

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)

PROGRAM OUTCOMES

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.

PO	PO Description A student completing Masters in Science program will be able to:
PO 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.
PO 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.
PO 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.
PO 4	Articulate scientific ideas, put forth a hypothesis, design and execute testing tools and draw relevant inferences. Communicate the research work in appropriate scientific language.
PO 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.
PO 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.
PO 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.
PO 8	Understand cross disciplinary relevance of scientific developments and relearn and reskill so as to adapt to technological advancements.

PROGRAM SPECIFIC OUTCOMES

PSO	PSO Description
	A student completing Masters in Science program in the subject of Botany will be able to:
PSO 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
PSO 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
PSO 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
PSO 4	Critically evaluate the functioning of organisms at the genomic and cellular level, Relate physiological adaptations, development and reproduction of higher plants.
PSO 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.
PSO 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
PSO 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.
PSO 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 <i>in vitro</i> techniques for product enhancement
PSO 9	Apply the fundamentals of Nanotechnology, Environmental biotechnology and food biotechnology in various fields
PSO 10	Understand and apply the techniques of plant breeding procedures for hybridization, stress tolerance and genetic engineering of plants.
PSO 11	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	SEMESTER	COURSE CODE	COURSE TITLE	COURSE TYPE	CREDITS	
FY	I	RPSBOT 101 (Core Course)	PLANT DIVERSITY – I	CC	04	
		I	Phycology			
		II	Mycology			
		III	Bryophyta			
		IV	Pteridophyta and Paleobotany			
				CORE COURSE		
		RPSBOT 102 (Core Course)	PLANT DIVERSITY- II	CC	04	
		I	Gymnosperms			
		II	Angiosperms- I			
		III	Angiosperms- II			
		IV	Palynology			
				CORE COURSE		
		RPSBOT 103 (Core Course)	BIOANALYTICAL TECHNIQUES & IPR	CC	04	
		I	Microscopy, Spectroscopy and PCR			
		II	Chromatography and Tracer techniques			
		III	Biostatistics			
		IV	Traditional Knowledge and IPR			
		RPSBOT 104 (Discipline Specific Elective)	BIOPROSPECTING FOR INDUSTRIAL MOLECULES	DSE	04	
		I	Bioprospecting for crop protection			
		II	Bioprospecting for anti-microbial products			
		III	Algal biomass for high-value biomolecules			
IV	Bioprospecting for flavours and fragrance					

		RPSBOT105 (Ability Enhancement Compulsory Course)	Emotional well-being through Logic-based Thinking	AECC	02
		I	Relation between Emotions and Thinking		
		II	Strengthening rational Thinking patterns		
			PRACTICAL		
		RPSBOTP 101	Plant Diversity- I		02
		RPSBOTP 102	Plant Diversity –II		02
		RPSBOTP 103	Bioanalytical techniques and IPR		02
		RPSBOTP 104	Bioprospecting for Industrial Molecules		02
FY	II	RPSBOT 201 (Core Course)	FORM AND FUNCTION- I	CC	04
		I	Anatomy		
		II	Developmental Botany		
		III	Environmental Botany		
		IV	Stress Physiology		
		RPSBOT 202 (Core Course)	FORM AND FUNCTION- II	CC	04
		I	Photosynthesis- I		
		II	Photosynthesis- II and Membrane Biophysics		
		III	Protein structure		
		IV	Plant Hormones		
		RPSBOT 203 (Core Course)	CURRENT TRENDS IN PLANT SCIENCES- I	CC	04
		I	Ethnobotany & Ethnopharmacology		
		II	Life guards of Coastal Ecosystems- Mangroves		
		III	Bioinformatics		
		IV	Molecular Modeling & Molecular Dynamics		
		RPSBOT 204 (Discipline Specific Elective)	IMMUNOLOGY AND CANCER BIOLOGY	DSE	04

		I	Immune system and Immunotechniques		
		II	Cancer biology		
		III	Cancer genetics		
		IV	Genetic disorders		
		RPSBOT 205 (Ability Enhancement Compulsory Course)	RESEARCH METHODOLOGY	AECC	02
		I	Research Methodology- I		
		II	Research Methodology- II		
			PRACTICAL		
		RPSBOTP 201	Forms and Functions- I		02
		RPSBOTP 202	Forms and Functions- II		02
		RPSBOTP 203	Current Trends in Plant sciences- I		02
		RPSBOTP 204	Immunology and Cancer Biology		02

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

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

Detailed Syllabus

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

	<ul style="list-style-type: none"> ➤ History of plant pathology, Host-parasite relationship. ➤ Classification of plant diseases based on symptoms. ➤ Industrial applications of fungi with respect to agriculture, industries, food and medicine, harmful activities, fungal pigments of commercial importance. ➤ Mycorrhiza- type, distribution and significance with reference to agriculture and forestry. 	
Unit III	Bryophyta	15 Lectures
	<ul style="list-style-type: none"> ➤ Classification of Bryophyta, up to orders, according to the system proposed by G.M.Smith, Campbell and Crandall-Stotler. ➤ Alternation of generation in Bryophyta. ➤ Origin and evolution of Bryophyta with reference to habitat and form. ➤ Evolution of gametophyte and sex organs in Bryophytes. ➤ Evolution of sporophyte in Bryophyta. ➤ Economic and ethnic uses of Bryophytes 	
UNIT IV	Pteridophyta and Paleobotany	15 Lectures
	<ul style="list-style-type: none"> ➤ Classification of Pteridophyta up to orders, according to the system proposed by G.M.Smith, Bold, Benson & Zimmermann. ➤ Cultivation and maintenance of ornamental ferns. ➤ Ethnomedicinal and ecological importance of Pteridophytes. ➤ The geological time scale and a study of fossil Pteridophytes. (<i>Horneophyton, Cladoxylon, Sphenophyllum</i>). 	
PRACTICALS		
RPSBOTP 101	Plant Diversity-I	Credits – 2
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"> ➤ 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). ➤ Collection and identification of common forest fungi (5 types). 	
6	Mycology: <i>Stemonitis, Saprolegnia, Phytophthora, Peziza, Claviceps, Daedalea, Auricularia,, Alternaria and Trichoderma.</i>	
7	Plant diseases: Late blight of potato Covered smut of barley, Citrus canker, Leaf curl.	
8	Economic Importance of fungi: <i>Beauveria, Verticillium, Monascus, Ganoderma, Mycorrhiza.</i>	
9	Bryophyta: Study of following type with reference to systematic position, thallus and reproductive structures: <i>Targionia, Plagiochasma, Fimbraria, Pogonatum.</i>	
10	Pteridophyta: Study of following type with reference to their systematic position, thallus and reproductive structures: <i>Isoetes, Ophioglossum, Pteris, Angiopteris,</i>	

	<i>Lygodium</i> and <i>Azolla</i> .
11	Ethnomedicinal and ecological importance of Pteridophytes : <i>Lycopodium</i>, <i>Azolla</i>.
12	Study of fossils: <i>Horneophyton</i>, <i>Cladoxylon</i>, <i>Sphenophyllum</i>.

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26. Siddiqui, K.A. (2002) Elements of Palaeobotany, Kitab Mahal, Allahabad.

