

**Resolution No.: AC/I(21-22).2(II).RPS4**

**S.P. Mandali's**

**RAMNARAIN RUIA AUTONOMOUS COLLEGE**

*(Affiliated to University of Mumbai)*



**Syllabus for: Semester I and II**

**Program: M. Sc.**

**Program Code: Botany (RPSBOT)**

**Specialization: Molecular Biology, Cytogenetics and  
Plant Biotechnology**

**(Choice Based Credit System for the academic year 2022–2023)**

## 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 revolutionary changes happening in this era of Industry 4.0.

<b>GA</b>	<b>GA Description</b> <b>A student completing Masters in Science program will be able to:</b>
<b>GA 1</b>	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.
<b>GA 2</b>	Critically evaluate, analyze and comprehend a scientific problem. Think creatively, experiment and generate a solution independently, check and validate it and modify if necessary.
<b>GA 3</b>	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.
<b>GA 4</b>	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
<b>GA 5</b>	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.
<b>GA 6</b>	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.
<b>GA 7</b>	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.
<b>GA 8</b>	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

## PROGRAM OUTCOMES

<b>PO</b>	<b>PO Description</b>
	<b>A student completing Masters in Science program in the subject of Botany will be able to:</b>
<b>PO 1</b>	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
<b>PO 2</b>	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
<b>PO 3</b>	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
<b>PO 4</b>	Critically evaluate the functioning of organisms at the genomic and cellular level, Relate physiological adaptations, development and reproduction of higher plants.
<b>PO 5</b>	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.
<b>PO 6</b>	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
<b>PO 7</b>	Apply the principles of biostatistics and bioinformatics in biological research, evaluate the scientific content, apply the scientific methods in formulating hypothesis and data analysis.
<b>PO 8</b>	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 <i>in vitro</i> techniques for product enhancement
<b>PO 9</b>	Apply the fundamentals of Nanotechnology, Environmental biotechnology and food biotechnology in various fields
<b>PO 10</b>	Understand and apply the techniques of plant breeding procedures for hybridization, stress tolerance and genetic engineering of plants.
<b>PO 11</b>	Develop critical and logical thinking capacity and prepare themselves to qualify various competitive exams like MPSC, UPSC, SET, GATE, CSIR and UGC NET

## PROGRAM OUTLINE

YEAR	SEM	COURSE CODE	COURSE TITLE	CREDITS
FY	I		<b>CORE COURSE-I</b>	
		<b>RPSBOT 101</b>	<b>PLANT DIVERSITY – I</b>	<b>04</b>
		I	Phycology	
		II	Mycology	
		III	Bryophyta	
		IV	Pteridophyta and Paleobotany	
			<b>CORE COURSE-II</b>	
		<b>RPSBOT 102</b>	<b>PLANT DIVERSITY- II</b>	<b>04</b>
		I	Gymnosperms	
		II	Angiosperms- I	
		III	Angiosperms- II	
		IV	Palynology	
			<b>CORE COURSE-III</b>	
		<b>RPSBOT 103</b>	<b>BIOANALYTICAL TECHNIQUES &amp; IPR</b>	<b>04</b>
		I	Microscopy, Spectroscopy and PCR	
		II	Chromatography and Tracer techniques	
		III	Biostatistics	
		IV	Traditional Knowledge and IPR	
			<b>DISCIPLINE SPECIFIC ELECTIVE-I</b>	
		<b>RPSBOT 104</b>	<b>BIOPROSPECTING FOR INDUSTRIAL MOLECULES</b>	<b>04</b>
		I	Bioprospecting for crop protection	
		II	Bioprospecting for anti-microbial products	
		III	Algal biomass for high-value biomolecules	
		IV	Bioprospecting for flavours and fragrance	
	<b>ABILITY ENHANCEMENT COMPULSORY COURSE-I</b>			
<b>RPSBOT105</b>	<b>Emotional well-being through Logic-based Thinking</b>	<b>02</b>		
I	Relation between Emotions and Thinking			
II	Strengthening rational Thinking patterns			
	<b>PRACTICAL</b>			
<b>RPSBOTP 101</b>	Plant Diversity- I	<b>02</b>		
<b>RPSBOTP 102</b>	Plant Diversity –II	<b>02</b>		
<b>RPSBOTP 103</b>	Bioanalytical techniques and IPR	<b>02</b>		

		<b>RPSBOTP 104</b>	Bioprospecting for Industrial Molecules	<b>02</b>
			<b>CORE COURSE-IV</b>	
		<b>RPSBOT 201</b>	<b>FORM AND FUNCTION- I</b>	<b>04</b>
		I	Anatomy	
		II	Developmental Botany	
		III	Environmental Botany	
		IV	Stress Physiology	
			<b>CORE COURSE- V</b>	
		<b>RPSBOT 202</b>	<b>FORM AND FUNCTION- II</b>	<b>04</b>
		I	Photosynthesis- I	
		II	Photosynthesis- II and Membrane Biophysics	
		III	Protein structure	
		IV	Plant Hormones	
			<b>CORE COURSE- VI</b>	
		<b>RPSBOT 203</b>	<b>CURRENT TRENDS IN PLANT SCIENCES- I</b>	<b>04</b>
		I	Ethnobotany & Ethnopharmacology	
		II	Life guards of Coastal Ecosystems- Mangroves	
		III	Bioinformatics	
		IV	Molecular Modeling & Molecular Dynamics	
			<b>DISCIPLINE SPECIFIC ELECTIVE-II</b>	
		<b>RPSBOT 204</b>	<b>IMMUNOLOGY AND CANCER BIOLOGY</b>	<b>04</b>
		I	Immune system and Immunotechniques	
		II	Cancer biology	
		III	Cancer genetics	
		IV	Genetic disorders	
			<b>ABILITY ENHANCEMENT COMPULSORY COURSE-II</b>	
		<b>RPSBOT 205</b>	<b>RESEARCH METHODOLOGY</b>	<b>02</b>
		I	Research Methodology- I	
		II	Research Methodology- II	
			<b>PRACTICAL</b>	
		<b>RPSBOTP 201</b>	Forms and Functions- I	<b>02</b>
		<b>RPSBOTP 202</b>	Forms and Functions- II	<b>02</b>
		<b>RPSBOTP 203</b>	Current Trends in Plant sciences- I	<b>02</b>
		<b>RPSBOTP 204</b>	Immunology and Cancer Biology	<b>02</b>

