Resolution No.: AC/II(18-19).2.RUS4

S.P. Mandali's

RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: Semester I and II

Program: M. Sc.

Course Code: Botany (RPSBOT)

(Credit Based Semester and Grading System with effect from the academic year 2019–2020)

SEMESTER I

Course Code	UNIT	TITLE	Credits	Lectures/ Week
RPSBOT 101	PLANT BIODIVERSITY: CRYPTOGAMS I			
	I	Phycology	4	1
	II	Applied Phycology		1
	III	Bryophyta I		1
	IV	Bryophyta II		1
RPSBOT 102	PLANT BIODIVERSITY: SPERMATOPHYTA I			
	I	Gymnosperms I	4	1
	II	Origin of Angiosperms		1
	III	Angiosperms I		1
	IV	Angiosperms II		1
RPSBOT 103	PLANT PHYSIOLOGY			
	I	Photosynthesis I (Eukaryotes)	4	1
	II	Photosynthesis II (Prokaryotes)		1
	III	Proteins		1
	IV	Plant Hormones		1
RPSBOT 104	CYTOGENETICS, MOLECULAR BIOLOGY, BIOTECHNOLOGY AND RESEARCH METHODOLOGY			
	I	Cytogenetics	4	1
	II	Molecular Biology		1
	III	Recombinant DNA technology		1
	IV	Research Methodology I		1
RPSBOTP 101	Plant Diversity :Cryptogams I (Algae and Bryophyta)		02	04
RPSBOTP 102	Plant Diversity – Spermatophyta I (Gymnosperms and Angiosperms)		02	04
RPSBOTP 103	Plant Physiology		02	04
RPSBOTP 104	Cytogenetics, Molecular Biology, Biotechnology & Research Methodology		02	04
			24	

SEMESTER II

Course Code	UNIT	TITLE	Credits	Lectures/ Week
RPSBOT 201	PLANT BIODIVERSITY: CRYPTOGAMS II			
	I	Mycology	4	1
	II	Applied Mycology		1
	III	Pteridophyta I		1
	IV	Pteridophyta II		1
RPSBOT 202	PLANT BIODIVERSITY: SPERMATOPHYTA II			
	I	Anatomy I	4	1
	II	Anatomy II		1
	III	Developmental Botany		1
	IV	Palynology		1
RPSBOT 203	PLANT PHYSIOLOGY AND ENVIRONMENTAL BOTANY			
	I	Seed Physiology	4	1
	II	Stress Physiology		1
	III	Environmental Botany I		1
	IV	Environmental Botany II		1
RPSBOT 204	MEDICINAL BOTANY ,DIETETICS AND RESEARCH METHODOLOGY			
	I	Traditional system of medicines	4	1
	II	Medicinal Botany		1
	III	Dietetics I		1
	IV	Research Methodology I		1
RPSBOTP 201	Plant Diversity :Cryptogams II (Mycology and Pteridophyta)		02	04
RPSBOTP 202	Plant Diversity: Spermatophyta II (Anatomy, Developmental Botany and Palynology)		02	04
RPSBOTP 203	Plant Physiology and Environmental Botany		02	04
RPSBOTP 204	Medicinal Botany, Dietetics and Research Methodology		02	04
			24	

SEMESTER I

Course Code: RPSBOT 101
Course Title:Plant Diversity-Cryptogams I
Academic year 2019 - 20

Learning objectives:

- The morphology, structure and importance of the organisms,
- Classification and interrelationships between various groups and reasons behind the same,
- Differentiation between various groups of Algae and Bryophytes, and Applications of algae and bryophytes in different fields.