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

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

Detailed Syllabus

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

	<ul style="list-style-type: none"> ➤ Evolution, Variation and speciation, Biosystematic categories, Biotypes and Ecotypes. ➤ Concept of characters: Introduction, type function values of taxonomic importance. ➤ Variations; OTUs, character weighting and coding; cluster analysis; Phenograms, cladograms (definitions and differences), methods of illustrating evolutionary relationship (phylogenetic tree, cladogram). 	
UNIT IV	Palynology	15 Lectures
	<ul style="list-style-type: none"> ➤ Special relationships of pollen grain in pollen tetrads: <ul style="list-style-type: none"> ● Young Microspores: their arrangement and number in tetrads. ● Pollen Wall: <ul style="list-style-type: none"> ○ Ultrastructure ○ Morphogenesis: Formation of Aperture Pattern, Primexine formation, Exine and Intine development, Pollen attaching vehicles. ➤ Phylogeny of Angiosperm Pollen: <ul style="list-style-type: none"> ● Evolutionary Trends among pollen grains based on Palynotaxonomic work: Evolutionary trends in Aperture, Ornamentation and Stratification. ● Phylogenetic Considerations: <ul style="list-style-type: none"> ○ Pollen Evolution in Early Angiosperms, ○ Phylogeny of Dicotyledons, and Monocotyledons ○ Role of Pollen Morphology in Phylogeny and Plant Taxonomy. ➤ Applications of Palynology in Agriculture and Horticulture. 	
PRACTICALS		
RPSBOTP 102	Plant Diversity – II	Credits – 2
1	Gymnosperms: 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	Study of fossils: <i>Glossopteris</i> , <i>Williamsonia</i> , <i>Medullosa</i> , <i>Cordaites</i> .	
3	Angiosperms: 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	Angiosperms: 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**Course Code: RPSBOT 103****Course Title: Bioanalytical Techniques and IPR****Academic year 2022– 23****COURSE OUTCOMES:**

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

Detailed Syllabus

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

	<ul style="list-style-type: none"> ➤ Null Hypothesis & Alternate Hypothesis ➤ Z-test ➤ Test of significance ➤ Introduction to ANOVA, One-way & two way ANOVA ➤ Dunett's test ➤ Randomized Block Design and Latin Square. (5 problems to be solved in each category) 	
UNIT IV	Traditional Knowledge and IPR	15 Lectures
	<ul style="list-style-type: none"> ➤ Different property rights & IPR in India ➤ IPR: Objectives, process & scope ➤ TRIPS & Patent laws: Introduction & standards for patent protection ➤ WTO, WIPO, GATT & Indian Patent Laws ➤ 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 ➤ International Depository authority ,Gene patenting, plant variety protection, trade secrets & plant breeders right 	
PRACTICALS		
RPSBOTP 103	Bioanalytical techniques and IPR	Credits – 2
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**Course Code: RPSBOT 104****Course Title: Bioprospecting for Industrial Molecules****Academic year 2022- 23****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners 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

RPSBOT 104	Title: Bioprospecting for Industrial Molecules	Credits – 4
UNIT I	Bioprospecting for crop protection	15 Lectures
	<ul style="list-style-type: none"> ➤ Introduction to Bioprospecting. ➤ Significance of plants in bioprospecting. ➤ Recent trends in bioprospecting. ➤ Entomotoxic proteins to control the crop insect pests and mechanism of insecticidal activity: <ul style="list-style-type: none"> ● Lectins ● Ribosome-Inactivating Proteins (RIPs) ● Arcelins ● Defensins ● Cyclotides 	
UNIT II	Bioprospecting for anti-microbial products	15 Lectures
	<ul style="list-style-type: none"> ➤ Use of plant products as antimicrobials: Historical perspective. ➤ Major groups of Plant-derived antimicrobial compounds: <ul style="list-style-type: none"> ● Phenols and Phenolic acids ● Terpenes and Essential oils ● Alkaloids ➤ Mechanisms of Antimicrobial activity: <ul style="list-style-type: none"> ● Plant extracts with efflux Pump Inhibitory Activity ● Plant extracts with Bacterial Quorum Sensing Inhibitory 	

	Activity <ul style="list-style-type: none"> ● Plant extracts with Biofilm Inhibitory Activity 	
UNIT III	Algal Biomass for high-value biomolecules	15 Lectures
	<ul style="list-style-type: none"> ➤ Algae in high-value biomolecule production: <ul style="list-style-type: none"> ● Polyphenols ● Polysaccharides ● Fatty acids ● Pigments 	
UNIT IV	Bioprospecting for flavours and fragrance	15 Lectures
	<ul style="list-style-type: none"> ➤ Physiological mechanism of biosynthesis of essential oils: <ul style="list-style-type: none"> ● Metabolic cycles of biosynthesis of Phenolic compounds. ● Methods of extraction of natural sources for flavours and fragrances. ● Designing of flavours and fragrance. ● sensory evaluation. 	
PRACTICALS		
RPSBOTP 104	Bioprospecting for Industrial Molecules	Credits - 2
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.	

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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

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	Relation between Emotions and Thinking	15 Lectures
	<ul style="list-style-type: none"> ➤ Fundamentals of emotional well-being. ➤ Tracing the thoughts behind an emotional problem. ➤ Some prominent faulty thinking patterns/fallacies causing harm to oneself and others: <ul style="list-style-type: none"> ● Demanding perfection ● World Revolves Around Me ● Damnation ● Awfulizing ● Can'tstipation. 	
UNIT II	Strengthening rational Thinking Patterns	15 Lectures
	<ul style="list-style-type: none"> ➤ How to refute the fallacies <ul style="list-style-type: none"> ● Fallacy-Antidotes-Virtues framework ➤ Some uplifting Antidotal reasoning to overcome the fallacies ➤ Corresponding Guiding virtues for the fallacies: <ul style="list-style-type: none"> ● Demanding perfection - Metaphysical security ● World Revolves Around Me - Empathy ● Damnation - Respect ● Awfulizing - Courage ● Can'tstipation - Temperance. 	

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
Total	50

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

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Explain the ecological principles, applying the same to conservation strategies.
CO 2	Describe the basic concepts in anatomy regarding the origin of tissue systems and organogenesis.
CO 3	Explain the fundamentals of the development of male and female gametophytes, embryo and fertilization.
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

RPSBOT 201	Title: Form and Functions- I	Credits – 4
UNIT I	Anatomy	15 Lectures
	<ul style="list-style-type: none"> ➤ Morphogenesis and organogenesis in plants: Organization of shoot and root apical meristems; shoot and root development, Quiescent centre; Root cap, origin of lateral root. ➤ Leaf development and phyllotaxy; transition of flowering, floral meristems and floral development in Arabidopsis and Antirrhinum ➤ Sensory and tactile tissue system: Tactile sense organs, gravitational optical sense organs. 	
UNIT II	Developmental Botany	
	<ul style="list-style-type: none"> ➤ Male gametophyte: Gene expression, male sterility sperm dimorphism and hybrid seed production; pollen storage; pollen embryos. ➤ Female gametophyte: Types of embryo sacs; structure of embryo sac cells. ➤ Pollination, pollen-pistil interaction and fertilization: floral characteristics. ➤ Sexual Incompatibility, Endosperm, Embryogenesis, Polyembryony, Parthenocarpy, Apomixis - Seed germination and Seedling growth, Embryology in relation to taxonomy and 	