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II

**S.P. Mandali's**  
**RAMNARAIN RUIA AUTONOMOUS COLLEGE**  
*(Affiliated to University of Mumbai)*



**Syllabus for: Semester I & II**

**Program: M. Sc.**

**Program Code: Botany (RPSBOT)**

(Choice Based Credit System for the academic year  
2022–2023)

**SEMESTER I****CORE COURSE- I****Course Code: RPSBOT 101****Course Title: Plant Diversity- I****Academic year 2022-23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Explain the structures of fossil forms highlighting their role in evolutionary studies.
<b>CO 2</b>	Describe the morphology, structure, reproduction, classification and evolution of Algae and Fungi.
<b>CO 3</b>	Identify various plant diseases, based on symptoms and environmentally sustainable control measures.
<b>CO 4</b>	Classify bryophytes and pteridophytes according to the recent systems of classification.
<b>CO 5</b>	List the members of bryophytes and pteridophytes of ecological and economic value.
<b>CO 6</b>	Comment on the different commercial algae cultivation technologies, thereby exploring their industrial applications

**Detailed Syllabus**

<b>RPSBOT 101</b>	<b>Title: Plant Diversity – I</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Phycology</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification of Algae upto orders as proposed by Gilbert M. Smith.</li> <li>➤ Origin and evolution of sex in Algae.</li> <li>➤ Techniques in commercial cultivation of Algae for protein &amp; secondary metabolites, carbon credit, antibiotics and biofuel.</li> <li>➤ Detrimental algae and their control.</li> <li>➤ Toxic algae, Parasitic algae &amp; Fossil algae</li> <li>➤ Water blooms &amp; red tides in India and across the world, their utility, disadvantages and control of algal blooms.</li> <li>➤ Algae as a source of Pharmaceuticals &amp; nutraceuticals.</li> <li>➤ Algal collection and preservation.</li> </ul>	
<b>UNIT II</b>	<b>Mycology</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification of fungi, upto orders, according to the system proposed by Alexopoulos.</li> <li>➤ Sexuality in Fungi.</li> <li>➤ General account of spore bearing organs and their</li> </ul>	

	<p>arrangements in various groups of fungi; spore release and dispersal.</p> <ul style="list-style-type: none"> <li>➤ History of plant pathology, Host-parasite relationship.</li> <li>➤ Classification of plant diseases based on symptoms.</li> <li>➤ Industrial applications of fungi with respect to agriculture, industries, food and medicine, harmful activities, fungal pigments of commercial importance.</li> <li>➤ Mycorrhiza- type, distribution and significance with reference to agriculture and forestry.</li> </ul>	
<b>Unit III</b>	<b>Bryophyta</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification of Bryophyta, up to orders, according to the system proposed by G.M.Smith, Campbell and Crandall-Stotler.</li> <li>➤ Alternation of generation in Bryophyta.</li> <li>➤ Origin and evolution of Bryophyta with reference to habitat and form.</li> <li>➤ Evolution of gametophyte and sex organs in Bryophytes.</li> <li>➤ Evolution of sporophyte in Bryophyta.</li> <li>➤ Economic and ethnic uses of Bryophytes</li> </ul>	
<b>UNIT IV</b>	<b>Pteridophyta and Paleobotany</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification of Pteridophyta up to orders, according to the system proposed by G.M.Smith, Bold, Benson &amp; Zimmermann.</li> <li>➤ Cultivation and maintenance of ornamental ferns.</li> <li>➤ Ethnomedicinal and ecological importance of Pteridophytes.</li> <li>➤ The geological time scale and a study of fossil Pteridophytes. (<i>Horneophyton, Cladoxylon, Sphenophyllum</i>).</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 101</b>	<b>Plant Diversity-I</b>	<b>Credits – 2</b>
1	Study of following type with reference to their systematic position, thallus and reproductive structures: <i>Scytonema, Lyngbya, Anabaena, Volvox, Oedogonium, Scenedesmus, Ulothrix, Ulva, Pithophora, Closterium, Nitella, Padina and Gracilaria.</i>	
2	Extraction of algal pigments and their separation by paper chromatography.	
3	Culturing of algae / Estimation of metabolites.	
4	Study of algal growth curve.	
5	<ul style="list-style-type: none"> <li>➤ Students are to collect and identify algae from different habitat and prepare a key based on 5 characters or visit an Algal research station. Prepare and submit a report of the field work/research station visit.3 and 4 project(submission).</li> <li>➤ Collection and identification of common forest fungi (5 types).</li> </ul>	
6	<b>Mycology:</b> <i>Stemonitis, Saprolegnia, Phytophthora, Peziza, Claviceps, Daedalea, Auricularia,, Alternaria and Trichoderma.</i>	
7	<b>Plant diseases:</b> Late blight of potato Covered smut of barley, Citrus canker, Leaf curl.	
8	<b>Economic Importance of fungi:</b> <i>Beauveria, Verticillium, Monascus, Ganoderma, Mycorrhiza.</i>	



9	<b>Bryophyta:</b> Study of following type with reference to systematic position, thallus and reproductive structures: <i>Targionia</i> , <i>Plagiochasma</i> , <i>Fimbraria</i> , <i>Pogonatum</i> .
10	<b>Pteridophyta:</b> Study of following type with reference to their systematic position, thallus and reproductive structures: <i>Isoetes</i> , <i>Ophioglossum</i> , <i>Pteris</i> , <i>Angiopteris</i> , <i>Lygodium</i> and <i>Azolla</i> .
11	<b>Ethnomedicinal and ecological importance of Pteridophytes :</b> <i>Lycopodium</i> , <i>Azolla</i> .
12	<b>Study of fossils:</b> <i>Horneophyton</i> , <i>Cladoxylon</i> , <i>Sphenophyllum</i> .

### References:

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**CORE COURSE- II****Course Code: RPSBOT 102****Course Title: Plant Diversity – II****Academic year 2022 - 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b> <b>Upon successful completion of this course, learners will be able to;</b>
<b>CO 1</b>	Summarize the rules of nomenclature according to the ICN.
<b>CO 2</b>	Interpret the evolutionary relationships among angiosperms.
<b>CO 3</b>	Differentiate between gymnosperms and angiosperms, as well as their origin and evolution in various eras.
<b>CO 4</b>	Make use of the palynological information for plant systematics, agriculture and horticulture
<b>CO 5</b>	Classify Gymnosperms and comprehend the affinities and interrelationships between various orders.
<b>CO 6</b>	.Elaborate the structure of angiosperm pollen and the special relationships between pollen grains in pollen tetrad.