Learning outcomes: The student will be able to: Classify algae into various groups, understand the importance in various fields and will be able to collect and identify them and Classify Bryophytes into various groups, their importance

Detailed Syllabus

RPSBOT 101	**Title: Plant Diversity-Cryptogams I**	**Credits – 4**
UNIT I	**Phycology**	**15 Lectures**
	Classification of Algae upto orders as proposed by Gilbert M Smith	
	Origin and Evolution of Sex in Algae	
	Fossil Algae	
UNIT II	**Applied Phycology**	**15 Lectures**
	Techniques in commercial Cultivation of Algae for Protein & Secondary metabolites, Carbon credit, Antibiotics, Biofuel	
	Detrimental Algae and their control	
	Toxic Algae, Parasitic Algae	
	Water Blooms and Red Tides in India and across the world, Utility,	
	Disadvantages and Control of Algal blooms	
	Algae as a Source of Pharmaceuticals &Nutraceuticals	
	Algal collection and preservation	
UNIT III	**Bryophyta I**	**15 Lectures**
	Classification of Bryophyta, up to orders, according to the system proposed by G.M.Smith.	
	Alternation of generation in Bryophyta.	
	Evolution of the gametophyte and sex organs in Bryophytes	
UNIT IV	**Bryophyta II**	**15 Lectures**
	Origin and evolution of Bryophyta with reference to habitat and form	
	Evolution of the Sporophyte in Bryophyta,	
	Economic importance of Bryophytes	
PRACTICALS		
RPSBOTP	**Plant Diversity-Cryptogams I**	**Credits - 2**

101		
1	Study of following type with reference to their systematic position, thallus and reproductive structures: *Scytonema, Lyngbya, Anabaena, Volvox, Oedogonium, Scenedesmus, Ulothrix, Ulva, Pithophora, Closterium, Nitella, Padina* and *Gracilaria*.	
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	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& 4 project(submission)	
6	**Bryophyta:** Study of following type with reference to systematic position, thallus and reproductive structures: *Targionia, Plagiochasma, Fimbraria, Pellia, Poganatum.*	

References:

1. Chapman, V. J. 1962. The Algae. Macmillan & Co. Ltd.
2. Fritsch, F. E. (Vol. I, II) 1977. The structure and reproduction of Algae. Cambridge UniversityPress.
3. Gilbert M Smith.1951. Manual of Phycology. ChronicaBotanica Co.
4. Gilbert M Smith. 1971. Cryptogamic Botany (Vol. 1): Algae and Fungi. Tata McGraw Hill.
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6. M O P Iyengar and T V Desikachary 1981. ICAR Publication.
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12. Morris I (1986) Introduction to the Algae. Cambridge University Press, UK
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14. Banks H.P. (1968) The early history of Land plants. In evolution and environment, ed. E.T.Drake. New Haven: Yale Univ. Press, pp, 73-107
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16. Lacey, W. A. (1969). Fossil Bryophytes.Biological Reviews, 44,189-205. 21. Mehra, P.N. and O. N. Handoo (1953).
17. Morphology of Anthoceros erectus and A. himalayensis and the phylogeny of the anthocerotales. Bot. Gaz.114:371-382.
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Course Code: RPSBOT 102
Course Title:Plant Diversity – Spermatophyta I
Academic year 2019 - 20

Learning objectives:

- The evolutionary trends amongfossil gymnosperms,
- The evolution of angiosperms.
- Norms for Nomenclature
- Concept of characters in Angiosperms

Learning outcomes:

The students will be able to differentiate between gymnosperms and angiosperms, as well as their origin and Evolution in various eras. They will be able to grasp Rules for nomenclature according to ICN and will be able to understand the concept of presentation of evolutionary relationships in different ways.

Detailed Syllabus

RPSBOT 102	**Title: Plant Diversity – Spermatophyta I**	**Credits – 4**
UNIT I	**Gymnosperms I**	**15 Lectures**
	Classification of gymnosperms upto orders according to the system proposed by C. J. Chamberlain.	
	General characters; affinities and interrelationships of Cycadofilicales, Bennettitales and Cordaitales.	
UNIT II	**Origin of Angiosperms**	**15 Lectures**
	Origin and evolution of angiosperms	
	The primitive angiospermic flower; primitive and advanced character in angiosperms.	
UNIT III	**Angiosperms I**	**15 Lectures**
	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	
UNIT IV	**Angiosperms II**	**15 Lectures**
	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).	
PRACTICALS		
RPSBOTP 102	**Plant Diversity – Spermatophyta I**	**Credits - 2**