	<p>applications of Embryology.</p> <ul style="list-style-type: none"> ➤ 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. 	
UNIT III	Environmental Botany	15 Lectures
	<ul style="list-style-type: none"> ➤ Habitat and Niche: concept of habitat and niche; niche width and overlap; fundamental and realized niche; resource partitioning; character displacement. ➤ 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. ➤ Biogeography: Major terrestrial biomes, theory of island biogeography; biogeographical zones of India. ➤ Environmental Botany: Present concern- Conservation of genetic resources, gene pools, land races, Global warming, Depletion of forest cover, Urbanization and plant cover. 	
UNIT IV	Stress Physiology	15 Lectures
	<ul style="list-style-type: none"> ➤ Responses of plants to biotic (pathogen and insects) and abiotic (water, temperature and salt) stresses. ➤ Mechanism of resistance to biotic stress and tolerance to abiotic stress. ➤ Role of phytoalexins in plant disease resistance 	
PRACTICALS		
RPSBOTP 201	Form and Functions- I	Credits - 2
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.	

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3. Forester, A.S. 1960. Practical Plant Anatomy. D. Van Nostrand Company Inc.

4. Mauseth, J.D. 1988. Plant Anatomy - The Benjamin Cumming Publishing Co.
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10. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego, USA.
11. Billings, W. B. 1964. Plants and the ecosystem Macmillan & co, London.
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13. Cragg, J. B. 1968. The theory and practice of conservation, IUCN Publ, New Series No. 12, 25- 35
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16. Odum EP 1963 Ecology Holt Reinhart and Winston Inc.
17. Odum EP 1983 Basic Ecology, Saunders Publ Philadelphia.
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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.
25. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (2nd ed). Academic Press, Diego, USA

CORE COURSE**Course Code: RPSBOT 202****Course Title: Form and Functions- II****Academic year 2022- 23****COURSE OUTCOMES:**

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

Detailed Syllabus

RPSBOT 202	Title: Form and Functions- II	Credits – 4
UNIT I	Photosynthesis I (Eukaryotes)	15 Lectures
	<ul style="list-style-type: none"> ➤ 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. ➤ C4 Photosynthesis: inter and intra-cellular transport of metabolites, carbonic anhydrase, PEPcase, NADP-MDH and PPDK. ➤ Regulation of CAM through transport of metabolites. ➤ Pentose Phosphate Pathway and its importance. ➤ Artificial photosynthesis 	
UNIT II	Photosynthesis II (Prokaryotes) & Membrane Biophysics	15 Lectures
	<ul style="list-style-type: none"> ➤ Photosynthesis of prokaryotes: Pigment systems in bacteria and Cyanobacteria, light harvesting mechanisms, reductive TCA cycle. ➤ Conformational properties of membranes, lipid composition of the membranes, lipid rafts, role of lipid rafts, diseases associated with rafts. ➤ Modification of cell membrane and Biophysical importance. ➤ Isolation and characterization of plant membranes. ➤ Effect of microgravity on plant growth. 	
UNIT III	Protein structure	15 Lectures
	Primary, secondary, tertiary and quaternary structural features and their analysis – Theoretical and experimental	

	<ul style="list-style-type: none"> ➤ Classification of Proteins ➤ Bonds involved in protein structure- Polypeptide backbone, covalent and non-covalent interactions. ➤ Configuration details of primary, secondary, tertiary and quaternary structures : structural features. ➤ Ramachandran plot ➤ structure-function relation of protein eg. Haemoglobin ➤ Denaturation of proteins Protein folding- Chaperones in protein folding.	
UNIT IV	Plant hormones	15 Lectures
	Biosynthesis, storage, breakdown, transport and bioassay techniques of: <ul style="list-style-type: none"> ➤ Auxins ➤ Gibberellins ➤ Cytokinins ➤ Ethylene ➤ Abscisic acid ➤ Inositol, Jasmonic acid, Brassinosteroids 	
PRACTICALS		
RPSBOTP 202	Form and Functions- II	Credits - 2
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:

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 3rd 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.
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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.

Ramnarain Ruia Autonomous College

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

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

RPSBOT 203	Title: Current Trends in Plant Sciences- I	Credits – 4
UNIT I	Ethnobotany and Ethnopharmacology	15 Lectures
	<ul style="list-style-type: none"> ➤ Classification - International, National and Regional ➤ Centres of Ethnobotanical studies in India ➤ Role of ethnomedicine and its scope in modern times. ➤ Role of Ethnobotany in conservation and sustainable development, ➤ General ethnobotanical techniques-Anthropological field methods. ➤ A brief account of Phytochemistry, pharmacodynamics and pharmacokinetics ➤ Difference between herbal/botanicals and pharmaceutical medicine. ➤ Classification and sources of crude drugs. Regulatory guidelines for conducting toxicity studies as per OECD ➤ Quality, safety and efficacy of herbal medicines/ nutraceuticals. Role of ethnopharmacology in drug development. ➤ Ethnobotany and Ethnopharmacology as a tool to protect interests of ethnic groups and rural development. 	
UNIT II	Life Guards of Coastal Ecosystems- Mangroves	15

		Lectures
	<ul style="list-style-type: none"> ➤ Adaptations in Mangroves ➤ 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) ➤ Key mangrove species of India ➤ Mangroves of Maharashtra, India and the Mangrove reserve forests ➤ Ecological significance of Mangrove ➤ Threats to Mangroves ➤ Conservation and Management strategies ➤ GIS systems 	
UNIT III	Bioinformatics	15 Lectures
	<ul style="list-style-type: none"> ➤ Specialized databases: EST, GSS, KEGG, OMIM ➤ System biology and Bioinformatics, Biological pathway analysis- System biology database and tools: Reactome, Plant Reactome, Pathway commons. ➤ Conserved regions in nucleotide and protein sequences- Gene finding and motif finding ➤ 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 IV	Molecular modeling and Molecular Dynamics simulations	15 Lectures
	<ul style="list-style-type: none"> ➤ Concept of molecular modeling, chirality & stereochemistry. ➤ 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. ➤ Differences between molecular mechanics energy and the quantum mechanical energy of a system. ➤ Differences between Class I, Class II and Class III forcefields. ➤ Parametrization of a forcefield. ➤ 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. 	
PRACTICALS		
RPSBOTP 203	Current Trends in Plant Sciences- I	Credits - 2
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:

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2. Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of herbaria. Bull. Bot. Surv. India 19.
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18. A. Leach. 2001. Molecular modeling- principles and applications. Pearson Education Ltd.
19. F. J. Burkowski. 2008. Structural bioinformatics: An algorithmic approach. CRC Press.
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DISCIPLINE SPECIFIC ELECTIVE