**Detailed Syllabus**

<b>RPSBOT 102</b>	<b>Title: Plant Diversity – II</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Gymnosperms</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification of gymnosperms upto orders according to the system proposed by C. J. Chamberlain &amp; recent classification systems by Raizada and Sahni, Sporne and Christenhusz <i>et al.</i></li> <li>➤ General characters; affinities and interrelationships of Cycadofilicales, Bennettitales and Cordaitales.</li> <li>➤ A study of fossil Gymnosperms- <i>Glossopteris</i>, <i>Williamsonia</i>, <i>Medullosa</i>.</li> </ul>	
<b>UNIT II</b>	<b>Angiosperms- I</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Origin and evolution of Angiosperms.</li> <li>➤ The primitive Angiosperm flower; primitive and advanced characters in Angiosperms.</li> <li>➤ An International Code of Nomenclature (I.C.N.), History and basic principles.</li> <li>➤ Principles for assessment of relationships, delimitation of taxa and attribution of rank: a. criteria b. guidelines c. practical considerations, d. use of categories.</li> <li>➤ APG system of classification.</li> <li>➤ Botanical Survey of India.</li> </ul>	

UNIT III	Angiosperms- II	15 Lectures
	<ul style="list-style-type: none"> <li>➤ Evolution, Variation and speciation, Biosystematic categories, Biotypes and Ecotypes.</li> <li>➤ Concept of characters: Introduction, type function values of taxonomic importance.</li> <li>➤ Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences), methods of illustrating evolutionary relationship (phylogenetic tree, cladogram).</li> </ul>	
UNIT IV	Palynology	15 Lectures
	<ul style="list-style-type: none"> <li>➤ Special relationships of pollen grain in pollen tetrads:               <ul style="list-style-type: none"> <li>● Young Microspores: their arrangement and number in tetrads.</li> <li>● Pollen Wall:                   <ul style="list-style-type: none"> <li>○ Ultrastructure</li> <li>○ Morphogenesis: Formation of Aperture Pattern, Primexine formation, Exine and Intine development, Pollen attaching vehicles.</li> </ul> </li> </ul> </li> <li>➤ Phylogeny of Angiosperm Pollen:               <ul style="list-style-type: none"> <li>● Evolutionary Trends among pollen grains based on Palynotaxonomic work: Evolutionary trends in Aperture, Ornamentation and Stratification.</li> <li>● Phylogenetic Considerations:                   <ul style="list-style-type: none"> <li>○ Pollen Evolution in Early Angiosperms,</li> <li>○ Phylogeny of Dicotyledons, and Monocotyledons</li> <li>○ Role of Pollen Morphology in Phylogeny and Plant Taxonomy.</li> </ul> </li> </ul> </li> <li>➤ Applications of Palynology in Agriculture and Horticulture.</li> </ul>	
<b>PRACTICALS</b>		
RPSBOTP 102	Plant Diversity – II	Credits – 2
1	<b>Gymnosperms:</b> Study of following type with reference to their systematic position, vegetative and reproductive structures: <i>Araucaria</i> , <i>Cupressus</i> , <i>Podocarpus</i> and <i>Juniperus</i> .	
2	<b>Study of fossils:</b> <i>Glossopteris</i> , <i>Williamsonia</i> , <i>Medullosa</i> , <i>Cordaites</i> .	
3	<b>Angiosperms:</b> A study of the following plant families their morphological peculiarities and economic importance: Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Meliaceae, Sapindaceae, Lythraceae, Boraginaceae, Chenopodiaceae, Liliaceae, Scitaminae, Cyperaceae.	
4	<b>Angiosperms:</b> Preparation of a cladogram with selected members of a family.	
5	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).	
6	<i>In vitro</i> germination of pollen grains.	
7	Effect of temperature on pollen viability.	
8	Study of the morphology of the pollen (using Chitale's and acetolysis method) from the families; Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Gramineae.	

**References:**

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**CORE COURSE- III****Course Code: RPSBOT 103****Course Title: Bioanalytical Techniques and IPR****Academic year 2022– 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Illustrate the basic principles, working and applications of chromatography.
<b>CO 2</b>	Develop a deeper understanding of different forms of IPR's, procedures and the process of patent filing.
<b>CO 3</b>	Apply biostatistics tools to interpret the given data.
<b>CO 4</b>	Determine the basic principles of tracer techniques and PCR and their applications.
<b>CO 5</b>	Compare and contrast between the principles, working and applications of various bioanalytical techniques.
<b>CO 6</b>	Demonstrate the preparation of various buffers and their applications in various experiments.

**Detailed Syllabus**

<b>RPSBOT 103</b>	<b>Title: Bioanalytical Techniques and IPR</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Microscopy, Spectroscopy and PCR</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Principles, instrumentation, working and applications of Fluorescence microscopy, Polarization microscopy, Phase contrast microscopy, TEM, SEM.</li> <li>➤ Biological sample preparation for electron microscopy.</li> <li>➤ IR, GC MS, LC MS, AAS, ICP- AES, Plasma Emission spectroscopy, NMR, 2D NMR.</li> <li>➤ PCR: Principle, Steps in PCR, Constraints in PCR, Modifications of PCR techniques and its applications.</li> </ul>	
<b>UNIT II</b>	<b>Chromatography and Tracer techniques</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ General Principle of chromatography.</li> <li>➤ Techniques and applications of Ion exchange, Affinity Chromatography and HPLC Application / validation of herbal drugs using HPTLC.</li> <li>➤ Radioactive isotopes and autoradiography-Principle, instrumentation &amp; technique: Geiger-Muller counter, Liquid scintillation counters.</li> <li>➤ Applications of isotopes in biology.</li> </ul>	