1	**Gymnosperms:** Study of following type with reference to their systematic position, vegetative and reproductive structures: *Cordaites* (Fossil), *Auraucaria, Cupressus , Podocarpus* and *Juniperus*
2	**Angiosperms:** A study of the following plant families their morphological peculiarities and economic importance:Menispermaceae, Portulacaceae, Guttiferae, Passifloraceae, Rhamnaceae, Sapindaceae, Lythraceae, Boraginaceae, Chenopodiaceae, Liliaceae, Scitaminae, Cyperaceae
3	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)
4	Preparation of a cladogram with selected members of a family

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2. Biswas C. and Johri B.M. (1997) TheGymnosperms. Narosa Publishing House, New Delhi.
3. Chamberlain C.J. (1998) Gymnosperms: Structure and evolution. CBS Publishers, New Delhi.
4. Arnold C. A. (1947) An Introduction to Paleobotany. McGraw Hill Book company, New York.
5. Coulter J.M. and Chamberlain C.J. (1991) Morphology of Gymnosperms. Central Books, Allahabad.
6. Singh V.P. (2006) Gymnosperms. Sarup&Sons, New Delhi.
7. Sporne K.R. (1994) The morphology of gymnosperms. BI Publications Pvt. Ltd. New Delhi
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12. Sharma O.P. (2002) Gymnosperms, PragatiPrakashan, Meerut.
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Course Code: RPSBOT 103
Course Title:Plant Physiology
Academic year 2019 - 20

Learning objectives:

- A comparative study of photosynthesis pathways involved in Eukaryotes and prokaryotes,
- Protein structure and folding methods
- Plant hormones- a comprehensive study

Learning outcomes: Students will be able to understand basic pathways in photosynthesis, protein dynamics and plant hormone production, utilisation and destruction. They will be able to understand the application of the basic concepts of Plant Physiology in other fields and also to know and discuss the concept of physiological processes of plants.

Detailed Syllabus

RPSBOT 103	**Title: Plant Physiology**	**Credits – 4**
UNIT I	**Photosynthesis I (Eukaryotes)**	**15 Lectures**
	Regulation of C_3, C_4 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.	
	C_4 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	**PhotosynthesisII (Prokaryotes)**	**15 Lectures**
	Photosynthesis of prokaryotes: Pigment systems in bacteria andCyanobacteria, light harvesting mechanisms, reductive TCA cycle.	
UNIT III	**Proteins**	**15 Lectures**
	Primary, secondary, tertiary and quaternary structural features andtheir analysis – Theoretical and experimental;	
	Protein folding – biophysical and cellular aspects.	
UNIT IV	**Plant hormones**	**15 Lectures**
	Biosynthesis, storage, breakdown and transport (Auxins, Gibberellins, Cytokines, Ethylene, Abscisic acid, Inositol, Jasmonic acid, Brassinosteroids).	
	Phytohormones in signal transduction, plant hormone receptors.	
PRACTICALS		
RPSBOTP 103	**Plant Physiology**	**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	Immobilisation 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

References:

1. William G. Hopkins, 1999. Introduction to Plant Physiology, 2nd edition, John Wiley A Sons, Inc.
2. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
3. Frank B. Salisbury and Cleon W.Ross, 2002. Plant physiology 3 rd edition CBS publishers and distributors.
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6. Bajracharya, D. 1999. Experiments in Plant Physiology: A Laboratory Manual. Narosa Publishing House, New Delhi.
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8. Copeland, R.A. 1996. Enzymes: A Practical Introduction to Structure, Mechanism andData Analysis. VCH Publishers, New York.
9. Dennison C. 1999.A guide to Protein Isolation. Kluwer Academic Publishers, Dordrecht,The Netherland.
10. Devi, P. 2000. Principles and Methods of Plant Molecular Biology, Biochemistry and Genetics. Agrobios, Jodhpur, India.