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"> ➤ Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibility complex cells of immune system, regulation of immune responses. ➤ Production of antibodies by plant cells and organs. ➤ Immunity in Health and Disease: Immunodeficiency and AIDS ➤ Immunotechniques- Antigen-antibody reactions: agglutination, precipitation, Immuno-electrophoresis, Coomb's test, ELISA, Radioimmunoassay. 	
UNIT II	Cancer Biology	15 Lectures
	<p>Cancer cells: Characteristics, division, spread, treatment.</p> <ul style="list-style-type: none"> ➤ Characteristics of Cancer: Course of Cancer formation, Division and Spread (Metastasis) ➤ Causes of cancer: What are carcinogens? (classification and latency period) ➤ 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) ➤ 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)	
UNIT III	Cancer genetics	15 Lectures
	<ul style="list-style-type: none"> ➤ Characteristics of Cancer cells: Telomerase activity, Genome Instability, Anaplasia, Cell surface proteins and Immune reaction ➤ Mutations and Cancers ➤ Two-hit mutation theory; Familial and Sporadic Cancers ➤ Genes involved in Oncogenesis: Proto-oncogenes/Oncogenes, Tumor suppressor genes, MicroRNA (miRNA) genes, and Mutator genes. ➤ Oncogenes and Growth Factors 	
UNIT IV	Genetic disorders	15 Lectures
	<ul style="list-style-type: none"> ➤ X linked Dominant disorders: X-linked hypophosphatemia, Focal dermal hypoplasia, Coffin-Lowry syndrome (CLS), Alport syndrome ➤ X linked Recessive disorders: Red Green Color Blindness, Royal Hemophilia, Duchenne Muscular Dystrophy (DMD), Barr bodies in Klinefelter syndrome ➤ Autosomal Dominant disorders: Familial hypercholesteremia, Huntington's disorder, Neurofibromatosis, Marfan Syndrome ➤ Autosomal Recessive disorders: Lysosomal Diseases, Peroxisomal Diseases, Cytoskeletal Diseases, Diseases due to Protein misfolding ➤ Biochemical disorders: Albinism, Phenylketonuria, Alkaptonuria ➤ Cardiovascular disorders: Coronary heart disease, Strokes and TIAs, Peripheral arterial disease, Aortic disease ➤ Need for Genetic counseling and its applications 	
PRACTICALS		
RPSBOTP 204	Immunology and Cancer Biology	Credits - 2
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. 6th Edition.
2. K. Murphy, P. Travers and M. Walport. 2008. Janeway's Immunology. Taylor and Francis Publishers. 7th Edition.
3. Swanon. M. & Young. 1982. Cytogenetics. Prentice Hall, India.
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6. Gerald Karp 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and Scnelne., USA.
7. De Robertis and De Robertis 2005 (Eight edition) (Indian) Cell and Molecular Biology, Lippincott Williams, Philadelphia. [B.I Publications Pvt. Ltd. New Delhi].
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9. Powar C.B 2005 (Third Edition). Cell Biology, Himalaya Publishing, Mumbai.
10. Roy S.C and KKDe 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
11. Verma P.S and Agarwal V.K 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
12. Russel, P. J. 1998 Genetics (5th Edi.) The Benjamin/ Cummings Publishing Com. Inc., USA.
13. Tamarin, R. H. 2001 Principles of Genetics 7th Edi.The McGraw-Hill Companies.
14. Wolf, S.L. 1993. Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
15. Gupta P K 2007 Genetics: Classical to Modern. Rastogi Publications, Meerut.
16. Hexter W and Yost Jr. H T 1977 The Science of Genetics. Prentice Hall of India Pvt. Ltd., New Delhi.
17. Hartl D L and Jones E W 1998 Genetics: Principles and Analysis (4thed.). Jones and Barflett Publishers, USA.
18. F Bunz. 2008. Principles of Cancer Genetics, Springer.

ABILITY ENHANCEMENT COMPULSORY COURSE**Course Code: RPSBOT 205****Course Title: Research Methodology****Academic year 2022- 23****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners 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

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

	<ul style="list-style-type: none"> ➤ Introduction to scientific writing: Meaning of Scientific and non-scientific writing; Scientific Vocabulary and grammar. Synopsis, Dissertations, Thesis, Posters. ➤ Correspondence: Formal letters, cover letters, drafting emails, replying to reviewers. ➤ Writing a Research paper: Title, Abstract, Introduction, Review of literature, Methodology, Observations, Results, Discussions, Summary, Conclusion, and Bibliography (Referencing and citation styles). Supplementary data. ➤ 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. ➤ Presentations: Presenting numerical data - Graphical, Tabular, Animations, Slides, etc. ➤ Data analysis –SPSS and MS Excel ➤ Ethics in research 	
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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
Total	50

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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Ramnarain Ruia Autonomous College

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 III and IV Program:

Program Code: Botany (RPSBOT)

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

**(Credit Based Semester and Grading System for the academic year 2022–
2023)**

PROGRAM OUTLINE

		SEMESTER III		
S Y	III	RPSBOT301	PLANT BIOTECHNOLOGY I	04
		I	Plant Tissue Culture I	
		II	Plant Tissue Culture II	
		III	Plant Tissue Culture III	
		IV	Commercial Aspects	
		RPSBOT302	PLANT BIOTECHNOLOGY II	04
		I	Environmental Biotechnology	
		II	Industrial and clinical uses of enzymes (Applied Enzymology)	
		III	Nanotechnology	
		IV	Food Biotechnology and Biosensors	
		RPSBOT303	PLANT BREEDING	04
		I	Plant Breeding I	
		II	Plant Breeding II	
		III	Molecular Plant Breeding	
		IV	Plant Genetic Engineering	
		RPSBOT304	INTERNSHIP / PROJECT	04
			PRACTICAL	
		RPSBOTP 301	Plant Biotechnology I	02
RPSBOTP 302	Plant Biotechnology II	02		
RPSBOTP 303	INTERNSHIP / PROJECT	02		
RPSBOTP 304		02		
SY	IV	SEMESTER IV		
		RPSBOT401	MOLECULAR BIOLOGY I	04
		I	DNA Replication	
		II	Transcription	
		III	RNA Processing	
		IV	Translation	
		RPSBOT402	MOLECULAR BIOLOGY II	04
		I	Gene regulation I	
		II	Gene regulation II	
		III	Gene regulation III	
		IV	Cell signaling	
		RPSBOT403	CYTOGENETICS I	04
I	Cytology			



		II	Cancer Biology	
		III	Immune Systems	



		IV	Membrane biophysics and plant growth in Microgravity	
		RPSBOT404	CYTOGENETICS II AND MOLECULAR BIOLOGY III	04
		I	Cytogenetics	
		II	Molecular Biology	
		III	Recombinant DNA technology	
		IV	Genetic Disorders	
			PRACTICAL	
		RPSBOTP 401	Molecular Biology I	02
		RPSBOTP 402	Molecular Biology II	02
		RPSBOTP 403	Cytogenetics II and Molecular Biology III	02
		RPSBOTP 404	Plant Breeding	02
Total				96

Resolution No.: AC/II(20-21).2.RPS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

(Affiliated to University of Mumbai)



Syllabus for: Semester III & IV

Program: M. Sc.