<b>UNIT III</b>	<b>Biostatistics</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Hypothesis testing: Theory of errors – Type I and Type II errors</li> <li>➤ Null Hypothesis &amp; Alternate Hypothesis</li> <li>➤ Z-test</li> <li>➤ Test of significance</li> <li>➤ Introduction to ANOVA, One-way &amp; two way ANOVA</li> <li>➤ Dunett's test</li> <li>➤ Randomized Block Design and Latin Square. (5 problems to be solved in each category)</li> </ul>	
<b>UNIT IV</b>	<b>Traditional Knowledge and IPR</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Different property rights &amp; IPR in India</li> <li>➤ IPR: Objectives, process &amp; scope</li> <li>➤ TRIPS &amp; Patent laws: Introduction &amp; standards for patent protection</li> <li>➤ WTO, WIPO, GATT &amp; Indian Patent Laws</li> <li>➤ Protection of traditional knowledge– objective, concept of traditional knowledge, holders, issue concerning, bio-prospecting and biopiracy; geographical indications, industrial designs, advantages of IPR, some case studies</li> <li>➤ International Depository authority ,Gene patenting, plant variety protection, trade secrets &amp; plant breeders right</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 103</b>	<b>Bioanalytical techniques and IPR</b>	<b>Credits – 2</b>
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	
10	Normal deviate test	
11	ANOVA- one way & two way	
12	Randomized block Design & Latin square	
13	Patent search and patent filing	

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**DISCIPLINE SPECIFIC ELECTIVE-I****Course Code: RPSBOT 104****Course Title: Bioprospecting for Industrial Molecules****Academic year 2022- 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Describe the role of entomotoxic proteins in crop protection.
<b>CO 2</b>	Enumerate the different extraction methods of natural sources for flavours and fragrances.
<b>CO 3</b>	Interpret the role of algae and plant products in bioprospecting.
<b>CO 4</b>	Comment on the economic potential of biological resources for obtaining industrial molecules of pharmaceutical, bioceutical & agricultural value.
<b>CO 5</b>	Elaborate on the plant resources as antimicrobials by testing their antimicrobial activity.

**Detailed Syllabus**

<b>RPSBOT 104</b>	<b>Title: Bioprospecting for Industrial Molecules</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Bioprospecting for crop protection</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Introduction to Bioprospecting.</li> <li>➤ Significance of plants in bioprospecting.</li> <li>➤ Recent trends in bioprospecting.</li> <li>➤ Entomotoxic proteins to control the crop insect pests and mechanism of insecticidal activity:               <ul style="list-style-type: none"> <li>● Lectins</li> <li>● Ribosome-Inactivating Proteins (RIPs)</li> <li>● Arcelins</li> <li>● Defensins</li> <li>● Cyclotides</li> </ul> </li> </ul>	
<b>UNIT II</b>	<b>Bioprospecting for anti-microbial products</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Use of plant products as antimicrobials: Historical perspective.</li> <li>➤ Major groups of Plant-derived antimicrobial compounds:</li> </ul>	



	<ul style="list-style-type: none"> <li>● Phenols and Phenolic acids</li> <li>● Terpenes and Essential oils</li> <li>● Alkaloids</li> <li>➤ Mechanisms of Antimicrobial activity:               <ul style="list-style-type: none"> <li>● Plant extracts with efflux Pump Inhibitory Activity</li> <li>● Plant extracts with Bacterial Quorum Sensing Inhibitory Activity</li> <li>● Plant extracts with Biofilm Inhibitory Activity</li> </ul> </li> </ul>	
<b>UNIT III</b>	<b>Algal Biomass for high-value biomolecules</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Algae in high-value biomolecule production:               <ul style="list-style-type: none"> <li>● Polyphenols</li> <li>● Polysaccharides</li> <li>● Fatty acids</li> <li>● Pigments</li> </ul> </li> </ul>	
<b>UNIT IV</b>	<b>Bioprospecting for flavours and fragrance</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Physiological mechanism of biosynthesis of essential oils:               <ul style="list-style-type: none"> <li>● Metabolic cycles of biosynthesis of Phenolic compounds.</li> <li>● Methods of extraction of natural sources for flavours and fragrances.</li> <li>● Designing of flavours and fragrance.</li> <li>● sensory evaluation.</li> </ul> </li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 104</b>	<b>Bioprospecting for Industrial Molecules</b>	<b>Credits - 2</b>
1	Anti-microbial activity of plant extracts by disc diffusion method/ well diffusion method/ MIC method.	
2	Bacterial Quorum Sensing Inhibitory Activity.	
3	Plant extracts with Biofilm Inhibitory Activity.	
4	Extraction of seed proteins.	
5	Protein profiling by PAGE.	
6	Applications of proteins to control insect pests.	
7	Fractional distillation of essential oils (mint/citronella/Chafa).	
8	Creation of flavours & fragrances and practical demonstration.	
9	Estimation of fragrance / flavours	
10	Application of fragrances in cosmetics, food Agarbatti, Soap, Cream, Talcum Powder etc. Application of flavours in soft drink, tooth powder, jam, ketchup etc.	

### References

1. Ramya Krishnan, Sudhir P. Singh, and Santosh Kumar Upadhyay. 2021. An introduction to 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. Algal Biomass: A Natural Resource of High-Value Biomolecules. Wiley Publications.
5. Monica Butnariu. 2021. Plants as Source of Essential Oils and Perfumery Applications. Wiley Publications.

### ABILITY ENHANCEMENT COMPULSORY COURSE-I

**Course Code: RPSBOT 105**

**Course Title: Emotional well-being through Logic-based thinking**

**Academic year 2022- 23**

#### COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Relate the connection between thinking patterns, emotions and behavior.
CO 2	Identify one's faulty thinking patterns (fallacies) and methods for refuting them.
CO 3	Change faulty thinking patterns with positive and rational thinking patterns.
CO 4	Adapt to a healthy state of mind using philosophical antidotes.