Course Code: RPSBOT 104
Course Title: Cytogenetic, Molecular Biology, Biotechnology and Research Methodology
Academic year 2019 - 20

Learning objectives:

- Karyotype analysis, chromosome visualisation techniques and dermatoglyphic analysis.
- Recombinant DNA technology and its applications
- Research methodology - basic aspects.

Learning outcomes: Students will be able to learn applications of karyotype analysis, rDNA technology and dermatoglyphics in view of recent findings.They will also be able to outline the genomic technologies, events involved in generating recombinant DNA molecules also basics of research methodology.

Students will understand a general definition of research design. Theywould know why educational research is undertaken, and the audiences that profit from research studies. Students should be able to identify the overall process of designing a research study from its inception to its report. Students should be familiar with ethical issues in educational research, including those issues that arise in using quantitative and qualitative research.

Detailed Syllabus

RPSBOT 104	**Title: Cytogenetic, Molecular Biology, Biotechnology and Research Methodology**	**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.	
	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: pUC19, phage, cosmid, BAC and YAC	

	vectors, High and low copy number plasmids and its regulation.	
	Application of recombinant DNA technology for production of herbicide resistant plants, insect resistant plants, improving seed storage proteins and golden rice	
UNIT IV	**Research Methodology**	**15 Lectures**
	Introduction: Research designprinciples, execution of work, interpretation of results.	
	R**eview of literature** • 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.	
	PRACTICALS	
RPSBOTP 104	**Cytogenetic, Molecular Biology, Biotechnology and Research Methodology**	**Credits - 2**
1	Preparation of cytological stains, fixatives and pretreatment agents.	
2	Squash preparation from pre-treated root tips (colchicines/ Paradichlorobenzene/ Aesculin	
3	Squash preparation from mutagen treated root tips for study of aberrations.	
4	Smear preparation from any suitable plant material.	
5	Study of dermatoglyphics analysis	
6	Giemsa Staining of blood sample	
7	Problems based on: Restriction map analysis and construction of restriction maps,	
8	Tetrad analysis in *Neurospora* – two genes and entromere, Deletion mapping in Bacteriophage	
9	**Research Methodology** Visit a scientific library or documentation centre and submit a report Prepare a project proposal Prepare an outline of dissertation and research paper Prepare a list of references. Present a published project	

References

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SEMESTER II

Course Code: RPSBOT 201
Course Title:Plant Diversity-Cryptogams I
Academic year 2019 - 20

Learning objectives:

- Fungal classification, reproduction and to develop basic methods in mycological studies and also to plant pathology and importance of fungi.
- The characteristics, classification, and importance of the group Pteridophytaand fossil pteridophytes.

Learning outcomes: Upon successful completion of this course, the student will be able toClassify fungi into various groups, understand the role of fungi in various fields and will be ableto collect and identify fungi, fungal pathogens and culture them. They will be able to classify pteridophytes into various groups, and also understand their importance and multiplication of important ferns

Detailed Syllabus

RPSBOT 201	**Title: Plant Diversity-Cryptogams II**	**Credits – 4**
UNIT I	**Mycology**	**15 Lectures**
	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.	
	History of plant pathology, Host-parasite relationship	
	Classification of plant diseases based on symptoms	
	Study of the following diseases with reference to symptoms, causal organism and disease cycle : Late blight of potato Covered smut of barley, Citrus canker, Leaf curl	
UNIT II	**Applied Mycology**	**15 Lectures**
	Economic importance of fungi: Application of fungi with respect to - agriculture, industries, food and medicine, Harmful activities.	
	Mycorrhiza: type, distribution and significance with reference to agriculture and forestry.	
UNIT III	**Pteridophyta I**	**15 Lectures**
	Classification of Pteridophyta, up to orders, according to the system proposed by G.M.Smith.	
	Cultivation and maintenance of ornamental Ferns	
	Economic importance of Pteridophytes.	
UNIT IV	**Pteridophyta II**	**15 Lectures**
	The geological time scale and a study of fossil Pteridophytes (*Horneophyton,Cladoxylon*, *Sphenophyllum*, *Glossopteris*,	