Program Code: Botany (RPSBOT)

(Credit Based Semester and Grading System for the
academic year 2022–2023)

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
RPSBOT 301	PLANT BIOTECHNOLOGY I			
	I	Plant Tissue Culture I	4	1
	II	Plant Tissue Culture II		1
	III	Plant Tissue Culture III		1
	IV	Commercial Aspects		1
RPSBOT 302	PLANT BIOTECHNOLOGY II			
	I	Environmental Biotechnology	4	1
	II	Industrial and clinical uses of enzymes (Applied Enzymology)		1
	III	Nanotechnology		1
	IV	Food Biotechnology and Biosensors		1
RPSBOT 303	PLANT BREEDING			
	I	Plant Breeding I	4	1
	II	Plant Breeding II		1
	III	Molecular Plant Breeding		1
	IV	Plant Genetic Engineering		1
RPSBOT 304	INTERNSHIP / PROJECT		4	
RPSBOTP 301		PLANT BIOTECHNOLOGY I	02	04
RPSBOTP 302		PLANT BIOTECHNOLOGY II	02	04
RPSBOTP 303		INTERNSHIP / PROJECT	04	
RPSBOTP 304				
			24	

Course Code	UNIT	TOPICS	Credits	Lectures/Week
RPSBOT 401	MOLECULAR BIOLOGY I			
	I	DNA Replication	4	1
	II	Transcription		1
	III	RNA Processing		1
	IV	Translation		1
RPSBOT 402	MOLECULAR BIOLOGY II			
	I	Gene regulation I	4	1
	II	Gene regulation II		1
	III	Gene regulation III		1
	IV	Cell signaling		1
RPSBOT 403	CYTOGENETICS I			
	I	Cytology	4	1
	II	Cancer Biology		1
	III	Immune Systems		1
	IV	Membrane biophysics and plant growth in microgravity		1
RPSBOT 404	CYTOGENETICS II AND MOLECULAR BIOLOGY III			
	I	Cytogenetics	4	1
	II	Genetics		1
	III	Recombinant DNA technology		1
	IV	Genetic Disorders		1
PRACTICALS				
RPSBOTP 401		MOLECULAR BIOLOGY I	02	04
RPSBOTP 402		MOLECULAR BIOLOGY II	02	04
RPSBOTP 403		CYTOGENETICS I	02	04
RPSBOTP 404		CYTOGENETICS II AND MOLECULAR BIOLOGY III	02	04
			24	

SEMESTER III**Course Code: RPSBOT 301****Course Title: PLANT BIOTECHNOLOGY I****Academic year 2022 - 23****COURSE OUTCOMES:**

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Recall the basic concepts in plant tissue culture.
CO 2	Interpret the advanced methods of biotransformation for product enhancement.
CO 3	Describe the basic principles of bioreactor design for large scale production of metabolites.
CO 4	Comment on the transgenic plants in phytoremediation and <i>in vitro</i> germ plasm conservation.
CO5	Apply the concepts of plant tissue culture for production of useful secondary metabolites through regulation of biosynthetic pathway

Detailed Syllabus

RPSBOT 301	Plant Biotechnology I	Credits – 4
UNIT I	Plant Tissue Culture I	15 Lectures
	Plant improvement through soma-clonal variations.	
	Plant cell culture systems: a potential renewable source of flavours, fragrances, and colorants	
	Metabolic engineering: Production of useful secondary metabolites through regulation of biosynthetic pathway in cell and tissue suspension culture	
	Protoplast culture and Somatic hybridization & its applications.	
UNIT II	Plant Tissue Culture II	15 Lectures
	Plant cell cultures as chemical factories: Cell suspension, enhancement of product formation using biotic and abiotic elicitors, immobilization, permeabilization and product recovery.	
	Biotransformation using: Freely suspended plant cells and Immobilized plant cells	
	Biotransformation for Vanillin production from <i>Capsicum</i> cell Cultures	
UNIT III	Plant Tissue Culture III	15 Lectures
	<i>In vitro</i> storage of Germplasm, Cryopreservation	
	Studies on <i>Agrobacterium</i> mediated transformed root cultures.	
	Transgenic plants in phytoremediation	



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	Risk assessment and the regulatory frame work	
UNIT IV	Commercial aspects	15 Lectures
	The quest for commercial production from plant cell: scaling up of cell cultures	
	Bioreactors: factors for bioreactor design, pneumatically agitated bioreactors, comparison of bioreactors, operating mode, batch, fed-batch, semi continuous, two stage operation, continuous cultivation.	
	Factors for growth in Bioreactors.	
	Shikonin production by <i>Lithospemum erythrorhizon</i> cell cultures.	
PRACTICALS		
RPSBOTP 301	Plant Biotechnology I	Credits - 2
1	Preparation of stock solutions	
2	Preparation of MS basal medium & Defined medium	
3	Callus induction	
4	Regeneration of the callus	
5	Micropropagation	
6	Isolation of bioactive compounds from callus and plant source using TLC.	
7	Enhancement of product formation using biotic or abiotic elicitor (Total phenolics/ flavonoids).	
8	Types of Bioreactors.	
9	<i>Agrobacterium</i> mediated transformed root cultures	

References:

- 1) Bhojwani. S.S. & Razdan. M.K. 1996. Plant Tissue Culture: Theory and Practice (Rev.Ed.). Elsevier Science Publishers, New York.
- 2) Chawla. H.S 1999. Introduction to Plant Biotechnology. Oxford & IBH.
- 3) Collin. H.A & Edwards. S. 1998. Plant Cell Culture. Bioscientific Publishers, Oxford, UK.
- 4) Gamborg & Phillips. Plant Cell, Tissue and Organ Culture. Narosa Publications.
- 5) Jain. S.M., Sopory. S.K. & Valleux. R.E. 1996. In Vitro Haploid Production in Higher Plants. Volumes 1 to 5. Fundamental Aspects and Methods. Kluwer Academic Publishers, Dordrecht, Netherlands.
- 6) Kalyan Kumar De. 1997. Plant Tissue Culture. NCB Agency, Kolkata.
- 7) Ramawat. K.G. & Merillon. J.M. 2007. Biotechnology: Secondary Metabolites. 2nd Ed. Science Pub., Netherlands.
- 8) Razdan. M.K. 2003. An Introduction to Plant Tissue Culture. Oxford & IBH, New Delhi
- 9) Shukla Y.M., Patel I.N.J., Jithendra J.D., Bhatnagar R., Talati J.G., Kathiria K.B. 2009, Plant Secondary Metabolites, New India Publishing Agency, Gujarat.

Course Code: RPSBOT 302

Course Title: PLANT BIOTECHNOLOGY II

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to:
CO 1	Recall the pros and cons of nanotechnology in various fields.
CO 2	Describe the methods for isolation and purification of different industrial and clinical enzymes
CO 3	Comment on the technologies involved in food biotechnology.
CO 4	Evaluate the ideas and technologies used to increase production of biofuels.
CO 5	Justify the current and future trends of applying enzyme technology for the commercialization of biotechnological products.
CO 6	Synthesize various types of metal nanoparticles, characterize them and study their biological activities.