#### Detailed Syllabus

RPSBOT 105	Title: Emotional well-being through Logic-based thinking	Credits – 2
UNIT I	<b>Relation between Emotions and Thinking</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Fundamentals of emotional well-being.</li> <li>➤ Tracing the thoughts behind an emotional problem.</li> <li>➤ Some prominent faulty thinking patterns/fallacies causing harm to oneself and others:               <ul style="list-style-type: none"> <li>● Demanding perfection</li> <li>● World Revolves Around Me</li> <li>● Damnation</li> <li>● Awfulizing</li> <li>● Can'tstipation.</li> </ul> </li> </ul>	
UNIT II	<b>Strengthening rational Thinking Patterns</b>	<b>15 Lectures</b>

	<ul style="list-style-type: none"> <li>➤ How to refute the fallacies           <ul style="list-style-type: none"> <li>● Fallacy-Antidotes-Virtues framework</li> </ul> </li> <li>➤ Some uplifting Antidotal reasoning to overcome the fallacies</li> <li>➤ Corresponding Guiding virtues for the fallacies:           <ul style="list-style-type: none"> <li>● Demanding perfection - Metaphysical security</li> <li>● World Revolves Around Me - Empathy</li> <li>● Damnation - Respect</li> <li>● Awfulizing - Courage</li> <li>● Can'tstipation - Temperance.</li> </ul> </li> </ul>	
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**References:**

1. Elliot D Cohen. 2003. What Would Aristotle Do: Self-Control through the Power of Reason, Prometheus Books.

## MODALITY OF ASSESSMENT

**Theory Examination Pattern:****A) Internal Assessment - 40%: 40 marks.**

Sr No	Evaluation type	Marks
1	Seminar presentation/ Survey report/ Literature review/ Short Project presentation / Photo documentation report of field visit/ Industry Visit Report /Presentation based on Research papers and references/ Case study/ Class test	40

**B) External examination - 60 %****Semester End Theory Assessment - 60 marks**

- i. Duration - These examinations shall be of **2½ hours** duration.
- ii. Paper Pattern:
  1. There shall be **05** questions each of **12**. On each unit there will be one question & last question will be based on all the **04** units.
  2. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)	Any 1 out of 2	12	Unit I
Q.2)	Any 1 out of 2	12	Unit II
Q.3)	Any 1 out of 2	12	Unit III
Q.4)	Any 1 out of 2	12	Unit IV
Q.5)	3 short notes out of 5	12	All Units

**Practical Examination Pattern:**

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

Particulars	Practical 1
Laboratory work and /or <i>Viva voce</i>	50
<b>Total</b>	<b>50</b>

**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 examination.**

**Overall Examination and Marks Distribution Pattern****Semester- I**

Course	RPSBOT101		RPSBOT 102		RPSBOT 103		RPSBOT 104		Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External		
Theory	40	60	40	60	40	60	40	60	100	400
Practical	50		50		50		50		50	200

**AECC- Assessment Method- Semester end Theory Examination -50 Marks**

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**SEMESTER II****CORE COURSE- IV****Course Code: RPSBOT 201****Course Title: Form and Functions- I****Academic year 2022– 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Explain the ecological principles, applying the same to conservation strategies.
<b>CO 2</b>	Describe the basic concepts in anatomy regarding the origin of tissue systems and organogenesis.
<b>CO 3</b>	Explain the fundamentals of the development of male and female gametophytes, embryo and fertilization.
<b>CO 4</b>	Interpret the theory of population ecology and biogeography.
<b>CO 5</b>	Comment on the responses of plants to abiotic and biotic stresses.

**Detailed Syllabus**

<b>RPSBOT 201</b>	<b>Title: Form and Functions- I</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Anatomy</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristems; shoot and root development, Quiescent centre; Root cap, origin of lateral root.</li> <li>➤ Leaf development and phyllotaxy; transition of flowering, floral meristems and floral development in Arabidopsis and Antirrhinum</li> </ul>	

	<ul style="list-style-type: none"> <li>➤ Sensory and tactile tissue system: Tactile sense organs, gravitational optical sense organs.</li> </ul>	
<b>UNIT II</b>	<b>Developmental Botany</b>	
	<ul style="list-style-type: none"> <li>➤ Male gametophyte: Gene expression, male sterility sperm dimorphism and hybrid seed production; pollen storage; pollen embryos.</li> <li>➤ Female gametophyte: Types of embryo sacs; structure of embryo sac cells.</li> <li>➤ Pollination, pollen-pistil interaction and fertilization: floral characteristics.</li> <li>➤ Sexual Incompatibility, Endosperm, Embryogenesis, Polyembryony, Parthenocarpy, Apomixis - Seed germination and Seedling growth, Embryology in relation to taxonomy and applications of Embryology.</li> <li>➤ Seed development and fruit growth; endosperm development during Early, Maturation and Desiccation stages; embryogenesis, ultrastructure and nucellar cytology; cell lineage during late embryo development; storage proteins of endosperm and embryo; apomixis; embryo culture; dynamics of fruit growth; biochemistry and molecular biology of fruit maturation.</li> </ul>	
<b>UNIT III</b>	<b>Environmental Botany</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Habitat and Niche: concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.</li> <li>➤ 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, interdemec extinctions, age structured population.</li> <li>➤ Biogeography: Major terrestrial biomes, theory of island biogeography; biogeographical zones of India.</li> <li>➤ Environmental Botany: Present concern- Conservation of genetic resources, gene pools, land races, Global warming, Depletion of forest cover, Urbanization and plant cover.</li> </ul>	
<b>UNIT IV</b>	<b>Stress Physiology</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses.</li> <li>➤ Mechanism of resistance to biotic stress and tolerance to abiotic stress.</li> <li>➤ Role of phytoalexins in plant disease resistance</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 201</b>	<b>Form and Functions- I</b>	<b>Credits - 2</b>
1	Study of wood elements in <i>Michelia</i> and <i>Thuja</i> stem, using maceration technique	
2	Study of the following leaves wrt leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth) in <i>Nymphaea</i> , <i>Nerium</i> , <i>Peperomia</i>	
3	Photosynthetic tissue system in <i>Araucaria</i> , <i>Cyperus</i> , <i>Ficus</i> .	
4	Breaking of seed dormancy by Physical and Chemical methods	

5	Effect of water and salinity stress on chlorophyll content of leaves.
6	Effect of water and salinity stress on Proline content of leaves
7	Comparison of two populations of a species collected from two areas.
8	Determination of primary production of an area by harvest method and chlorophyll method. (Terrestrial/ aquatic).
9	Determination of Nygard index of algae in a water body.
10	Determination of dust load on leaves of roadside plant
11	Determination of Stomatal Index of leaves
12	Determination of epidermal architecture of leaves.