	Williamsonia, Medullosa)	
PRACTICALS		
RPSBOTP 201	**Plant Diversity-Cryptogams II**	**Credits - 2**
1	**Mycology:** *Stemonitis, Saprolegnia, Phytophthora, Xylaria, Peziza, Daedalea, Ganoderma, Alternaria* and*Trichoderma.*	
2	Collection and identification of common forest fungi (5 types).	
3	**Plant diseases:** Late blight of potato Covered smut of barley, Citrus canker, Leaf curl	
4	**Economic Importance of fungi**: *Beauveria, Verticillium, Penicillium , Yeast, Ganoderma, Mycorrhiza*	
5	**Pteridophyta:** Study of following type with reference to their systematic position, thallus and reproductive structures: *Isoetes, Ophioglossum, Pteris, Angiopteris, Lygodium*and*Azolla*	
6	**Economic Importance Pterdiophytes :** *Lycopodium***,** *Azolla*	
7	**Study of fossils:** *Horneophyton, , Cladoxylon*, *Sphenophyllum*, *Glossopteris*, *Williamsonia, Medullosa*	

References:

1. Alexopoulos C.J., Mims, C.W. & Blackwell, M. 1996. lntroductory Mycology. 4th edition. John Wiley& Sons lnc.
2. Ainsworth, G.C., Sparrow, K.F.&Susmann, A.S.(Eds.) 1973.The Fungi - An Advanced Treatise. Vol 1 -4. Academic Press.
3. Burnett, J.H. 1970. Fundamentals of Mycology. Edward Amolds.
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13. Mehrotra, R.S.1980. Plant Pathology. Tata McGraw Hill.
14. Pandey, B. P. 1999. Plant Pathology -pathogen and plant disease. S. Chand & Co.

Course Code: RPSBOT 202
Course Title:SpermatophytaII
Academic year 2019 - 20

Learning objectives:

- Meristem tissue and its role in plant development and growth, with focus on organogenesis.
- The pollen, pollen development, fertilization and to apply the information they learned in basic palynology, to various fields related to palynology.

Learning outcomes: The students will be able to understand the process of meristem development and organogenesis.Students will be able to understand the development of pollen, spore, and fertilization and to apply palynological information to plant systematic and other fields.

Detailed Syllabus

RPSBOT 202	**Title: SpermatophytaII**	**Credits – 4**
UNIT I	**Anatomy I**	**15 Lectures**
	Meristems: Definition type of meristems, apical cell theory, histogen theory and Tunica corpus theory	
	Sensory and tactile tissue system: Tactile sense organs, gravitationaland optical sense organs	
UNIT II	**Anatomy II**	**15 Lectures**
	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*	
UNIT III	**Developmental Botany**	**15 Lectures**
	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	
	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 IV	**Palynology**	**15 Lectures**
	Special relationships of pollen grain in pollen tetrads. Pollen wall	

	morphogenesis, ultrastructure, primexin formation.	
	• Phylogeny of Pollen and Spores	
	Systemic Palynology- Monocotyledonae and Dicotyledonae	
	Evolutionary Trends among pollen grains based on Palynotaxonomical works	
	Applications of Palynology in Agriculture and Horticulture	
PRACTICALS		
RPSBOTP 202	**SpermatophytaII**	**Credits - 2**
1	Study of wood elements in *Annona, Michelia, Sterculia* and *Thuja*, using the maceration technique.	
2	Study of the following leaves with respect to leaf surface characters (wax, cuticle, epidermis, stomata, epidermal outgrowth): *Pistia , Ficus, Avicennia* and *Peperomia*	
3	Photosynthetic system in *Pinus* (arm palisade): *Cyperus, Ficus,* and *Oxalis*	
4	A study of Microsporogenesis and megasorogenesis with the help of permanent sides	
5	*In vitro* germination of pollen grains, effect of temperature on pollen viability and short - term storage.	
6	Study of the morphology of the pollen (using Chitale's and acetolysis method) from the families; Malvaceae, Asteraceae, Convolvulaceae, Labiatae and Graminae.	