Detailed Syllabus

RPSBOT 302	Plant Biotechnology II	Credits – 4
UNIT I	Environmental Biotechnology	15 Lectures
	Biosorption: use of fungi, algae and biological components	
	Biomass for energy: Sources of biomass, advantages & disadvantages, uses of biomass	
	Biogas production from food processing waste: vegetable canning waste, flour, molasses etc.	
	Bio-composting	
	Ethanol from biomass and Ligno-cellulosic residues	
	GMO's	
UNIT II	Industrial and clinical uses of enzymes (Applied Enzymology)	15 Lectures
	Enzymes of industrial importance (amylase, glucose isomerase, cellulase, lipase, protease, xylanase, invertase, peroxidases Thermophilic enzymes- enzymes used in various fermentation processes).	
	Clinical enzymes – Enzymes as thrombolytic agents, anti-inflammatory agents, cholinesterase, amylase, phosphatase, Serum enzymes in health and disease - diagnostic and therapeutic applications	

	Enzyme Technology-Production, recovery, stability and formulation of bacterial and fungal enzymes-amylase, protease, penicillin acylase, glucose isomerase. ELIZA.	
	Isolation and purification of enzymes and criteria of purity.	
	Enzyme engineering - modifying enzymes to make them stable and heat resistant. Enzyme engineered for new reactions-novel catalyst for organic synthesis.	
	Case studies: thermozyms cold adopted enzymes, Ribozymes, hybrid enzymes, diagnostic enzymes, therapeutic, inteins. Designer enzymes- Abzymes, Ribozymes	
UNIT III	Nanotechnology	15 Lectures
	Introduction, properties of nano-materials.	
	Green synthesis of nano-materials, biological methods, use of microbial system & plant extracts, use of proteins & templates like DNA	
	Characterization of nanoparticles (FTIR, SEM, TEM, STEM, Scanning Tunneling Microscope, Atomic Force Microscope, UV-Vis,)	
	Application of nano-materials in food, cosmetics, agriculture, environment management and medicine	
	Risk of Nanomaterial to human health and Environment	
UNIT IV	Food Biotechnology and Biosensors	15 Lectures
	Food Biotechnology	
	Methods of molecular cloning, Genetically modified foods (GMF)	
	Food Fermentation technology- bioreactors and bioprocessing, Production of food flavour, colour. polysaccharides, amino acids, vitamins, baker's yeast, brewer's yeast, Single Cell Protein and Single Cell Oil(any one example from each).	
	Factors affecting food spoilage	
	Biosensors	
	Introduction to Biosensors Components of biosensors Types of biosensors Uses of biosensors Recent advances in biosensors	
PRACTICALS		
RPSBOTP 302	Plant Biotechnology II	Credits - 2
1	Biogas production from food processing waste	
2	Biocomposting (pH, conductivity and organic matter content)	
3	Market survey on the availability of Genetically modified foods (GMF).	

4	Microbial production and downstream processing of an enzyme, e.g. amylase.
5	Synthesis of nanoparticles
6	Characterization of nanoparticles by UV spectroscopy.
7	Production of yoghurt using Direct into Vat cultures
8	Development of a fermented food/drink utilizing plant products /animal products or byproducts as substrate

References:

- 1) Botkin, D.B. and E.A. Keller. 2004. Environmental Science. 5th ed. John Wiley and Sons.
- 2) Bernhardsen, T. 1999. Geographic Information System: An Introduction. 02nd Edition, John Wiley and Sons.
- 3) Canter, L.W. 1996. Environmental Impact Assessment. McGraw Hill, New York.
- 4) Alan Scragg, 2005. Environmental Biotechnology. II Edition. Oxford University Press. New York.
- 5) Bernard R. Glick and Jack J. Pasternak, 2001. Molecular Biotechnology – 2nd edition, ASM press Washington DC.
- 6) Brown, C.W, I.Campbell and F.G. Priest, 1987. Introduction to Biotechnology. Blackwell scientific publications, Oxford
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- 8) Wood ,A., Pamela, S.E.and Johanna, M.(2000). The root causes of biodiversity loss. United Kingdom: Early –Scan Publications.
- 9) Bagchi, D., Lau, F.C. and Ghosh, D.K. (Eds.). 2010. Biotechnology in functional foods and nutraceuticals. CRC Press, Boca Raton, Florida, USA.
- 10) Duggan, C., Watkins, J.B. and Walker, W.A. (Eds.). 2008. Nutrition in pediatrics: basic science and clinical applications. People’s Medical Publishing House, Hamilton, USA.
- 11) Government of Canada, 2013. Nutraceuticals / Functional Foods and Health Claims on Foods. Policy Paper. Hasler, C.M. (Ed.) 2005. Regulation of functional foods and nutraceuticals: A global perspective. IFT Press and Wiley-Blackwell, Ames, Iowa, USA.
- 12) Katsilambros, K. 2011. Clinical nutrition in practice. John Wiley & Sons, New York. USA.
- 13) Nestle, M. 2002. Food politics. University of California Press, Berkeley, USA.
- 14) Pathak, Y.V. (Ed.) 2010. Handbook of nutraceuticals. vol. 1: Ingredients, formulations, and applications. CRC Press, Boca Raton, Florida, USA.
- 15) Shahidi, F. and Naczk, M. (Eds.) 2003. Phenolics in food and nutraceuticals. 2nd edition. CRC Press, Boca Raton, Florida, USA.
- 16) J. Draper 1988. Plant Genetic Transformation and Gene Expression Blackwell Scientific Publications, Oxford.
- 17) R.W. Old, S.B. Primrose. 2004. Principles of Gene Manipulation. An Introduction to Genetic Engineering. Fifth Edition, Blackwell Science Publications.

Course Code: RPSBOT 303

Course Title: PLANT BREEDING

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Describe the major contributions of plant breeding institutes in India.
CO 2	Relate the fundamental aspects of plant breeding and hybridization with the latest molecular techniques.
CO 3	Analyze the achievements of distant hybridization in crop improvement.
CO 4	Evaluate the DNA-based molecular marker aided breeding techniques in plant genetic engineering.
CO 5	Elaborate on the principles of plant breeding for large scale production of high yielding & stress resistant plants in agriculture and horticulture.

Detailed Syllabus

RPSBOT 303	PLANT BREEDING	Credits – 4
UNIT I	Plant Breeding I	15 Lectures
	Aims and objectives, plant introductions and acclimatization.	
	Selection – mass, pure line and clonal.	
	Hybridization techniques, hybridization in self-pollinated and cross pollinated plants.	
	Genetic control and manipulation of breeding systems including male sterility and apomixes	
UNIT II	Plant Breeding II	15 Lectures
	Distant hybridization: In nature (plant breeding) – Barriers to the production of distant hybrids; Unreduced gametes in distant hybridization; Sterility in distant hybrids; Consequences of segregation in distant hybrids;	
	Applications and Achievements of distant hybridization in crop improvement; Limitations of distant hybrids.	
UNIT III	Molecular plant Breeding (Transgenic Crops)	15 Lectures
	Natural method of gene transfer (<i>Agrobacterium</i> and virus), selectable markers	
	Artificial methods of gene transfer: Direct DNA uptake by protoplast, electroporation, liposome mediated and particle gun transformation	

	Production of Transgenic plants :virus resistant & Herbicide – resistant, plants, Bt Cotton, Golden rice	
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UNIT IV	Plant Genetic Engineering	15 Lectures
	Production of bio pharmaceuticals in transgenic plants.	
	Edible vaccines & Plantibodies	
	DNA-based molecular marker aided breeding: RAPD, RFLP, AFLP, STS, ISSR, Microsatellites	
	Contribution of plant breeding institutes in India	
PRACTICALS		
RPSBOTP 303	INTERNSHIP / PROJECT	Credits - 2

References:

- 1) Al Chaudhari, H.K. (1984). Elementary principles of plant breeding Oxford IBH, New Delhi and R W (1995). Principles of Plant Breeding. John Wiley and Sons, Inc.
- 2) Allard, R.W, 1960. Principles of plant breeding. John Willeg, New York.
- 3) Chaudhary, H. K. (2001) Plant Breeding Theory and Practice, Oxford IBH Ltd, New Delhi, India
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- 5) Dwivedi and Singh (1980) Essentials of Plant Techniques, 2nd Ed., Scientific Publishers. Moan Bhavan Udaipur, India.
- 6) Gardner, E.J. (1972). Principles of genetics. Willey Eastern Pvt.Ltd.
- 7) Ghahal G S and Gosal S S (2002). Principles and procedures of Plant Breeding. Narosa Publishing House.
- 8) Hays, K.K. Immer, F.R. and Smith, D.C. (1985). Methods in plant breeding .Tata McGraw Hill. Newyork.
- 9) Neal.C.Stopskopf. (1999). Plant Breeding Theory & Practices. Scientific Publ, Jodhpur.
- 10) Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers
- 11) Singh, B.D. 2001. Plant Breeding, Principles and Methods. Kalyani Publications,
- 12) Swaminathan, M.S, P.K.Gupta and V.Singa. (1983). Cytogenetics of crop plants. Macmillan India Ltd, New Delhi.
- 13) Sharma J R (1994). Principles and practices of Plant Breeding. Tata McGraw-Hill Publishers
- 14) Potrykus and G.Spangenberg, 1995 Gene Transfer to plants Springer, Berlin. Heidelberg
- 15) J. Sambrook, E.F.Fritsch and T.Maniatis 1989. Molecular Cloning - A Laboratory Manual
- 16) Adrian Slater, Nigel Scott and Mark Flower, 2000 Plant Biotechnology -The Genetic Manipulation of Plants, Oxford University Press,).

Course Code: RPSBOT304 AND RPSBOTP304

INTERNSHIP / PROJECT

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** marks. 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)	Any 3 out of 5	12	All Units

Practical Examination Pattern:

External (Semester end practical examination):

Particulars	Practical 1
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Laboratory work / Viva	50
Total	50

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- III									
Course	RPSBOT 301		RPSBOT 302		RPSBOT 303		RPSBOT 304	Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External	Internship/ Project		
Theory	40	60	40	60	40	60	100	100	400
Practical	50		50		Internship/ Project 50 + 50			50	200

.....x.....0.....x.....

SEMESTER IV

Course Code: RPSBOT 401 Course

Title: MOLECULAR BIOLOGY I

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Comment on the different types of snRNAs.
CO 2	Distinguish between molecular mechanisms of prokaryotes and eukaryotes.
CO 3	Compare and contrast between various mechanisms of DNA recombination.
CO 4	Elaborate on the recent advances in molecular biology.

Detailed Syllabus

RPSBOT 401	Molecular Biology I	Credits – 4
UNIT I	DNA Replication	15 Lectures
	Molecular details of DNA replication in prokaryotes and eukaryotes.	
	Assembly of raw DNA into nucleosomes.	
	DNA recombination, Holliday model for recombination.	
UNIT II	Transcription	15 Lectures
	Transcription, RNA synthesis, classes of RNA and the genes that code for them.	
	Transcription of protein coding genes, prokaryotes and eukaryotes, mRNA molecule.	
	Transcription of other genes, ribosomal RNA, tRNA.	
UNIT III	RNA processing	15 Lectures
	Capping, polyadenylation, splicing, introns and exons.	
	snRNA, Types and significance of snRNA, snRNA in spliceosome,	
	Non coding RNAs, ribozyme, riboswitches, RNA localization.	
UNIT IV	Translation	15 Lectures
	Protein structure, nature of genetic code, translation of genetic message.	
	Post translational modifications, localization, chaperons.	

PRACTICALS		
RPSBOTP 401	Molecular Biology I	Credits - 2

1	Aseptic techniques, safe handling of microorganisms.
2	Establishing pure cultures, streak plate method (T-streak and pentagon method), Pour plate, spread plate.
3	Maintenance of cultures - Paraffin embedding, Lyophilisation.
4	Preparation of culture medium, stock solutions
5	Determination of cell number, viable count method (using pour plate and serial dilution technique).
6	Separation of seed proteins using PAGE.
7	Analysis of proteins by one and two dimensional gel electrophoresis.
8	Genomic DNA isolation and quantification.

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Course Code: RPSBOT 402

Course Title: MOLECULARBIOLOGYII

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Summarize the concept of “omics”.
CO 2	Describe the regulation of signal transduction.
CO 3	Interpret major signaling pathways of phytohormones responsible for the metabolism and development of the plant.
CO 4	Distinguish between the regulation of gene expression in prokaryotes and eukaryotes.
CO 5	Comment on the working of the operon system.

Detailed Syllabus

RPSBOT 402	Molecular Biology II	Credits – 4
UNIT I	Gene Regulation I	15 Lectures
	Regulations of gene expression in bacteria –Lactose operon, arabinose operon, tryptophan operon	
	Regulation of gene expression in bacteriophage λ .	
UNIT II	Gene Regulation II	15 Lectures
	Control of gene expression in eukaryotes, Transcriptional control, RNA processing control, mRNA translocation control, mRNA degradation control, protein degradation control	
	Gene editing-(CRISPR-cas technologies – Biotechnology application)	
UNIT III	Gene Regulation III	15 Lectures
	Genomics, proteomics and metabolomics	
	Genetic regulation of development in <i>Drosophila</i> Developmental stages in <i>Drosophila</i> – embryonic development, imaginal discs, homeotic genes	
UNIT IV	Cell signaling	15 Lectures

	Hormones and their receptors: cell surface receptor, intracellular receptor, signaling through G-protein coupled receptors, signal relay pathways-signal transduction pathways, second messengers, regulation of signaling pathways, bacterial and plant two-component systems, light signaling in plants, bacterial chemotaxis and quorum sensing.	
	Forms of signaling (paracrine, synaptic, autocrine, endocrine, cell to cell contact)	

PRACTICALS		
RPSBOTP 402	Molecular Biology II	Credits - 2
1	Isolation of plasmid DNA	
2	Quantification of plasmid DNA	
3	Agarose gel electrophoresis separation of plasmid DNA	
4	Restriction enzyme digestion and separation of fragments	
5	Southern blot transfer technique	
6	Transformation of <i>E. coli</i> cell by plasmid DNA	
7	β -galactosidase expression and assay	
8	<i>Drosophila</i> : study of genetic traits.	

References:

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- 20) Strickberger (2005). Genetics (III Edn). Prentice Hall of India Pvt. Ltd.

Course Code: RPSBOT 403
Course Title: CYTOGENETICS I

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Explain the regulatory aspects of cell division and Programmed Cell Death.
CO 2	Outline the nature, development and causes of cancer.
CO 3	Describe the components of the immune system and applications in health care.
CO 4	Comment on the conformational properties, isolation and characterization of plant membranes.
CO 5	Evaluate the effect of microgravity on plant growth.
CO 6	Elaborate on the structure and function of the cell membrane.