### References:

1. Easu, K. 1983. Plant Anatomy - Wiley Eastern Limited.
2. Fahn, A. 1977 – Plant Anatomy. Pergamon Press.
3. Forester, A.S. 1960. Practical Plant Anatomy. D. Van Nostrand Company Inc.
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5. Bhojwani S S and Bhatnagar S. S 2001. Embryology of Angiosperms Vikas Publishers, New Delhi
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7. Raghavan, V. 1997. Molecular Embryology of Flowering Plants. Cambridge University Press, Cambridge.
8. Sedgley, M. and Griffin, A.R. 1989. Sexual Reproduction of Tree Crops, Academic Press, London.
9. Ambasht R.S. 1995 A text book of plant ecology Student and co. Varanasi-5
10. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego, USA.
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18. William G. Hopkins, 1999. Introduction to Plant Physiology, 2nd edition, John Wiley A Sons, Inc.
19. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
20. Frank B. Salisbury and Cleon W. Ross 2002. Plant Physiology 3rd edition CBS publishers and distributors.
21. Noggle G.R. and Fritz G. J. 1986. Introductory Plant Physiology Prentice Hall.
22. Goodwin Y.W., and Mercer E.I. 2003. Introduction to Plant Biochemistry, 2nd edition. CBS Publishers and distributors.
23. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
24. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd ed). Springer Verlag, New York, USA.
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**CORE COURSE- V****Course Code: RPSBOT 202****Course Title: Form and Functions- II****Academic year 2022- 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Describe the conformational properties, isolation and characterization of plant membranes.
<b>CO 2</b>	Illustrate the phenomenon of protein dynamics.
<b>CO 3</b>	Comment on the effect of microgravity in plant research.
<b>CO 4</b>	Interpret the production, utilization and destruction of phytohormones.
<b>CO 5</b>	Compare photosynthetic pathways in Eukaryotes and Prokaryotes.

**Detailed Syllabus**

<b>RPSBOT 202</b>	<b>Title: Form and Functions- II</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Photosynthesis I (Eukaryotes)</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ 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.</li> <li>➤ C4 Photosynthesis: inter and intra-cellular transport of metabolites, carbonic anhydrase, PEPcase, NADP-MDH and PPDK.</li> <li>➤ Regulation of CAM through transport of metabolites.</li> <li>➤ Pentose Phosphate Pathway and its importance.</li> </ul>	



	➤ Artificial photosynthesis	
<b>UNIT II</b>	<b>Photosynthesis II (Prokaryotes) &amp; Membrane Biophysics</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Photosynthesis of prokaryotes: Pigment systems in bacteria and Cyanobacteria, light harvesting mechanisms, reductive TCA cycle.</li> <li>➤ Conformational properties of membranes, lipid composition of the membranes, lipid rafts, role of lipid rafts, diseases associated with rafts.</li> <li>➤ Modification of cell membrane and Biophysical importance.</li> <li>➤ Isolation and characterization of plant membranes.</li> <li>➤ Effect of microgravity on plant growth.</li> </ul>	
<b>UNIT III</b>	<b>Protein structure</b>	<b>15 Lectures</b>
	Primary, secondary, tertiary and quaternary structural features and their analysis – Theoretical and experimental <ul style="list-style-type: none"> <li>➤ Classification of Proteins</li> <li>➤ Bonds involved in protein structure- Polypeptide backbone, covalent and non-covalent interactions.</li> <li>➤ Configuration details of primary, secondary, tertiary and quaternary structures : structural features.</li> <li>➤ Ramachandran plot</li> <li>➤ structure-function relation of protein eg. Haemoglobin</li> <li>➤ Denaturation of proteins</li> </ul> Protein folding- Chaperones in protein folding.	
<b>UNIT IV</b>	<b>Plant hormones</b>	<b>15 Lectures</b>
	Biosynthesis, storage, breakdown, transport and bioassay techniques of: <ul style="list-style-type: none"> <li>➤ Auxins</li> <li>➤ Gibberellins</li> <li>➤ Cytokinins</li> <li>➤ Ethylene</li> <li>➤ Abscisic acid</li> <li>➤ Inositol, Jasmonic acid, Brassinosteroids</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 202</b>	<b>Form and Functions- II</b>	<b>Credits - 2</b>
1	Enzyme kinetics : Determination of Km and Vmax of the enzyme amylase purified (amylase)	
2	Extraction of cellulase from a suitable fungal culture and study of enzyme activity by DNSA method	
3	Immobilization of yeast cells and study of invertase activity.	
4	Quantitative study of diurnal fluctuation in titratable acid number (TAN) in a CAM plant.	
5	Extraction and estimation of GOT and GPT from suitable plant material.	
6	Separation of organic acids by paper chromatography.	
7	Separation of sugars by paper chromatography	
8	A study of the enzyme polyphenol oxidase, from potato peels.	
9	Solvent extraction of chlorophyll a/b, xanthophylls and study of absorption pattern	

10	Viscosity studies of proteins: standard BSA and varying concentrations of urea
11	Plant hormones TLC -Auxins, GA-amylase activity

**References:**

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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.
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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 and Data Analysis. VCH Publishers, New York.
9. Dennison C. 1999. A guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht, The Netherlands.
10. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.
11. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd ed). Springer Verlag, New York, USA.

**CORE COURSE- VI****Course Code: RPSBOT 203****Course Title: Current Trends in Plant Sciences- I****Academic year 2022- 23****COURSE OUTCOMES:**

<b>COURSE OUTCOME</b>	<b>DESCRIPTION</b>
	Upon successful completion of this course, learners will be able to;
<b>CO 1</b>	Recall the general ethnobotanical techniques.
<b>CO 2</b>	Explain the concept of molecular modeling and molecular dynamics simulation.
<b>CO 3</b>	Apply the tools of bioinformatics to derive sequence properties, elucidate structures and for biological pathway analysis
<b>CO 4</b>	Comment on the role of mangroves in mitigating climate change effects and strategies to help manage mangroves in the future.
<b>CO 5</b>	Justify the role of ethnobotany in modern medicine and sustainable development.
<b>CO 6</b>	Elaborate on the physical mangrove environment and the processes underlying them.