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Course Code: RPSBOT 203
Course Title:Plant Physiology and Environmental Botany
Academic year 2019 - 20

Learning objectives1:

- The seed physiology and biochemistry – basic aspects
- Flowering Physiological aspects
- Physiological and morphological response of plants to the environmental stress.
- Ecological interactions and conservation.

Learning outcomes: On completion of the course students should be able to distinguish key physiological processes underlying the seed germination. Identify the physiological factors that regulate growth and developmental processes of plants. Demonstrate clear understanding of crop-environment interaction and its implication on crop growth and yield. Integrate and apply their knowledge of crop physiology for analytical thinking and solving practical problems experienced in agricultural systems. They will be able to develop a deeper understanding of ecological principles and apply the same for learning techniques of conservation.

Detailed Syllabus

RPSBOT 203	**Title: Plant Physiology and Environmental Botany**	**Credits – 4**
UNIT I	**Seed Physiologyandphysiologyof flowering**	**15 Lectures**
	Physiology and biochemistry of seed germination mobilization of food reserves, germination and growth factors, seed dormancy, control and release of dormancy	
	MADS - box genes	
UNIT II	**Stress Physiology**	**15 Lectures**
	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	
UNIT III	**Environmental Botany I**	**15 Lectures**
	The Environment: Physical environment; biotic environment; biotic andabiotic interactions.	
	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, interdemic extinctions, age structured population.	
UNIT IV	**Environmental Botany II**	**15 Lectures**
	Species interactions: types of interactions, interspecific competition, herbivory, carnivory, pollination and symbiosis	
	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 and costal ecosystems.	
	Depletion of forest cover, threats to mangroves. Urbanization and plant cover	
PRACTICALS		
RPSBOTP 203	**Plant Physiology and Environmental Botany**	**Credits - 2**
1	Practical exercises are planned for better understanding of the state of environment, rather than 5-hour units. Field exercises are expected to be completed during excursion and field diaries maintained for submission during tests. Other practical work can be carried out in the laboratory with help of plant and soil samples collect from the field.	
2	Breaking of seed dormancy by Physical and Chemical methods	
3	Effect of water and salinity stress on chlorophyll content of leaves.	
4	Effect of water and salinity stress on Proline content of leaves	
5	Comparison of two population of a species collected from two areas.	
6	Determination of primary production of an area by harvest method (Terrestrial/ aquatic).	
7	Determination of primary production of an area by chlorophyll method.	
8	Determination of Nygard index of algae in a water body.	
9	Determination of dust load on leaves of roadside plant.	
10	Determination of Stomatal Index of leaves	
11	Determination of epidermal architecture of leaves.	
12	Determination of LAI of different types of trees.	
13	**Field exercises:** Assessment of pollution in ambient air, on the basis of injured leaf area. Assessment of erosion status of land along a 'stream' on a slope or on flat land Assessment of status of waste land, on the basis of its appearance and visible plant growth. Assessment of degradation of a forest on the basis of its canopy cover and height, strata and species diversity	

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2. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer Associates, Inc. Publishers Sunderland, Massachusetts.
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24. Odum EP 1963 Ecology Holt Reinhart and Winston Inc.
25. Odum EP 1983 Basic Ecology, Saunders Publ Philadelphia.
26. Reynolds CS 1984 The ecology of phytoplankton, Cambridge Univ Press
27. Silverton JW 1982 Introduction to plant population ecology, Longman.
28. Southwick CH 1983 (ed) Global Ecology Sinauer.
29. Whittaker RH 1975 Communities and Ecosystems (2nded) MacMillan, New York

Course Code: RPSBOT 204
Course Title: Medicinal Botany, Dietetics and Research Methodology
Academic year 2019 - 20

Learning objectives:

- The uses and therapeutic effects of medicinal plants, including herbal supplements.
- Students will learn how different cultures perceive diseases and then utilize plants to treat them.
- Advanced research methodology.