Syllabus

RPSBOT 403	Cytogenetics I	Credits – 4
UNIT I	Cytology	15 Lectures
	Cell membrane and permeability: Molecular models of cell membrane, cell permeability. Differentiation of cell membrane, intercellular communications and gap junctions. Cell coat and cell recognition, cell surface.	
	Cell Cycle and Apoptosis: Check points during cell cycle-G1 to S, progression of S phase, G2 to M phase, Anaphase check points and components involved as regulators of check points, role of cyclins and CDKs, synthesis and degradation of cyclins, structural features of CDKs and cyclins, activation and inactivation of cyclin dependent kinases; role of RBs, E2Fs, and DP proteins, P53, different types of Cyclin dependent CDKs, CDC25, CAKs, Wee1 proteins, nim-proteins, SCFs, Anaphase Promoting Complexes APC (cyclosomes), Centrosome activation- structure, duplication of centrosomes, Role of nucleophosmins, organization of mitotic apparatus, binding of tractile fibers to kinetochore complexes, molecular motors involved in movement of chromosomes to equatorial plate and in anaphase movement; cytokinesis by cleavage and phragmoplast formation- different gene products and structures involved and the mechanisms of cytokinesis. Cell Plate formation, PCD.	
	Organization and function of mitochondrial and chloroplast genomes.	

UNIT II	Cancer Biology	15 Lectures
	Cancer cells: Characteristics, division, spread, treatment. Course of cancer cell formation, Carcinogens: radiations, chemicals, oncogenic virus	

	Cancer and mutations, reproductive properties of transformed animal cell in culture, oncogenes, protooncogenes and their conversion. Oncogenes and growth factors.	
	Stem cells, Regenerative medicine	
UNIT III	Immune System	15 Lectures
	Phylogeny of immune system, innate and acquired immunity, nature and biology of antigens, major histocompatibility complex cells of immune system, regulation of immune responses.	
	Immunity in Health and Disease: Immunodeficiency and AIDS	
UNIT IV	Membrane biophysics and plant growth in Microgravity	15 Lectures
	Conformational properties of membranes, lipid composition of the membranes, lipid rafts, role of lipid rafts, diseases associated with rafts.	
	Modification of cell membrane and Biophysical importance.	
	Isolation and characterization of plant membranes.	
	Effect of microgravity on plant growth.	
RPSBOTP 403	PRACTICALS	Credits - 2
1	Preparation of cytological stains, fixatives and pretreatment agents.	
2	Study of mitotic index.	
3	Squash preparation from pre-treated root tips (colchicines/ Paradichlorobenzene/ Aesculin	
4	Squash preparation from mutagen treated root tips for study of aberrations.	
5	Smear preparation from any suitable plant material.	
6	Cancer study: Acute myeloid leukemia	
7	Isolation of plasma membrane	
8	Study of SDH activity from isolated plasma membrane.	

References:

- 1) Glick. B.R. & Thompson. J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boc Raton, Florida.
- 2) Sybenga. J. 1973. General Cytogenetics. American Elsevier Pub. Co., New York.
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Course Code: RPSBOT 404

Course Title: CYTOGENETICS II AND MOLECULAR BIOLOGY III

Academic year 2022 - 23

COURSE OUTCOMES:

COURSE OUTCOME	DESCRIPTION
	Upon successful completion of this course, learners will be able to;
CO 1	Explain the molecular mechanism of nitrogen fixation.
CO 2	Describe the genomic technologies involved in generating recombinant DNA molecules.
CO 3	Analyze various types of genetic disorders for genetic counseling and therapy.
CO 4	Elaborate on the karyotype analysis, rDNA technology and dermatoglyphics.

Detailed Syllabus

RPSBOT 404	Title: CYTOGENETICS II AND MOLECULAR BIOLOGY III	Credits – 4
UNIT I	Cytogenetics	15 Lectures
	Karyotype Studies: Analysis and Nomenclature, Banding Techniques- Giemsa banding, R- banding, C- banding, Techniques of Detecting human syndromes	
	Molecular Cytogenetics Methods: Principle, Technique and Applications of FISH, CGH, SKY	
	Dermatoglyphics: Meaning and terminology. Finger patterns – types, ridge count. Different types of palmer patterns, soles and flexion creases. Methods of observation and printing of dermal ridges.	
	Dermatoglyphic analysis: Its uses and limits. Finger printing in Forensic Analysis. Dermatoglyphic features of syndromes. Abnormal dermatoglyphics	
UNIT II	Genetics	15 Lectures
	Molecular basis of transformation, transduction, conjugation; fine structure of the gene, T4 Phage, complementation analysis, deletion mapping, cis-trans tests. <i>Neurospora</i> genetics	
	Molecular biology of nitrogen fixation: Genetic engineering of nitrogenase cluster, genetic engineering of nodulation genes	

UNIT III	Recombinant DNA Technology	15 Lectures
	Vectors in gene cloning: General information on SV-40, Vaccinia, Baculovirus & retroviral vectors. pUC19, phage, cosmid, BAC and YAC vectors, High and low copy number plasmids and its regulation. Use of YAC or YEp of yeast (<i>Saccharomyces cerevisiae</i>) as effective cloning vectors because of their high copy numbers in production of HBsAg vaccine. Use of BAC and its advantages	

	<p>Application of recombinant DNA technology for production of herbicide resistant plants, insect resistant plants, improving seed storage proteins and golden rice</p> <p>Strategies to create Transgenic plants with herbicide resistance: Following strategies to be studied in detail with reference to herbicide Glyphosate resistance:</p> <p>a) Overexpression of the target protein by using a strong promoter. b) Improved plant detoxification resulting in a more and faster conversion of toxic herbicide to non-toxic or less toxic compound. c) Detoxification of herbicide by using a foreign gene. d) Mutation of target protein</p> <p>Methods of modifying the Diazotrophs (N₂ fixing bacteria) by Gene alterations in Rhizobium sp. to</p> <p>a) Improve nitrogen fixing efficiency and bacteria host plant interaction. b) Induce symbiotic relationship with non- leguminous plants such as wheat , rice and corn</p>	
UNIT IV	Genetic disorders	15 Lectures
	Genetic disorders, genetic counselling and gene therapy	
	Biochemical disorders, sex linked disorders	
	Cardiovascular disorders.	
PRACTICALS		
RPSBOTP 404	CYTOGENETICS II AND MOLECULAR BIOLOGY III	Credits - 2
1	Study of dermatoglyphics analysis	
2	Giemsa Staining of blood sample	
3	Blood group testing.	
4	Problems based on: Restriction map analysis and construction of restriction maps	
5	Tetrad analysis in <i>Neurospora</i> – two genes and centromere	
6	Deletion mapping in Bacteriophage	
7	Identification of genetic diseases by chemical tests.	
8	Karyotypes of genetic disorders.	

References

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8. Malacinski, G. M. and Freifelder, D. 1998 Essentials of Molecular Biology (3rd Edi.)Jones and Bartiet Pub. Inc., London.
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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** marks. 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)	Any 3 out of 5	12	All Units

Practical Examination Pattern:

External (Semester end practical examination):

Particulars	Practical 1
Laboratory work /Viva	50
Total	50

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- IV

Course	RPSBOT 401		RPSBOT 402		RPSBOT 403		RPSBOT 404		Total per Course	Grand Total
	Internal	External	Internal	External	Internal	External	Internal	External		
Theory	40	60	40	60	40	60	40	60	100	400
Practicals	50		50		50		50		50	200

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