<b>RPSBOT 203</b>	<b>Title: Current Trends in Plant Sciences- I</b>	<b>Credits – 4</b>
<b>UNIT I</b>	<b>Ethnobotany and Ethnopharmacology</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Classification - International, National and Regional</li> <li>➤ Centres of Ethnobotanical studies in India</li> <li>➤ Role of ethnomedicine and its scope in modern times.</li> </ul>	

	<ul style="list-style-type: none"> <li>➤ Role of Ethnobotany in conservation and sustainable development,</li> <li>➤ General ethnobotanical techniques-Anthropological field methods.</li> <li>➤ A brief account of Phytochemistry, pharmacodynamics and pharmacokinetics</li> <li>➤ Difference between herbal/botanicals and pharmaceutical medicine.</li> <li>➤ Classification and sources of crude drugs. Regulatory guidelines for conducting toxicity studies as per OECD</li> <li>➤ Quality, safety and efficacy of herbal medicines/ nutraceuticals. Role of ethnopharmacology in drug development.</li> <li>➤ Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development.</li> </ul>	
<b>UNIT II</b>	<b>Life Guards of Coastal Ecosystems- Mangroves</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Adaptations in Mangroves</li> <li>➤ 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)</li> <li>➤ Key mangrove species of India</li> <li>➤ Mangroves of Maharashtra, India and the Mangrove reserve forests</li> <li>➤ Ecological significance of Mangrove</li> <li>➤ Threats to Mangroves</li> <li>➤ Conservation and Management strategies</li> <li>➤ GIS systems</li> </ul>	
<b>UNIT III</b>	<b>Bioinformatics</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Specialized databases: EST, GSS, KEGG, OMIM</li> <li>➤ System biology and Bioinformatics, Biological pathway analysis-System biology database and tools: Reactome, Plant Reactome, Pathway commons.</li> <li>➤ Conserved regions in nucleotide and protein sequences- Gene finding and motif finding</li> <li>➤ 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</li> </ul>	
<b>UNIT IV</b>	<b>Molecular modeling and Molecular Dynamics simulations</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Concept of molecular modeling, chirality &amp; stereochemistry.</li> <li>➤ 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.</li> </ul>	

	<ul style="list-style-type: none"> <li>➤ Differences between molecular mechanics energy and the quantum mechanical energy of a system.</li> <li>➤ Differences between Class I, Class II and Class III forcefields.</li> <li>➤ Parametrization of a forcefield.</li> <li>➤ Molecular dynamics simulation: Major steps, simulation models such as coarse grained, bead rod and bead spring models, Ensembles- microcanonical, canonical, isobaric-isothermal &amp; grand canonical ensembles.</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 203</b>	<b>Current Trends in Plant Sciences- I</b>	<b>Credits - 2</b>
1	Field trip to tribal settlement to survey, document and frame hypothesis on the people-plant relationship	
2	Collection, processing and preservation of ethnobotanical specimens in the institutional repository.	
3	Identify and document plant parts used in the preparation of crude drugs/herbal formulations	
4	Testing of Antimicrobial activity of herbal drugs by disc diffusion method.	
5	Estimation of antioxidant activity of the herbal drug.	
6	Field visit to Godrej Mangroves/ conduct a survey on mangrove conservation strategies.	
7	Visualization of biological pathway- KEGG Pathway, Plant Reactome.	
8	Use of BLAST and its variants.	
9	Motif finding using MEME.	
10	Protein structure prediction: Homology modeling based structure prediction tool- SWISS model.	
11	Protein profiling using SWISSPROT : MASCOT.	
12	Gromacs and Discovery studio (Demonstration).	

**References:**

1. Chaudhuri, Rai, H. N., Guha, A., Roychowdhury, E. & Pal, D. C. 1980. Ethnobotanical uses of Herbaria-II. J. Econ. Tax. Bot. 1
2. Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of herbaria. Bull. Bot. Surv. India 19.
3. Faulks, P.J. 1958. An Introduction to Ethnobotany. Moredale Publications Ltd., London.
4. Ford, R. I.(Ed.). 1978. The Nature and Status of Ethnobotany. Anthropological Paper no.67. Museum of Anthropol., Univ. of Michigan.
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9. Jain, S. K. 1967. Ethnobotany – Its scope and study. Indian Museum Bull.
10. Jain, S. K. 1995. A Manual of Ethnobotany. Scientific Publishers
11. Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. & Das, D. 1984.
12. Bibliography of Ethnobotany. Botanical Survey of India.

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14. Bryan Bergeron M.D. 2008, Bioinformatics Computing. PHI Publications New Delhi.
15. Jin Xiong. 2006. Essential Bioinformatics. Cambridge University Press.
16. P. Clote and R. Backofen. 2000. Computational Molecular Biology: an Introduction. Wiley and Sons.
17. J. M. Keith. 2008. Bioinformatics; Vol 2: Structure, function and applications. Humana Press.
18. A. Leach. 2001. Molecular modeling- principles and applications. Pearson Education Ltd.
19. F. J. Burkowski. 2008. Structural bioinformatics: An algorithmic approach. CRC Press.
20. A. K. Konopka and M. J. Crabb. 2004. Compact handbook of computational biology. Marcel Dekker, New York.

### DISCIPLINE SPECIFIC ELECTIVE-II

**Course Code: RPSBOT 204**

**Course Title: Immunology and Cancer Biology**

**Academic year 2022 - 23**

#### COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Recall the various genes involved in oncogenesis.
CO 2	Enumerate various genetic disorders for genetic counseling and therapy.
CO 3	Enlist the different cancer diagnostic tools and imaging techniques in the field of research.
CO 4	Comment on the various components of immune system and their applications in health care.
CO 5	Elaborate on the nature, development and causes of cancer.

#### Detailed Syllabus

RPSBOT 204	Title: Immunology and Cancer Biology	Credits – 4
Unit I	Immune system and Immunotechniques	15 Lectures
	<ul style="list-style-type: none"> <li>➤ Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibility complex cells of immune system, regulation of immune</li> </ul>	