Learning outcomes: Students will get a deeper exposure to traditional forms of medicine and understand their basic principles. They will be able to critically evaluate the various pharmaceutical forms for administration of herbs therapeutically and their appropriateness to different health conditions. Students will be able to identify medicinal plants and understand the effects of plant chemical constituents on humans. Students will be familiar with conducting a literature review for an educational study and different types of literature reviews. Students should be able design good research hypotheses and select an appropriate data analysis method.

Detailed Syllabus

RPSBOT 204	**Title: Medicinal Botany, Dietetics and Research Methodology**	**Credits – 4**
UNIT I	**Traditional system of medicines**	**15 Lectures**
	History, scope and importance of medicinal botany	
	Principles of traditional systems of medicines: • Ayurveda • Siddha • Unani	
	Traditional systems of medicine as an alternate/ complementary system of medicine	
	Ayurvedic concepts of Nutrition	
	Preparation and uses of the following (any two): • Churnas/ Vatis/Tailas/ Arishtas	
UNIT II	**Medicinal Botany**	**15 Lectures**
	Monograph of Drugs with respect to Botanical Source, Geographical distribution, Macroscopic and microscopic Characters, Chemical constituents and therapeutic uses.	
	Adulterants: a) *Terminalia chebula*(fruits), b) *Terminalia bellerica* (fruits) and c) *Butea monosperma*(Flowers, leaves and bark), d) *Curcuma longa* (Rhizome) e) *Tinospora cordifolia* (stem)	
	Essential oils (*Eucalyptus* and *Citronella*), fatty oil (Sesame, and coconut), Vegetable fat (Cocum butter) and Medicinal uses of the above.	
UNIT III	**Dietetics**	**15 Lectures**
	Food as Medicine for the treatment of –Arthritis, Renal Disease (Kidney Stone and nephrotoxicity), Constipation, Piles, blood pressure and female reproductive disorders.	

	Therapeutic value of Indian Plant Foods: • Cereals –Oats and Ragi; • Pulses – Green Gram, Black Gram andSoyabean; • Fruits – Jambul, Amla, Guava, Mulberry and Ber; • Spices and Condiments – Coriander, Cumin, Asafoetida and Clove	
UNIT IV	**Research Methodology**	**15 Lectures**
	Research and sampling design	
	Measurement of scaling technique	
	Methods of data collection	
	Data analysis –SPAS/ SPSS,/ Origin/ GraphPad Prism	
	Ethics in research	
PRACTICALS		
RPSBOTP 204	**Medicinal Botany, Dietetics and Research Methodology**	**Credits - 2**
1	Preparation of a traditional formulation *Churnas/ Vati/ Tailas/ Arishtas/ Sufoofs*	
2	A study of the following medicinal plants/plant parts with respect to their pharmacognostic characters for authentication of the drug source: a) *Terminalia chebula*(fruits), b) *Terminalia bellerica* (fruits) c) *Butea monosperma* (Flowers, leaves and bark), d) *Curcuma longa* (Rhizome) e) *Tinospora cordifolia*(stem)	
3	Estimation of total ash content, extractive values in solvents of varying polarities and using different extraction techniques from any medicinal plant material as per Indian Pharmacopeia standards.	

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2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine, Businesshorizons, New Delhi, First edition, 2003. Robert Verpoorte, Pulok K Mukharjee.
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MODALITY OF ASSESSMENT

Theory Examination Pattern:

A) Internal Assessment - 40%: 40 marks.

Sr No	Evaluation type	Marks
1	Seminar presentation/ Short Project presentation / Photo documentation report of field visit/ Industry Visit Report /Presentation based on Research papers and references/Class Tests	30
2	Continuous assessment on the basis of participation in departmental activities	10

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 and **01** question 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)	None	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)	4 short notes	12	All Units

Practical Examination Pattern:

(A) External (Semester end practical examination):

Particulars	Practical 1
Laboratory work and /or *Viva voce*	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 and II

Course	101/201		102/202		103/203		104/204		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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RAMNARAIN RUIA AUTONOMOUS COLLEGE

Syllabus for: Semester III and IV

Program: M. Sc.

