** |

| | |
|---|---|
| 1 | ELISA. |
| 2 | Western Blotting. |
| 3 | Identification of genetic disorders using 'Karyotype' App. |
| 4 | Karyotypes of genetic disorder- Acute Myeloid Leukemia. |
| 5 | Karyotypes of genetic disorder- B-cell Acute Lymphoblastic Leukemia. |
| 6 | Karyotypes of genetic disorder- Chronic Myeloid Leukemia. |
| 7 | Identification of genetic diseases by chemical tests. |
| 8 | Cytogenetic Diagnostic techniques: FISH and SKY (Demonstration). |
| 9 | Demonstrate the presence of Barr body from the oral mucosa of a human male and female students. |

## References


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# Modality of Assessment-DSC/DSE

**Theory Examination Pattern:**

**E) Internal Assessment- 40%- 30 Marks**

| Sr No | Evaluation type | Marks |
|---|---|---|
| 1 | Class Test | 20 |
| 2 | Assignment | 10 |
| | **TOTAL** | **30** |

**F) External Examination (Semester End)- 60%- 45 Marks**

**Semester End Theory Examination:**

7. Duration – The duration for these examinations shall be of **two hours**.
8. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q.1 | Any 3 out of 4. | 15 | Unit- I |
| Q.2 | Any 3 out of 4. | 15 | Unit- II |
| Q.3 | Any 3 out of 4. | 15 | Unit- III |
| | **TOTAL** | **45** | |

**Practical Examination Pattern:**

**External (Semester end practical examination):**

| Particulars | Practical 1 |
|---|---|
| Laboratory work /Viva | 25 |
| **Total** | **25** |

**PRACTICAL BOOK/JOURNAL**

The students are required to present a duly certified journal for appearing at the practical examination, failing which they will not be allowed to appear for the examination.

**In case of loss of Journal and/ or Report, a Lost Certificate should be obtained from Head/ Co-ordinator / Incharge of the department; failing which the student will not be allowed to appear for the practical examinations.**

# Modality of Assessment- Bioinformatics and Molecular Modeling

**External Examination (Semester End)- 60%- 50 Marks**

**Semester End Theory Examination:**

9. Duration – The duration for this examination shall be of **two hours**.
10. Theory question paper pattern:

**Paper Pattern:**

| Question | Options | Marks | Questions Based on |
|---|---|---|---|
| Q.1 | Any 2 out of 3. | 20 | Unit- I |
| Q.2 | Any 2 out of 3. | 20 | Unit- II |
| Q.3 | Any 2 out of 3. | 10 | Unit- I and II |
| | **TOTAL** | **50** | |

## Overall Examination and Marks Distribution Pattern

### Semester- II

| Course | RPSBOTE511<br>RPSBOTE512<br>RPSBOTE513<br>RPSBOTE516 | | Total of 4 courses | | RPSBOTE514 | RPSBOTE515 | Grand Total |
|---|---|---|---|---|---|---|---|
| | Internal | External | Internal | External | External | Field Project | |
| Theory | 30 | 45 | 120 | 180 | 50 | 100 | 450 |
| Practicals | 25 | | 100 | | - | | 100 |

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