	<p>responses.</p> <ul style="list-style-type: none"> <li>➤ Production of antibodies by plant cells and organs.</li> <li>➤ Immunity in Health and Disease: Immunodeficiency and AIDS</li> <li>➤ Immunotechniques- Antigen-antibody reactions: agglutination, precipitation, Immuno-electrophoresis, Coomb's test, ELISA, Radioimmunoassay.</li> </ul>	
<b>UNIT II</b>	<b>Cancer Biology</b>	<b>15 Lectures</b>
	<p>Cancer cells: Characteristics, division, spread, treatment.</p> <ul style="list-style-type: none"> <li>➤ Characteristics of Cancer: Course of Cancer formation, Division and Spread (Metastasis)</li> <li>➤ Causes of cancer: What are carcinogens? (classification and latency period)</li> <li>➤ Types of carcinogens: chemical, radiation, Internal factors (hormonal and genetic factors), Biological carcinogens (Bacteria, Helminths, Oncovirus); Other factors (Dietary and Lifestyle, Pollution, Occupational, Medical Carcinogens)</li> <li>➤ 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)</li> </ul>	
<b>UNIT III</b>	<b>Cancer genetics</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Characteristics of Cancer cells: Telomerase activity, Genome Instability, Anaplasia, Cell surface proteins and Immune reaction</li> <li>➤ Mutations and Cancers</li> <li>➤ Two-hit mutation theory; Familial and Sporadic Cancers</li> <li>➤ Genes involved in Oncogenesis: Proto-oncogenes/Oncogenes, Tumor suppressor genes, MicroRNA (miRNA) genes, and Mutator genes.</li> <li>➤ Oncogenes and Growth Factors</li> </ul>	
<b>UNIT IV</b>	<b>Genetic disorders</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ X linked Dominant disorders: X-linked hypophosphatemia, Focal dermal hypoplasia, Coffin-Lowry syndrome (CLS), Alport syndrome</li> <li>➤ X linked Recessive disorders: Red Green Color Blindness, Royal Hemophilia, Duchenne Muscular Dystrophy (DMD), Barr bodies in Klinefelter syndrome</li> <li>➤ Autosomal Dominant disorders: Familial hypercholesteremia, Huntington's disorder, Neurofibromatosis, Marfan Syndrome</li> <li>➤ Autosomal Recessive disorders: Lysosomal Diseases, Peroxisomal Diseases, Cytoskeletal Diseases, Diseases due to Protein misfolding</li> <li>➤ Biochemical disorders: Albinism, Phenylketonuria, Alkaptonuria</li> </ul>	

	<ul style="list-style-type: none"> <li>➤ Cardiovascular disorders: Coronary heart disease, Strokes and TIAs, Peripheral arterial disease, Aortic disease</li> <li>➤ Need for Genetic counseling and its applications</li> </ul>	
<b>PRACTICALS</b>		
<b>RPSBOTP 204</b>	<b>Immunology and Cancer Biology</b>	<b>Credits - 2</b>
1	ELISA.	
2	Western Blotting.	
3	Human karyotyping.	
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

1. R. A. Goldsby, T. J. Kindt and B. A. Osborne. 2000. Kuby's Immunology, W. H. Freeman & Co. 6<sup>th</sup> Edition.
2. K. Murphy, P. Travers and M. Walport. 2008. Janeway's Immunology. Taylor and Francis Publishers. 7<sup>th</sup> Edition.
3. Swanon. M. & Young. 1982. Cytogenetics. Prentice Hall, India.
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**ABILITY ENHANCEMENT COMPULSORY COURSE-II****Course Code: RPSBOT 205****Course Title: Research Methodology****Academic year 2022- 23****COURSE OUTCOMES:**

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

**Detailed Syllabus**

<b>RPSBOT 205</b>	<b>Title: Research Methodology</b>	<b>Credits – 2</b>
<b>UNIT I</b>	<b>Research Methodology- I</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Introduction: Research design principles, execution of work, interpretation of results.</li> <li>➤ Review of literature               <ul style="list-style-type: none"> <li>● Library: Structure of a scientific library, journals, books, Digital library and E books</li> <li>● Catalogue: Classification of books (Universal Decimal System).</li> <li>● Journals: Indexing journals, H-index, abstracting journals, research journals, review journals, e-journals.</li> <li>● Impact factor of journals, NCBI-Pub Med.</li> <li>● Reprints, Secondary storage devices, Internet, open access initiative, INFLIBNET, INSDOC. Google Scholar</li> <li>● Preparation of index cards: Author index and subject index;</li> </ul> </li> </ul>	

	Open source, bibliography management system.	
<b>UNIT II</b>	<b>Research Methodology- II</b>	<b>15 Lectures</b>
	<ul style="list-style-type: none"> <li>➤ Introduction to scientific writing: Meaning of Scientific and non-scientific writing; Scientific Vocabulary and grammar. Synopsis, Dissertations, Thesis, Posters.</li> <li>➤ Correspondence: Formal letters, cover letters, drafting emails, replying to reviewers.</li> <li>➤ Writing a Research paper: Title, Abstract, Introduction, Review of literature, Methodology, Observations, Results, Discussions, Summary, Conclusion, and Bibliography (Referencing and citation styles). Supplementary data.</li> <li>➤ 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.</li> <li>➤ Presentations: Presenting numerical data - Graphical, Tabular, Animations, Slides, etc.</li> <li>➤ Data analysis –SPSS and MS Excel</li> <li>➤ Ethics in research</li> </ul>	

**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 International LTd. Publishers, New Delhi.

## MODALITY OF ASSESSMENT

### Theory Examination Pattern:

#### C) Internal Assessment - 40%: 40 marks.

Sr No	Evaluation type	Marks
1	Seminar presentation/ Survey report/ Literature review/ Short Project presentation / Photo documentation report of field visit/ Industry Visit Report /Presentation based on Research papers and references/ Case study/ Class test	40

#### D) External examination - 60 %

##### Semester End Theory Assessment - 60 marks

- iii. Duration - These examinations shall be of **2½ hours** duration.
- iv. Paper Pattern:
- There shall be **05** questions each of **12**. On each unit there will be one question & last question will be based on all the **04** units.
  - All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)	Any 1 out of 2	12	Unit I
Q.2)	Any 1 out of 2	12	Unit II
Q.3)	Any 1 out of 2	12	Unit III
Q.4)	Any 1 out of 2	12	Unit IV
Q.5)	3 short notes out of 5	12	All Units

### Practical Examination Pattern:

#### (A) External (Semester end practical examination):

Particulars	Practical 1
Laboratory work and /or <i>Viva voce</i>	50
<b>Total</b>	<b>50</b>

## 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 examination.

**Overall Examination and Marks Distribution Pattern**

**Semester- I**

Course	RPSBOT101		RPSBOT 102		RPSBOT 103		RPSBOT 104		Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External		
Theory	40	60	40	60	40	60	40	60	100	400
Practical	50		50		50		50		50	200

**AECC- Assessment Method- Semester end Theory Examination -50 Marks**

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