Course Code: Botany (RPSBOT)

(Credit Based Semester and Grading System with effect from the academic year 2019 – 2020)

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SEMESTER III

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
RPSBOT 301	**TECHNIQUES AND INSTRUMENTATION I**			
	I	Biostatistics	**4**	**1**
	II	Bioinformatics		**1**
	III	pH and buffers and Electrophoresis		**1**
	IV	Centrifugation		**1**
RPSBOT 302	**MOLECULAR BIOLOGY I**			
	I	DNA Replication	**4**	**1**
	II	Transcription		**1**
	III	RNA Processing		**1**
	IV	Translation		**1**
RPSBOT 303	**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 304	**MOLECULAR BIOLOGY AND CYTOGENETICS I**			
	I	Cytology	**4**	**1**
	II	Cancer Biology		**1**
	III	Immune Systems		**1**
	IV	Genetic Disorders		**1**
RPSBOTP 301		Techniques and Instrumentation I	**02**	**04**
RPSBOTP 302		Molecular Biology I	**02**	**04**
RPSBOTP 303		Plant Biotechnology I	**02**	**04**
RPSBOTP 304		PROJECT	**02**	**04**
			24	

SEMESTER IV

Course Code	UNIT	TOPICS	Credits	Lectures/ Week
RPSBOT 401	**TECHNIQUES AND INSTRUMENTATION II**			
	I	Microscopy & Spectroscopy	**4**	**1**
	II	Chromatography		**1**
	III	Tracer Techniques and PCR		**1**
	IV	Membrane biophysics and plant growth in microgravity		**1**
RPSBOT 402	**MOLECULAR BIOLOGY II**			
	I	Gene regulation I	**4**	**1**
	II	Gene regulation II		**1**
	III	Gene regulation III		**1**
	IV	Cell signalling		**1**
RPSBOT 403	**PLANT BIOTECHNOLOGY II**			
	I	Environmental Biotechnology	**4**	**1**
	II	Traditional knowledge and IPR		**1**
	III	Nanotechnology		**1**
	IV	Food Biotechnology		**1**
RPSBOT 404	**MOLECULAR BIOLOGY AND CYTOGENETICS II**			
	I	Plant Breeding I	**4**	**1**
	II	Plant Breeding II		**1**
	III	Molecular Plant Breeding		**1**
	IV	Plant Genetic Engineering		**1**
RPSBOTP 401		Techniques and Instrumentation II	**02**	**04**
RPSBOTP 402		Molecular Biology II	**02**	**04**
RPSBOTP 403		Plant Biotechnology II	**02**	**04**
RPSBOTP 404		PROJECT	**02**	**04**
			24	

SEMESTER III

Course Code: RPSBOT 301
Course Title:Techniques and Instrumentation I
Academic year 2019 - 20

Learning Objectives:

- Study various tools of Statistical analysis.
- Learn about the concepts of bioinformatics,
- Science and applications of buffers
- Centrifugation techniques

Learning Outcome: The students will be able to: understand the importanceand applications of Biostatistics in Plant breeding, use bioinformatics softwares and work with different databases for recent and novelapplications in upcoming fields of biology,understand the science behind the preparation of various buffers and also the techniques and application of centrifugation

Detailed Syllabus

RPSBOT 301	**Techniques and Instrumentation I**	**Credits – 4**
UNIT I	**Biostatistics**	**15 Lectures**
	Hypothesis testing: Theory of errors – Type I and Type II errors, Null 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 II	**Bioinformatics**	**15 Lectures**
	Databases of bioinformatics: Primary, Secondary and tertiary • Nucleic acid sequence databases: GenBank, EMBL, DDBJ • Protein sequence databases: SWISS-PROT, TrEMBL, PIR, PDB • Genome Databases at NCBI, EBI, TIGR, SANGER	
	Markov Chains & Hidden Markov Models:	
	Introduction to Markov Chains and Hidden Markov models, HMM for protein structure prediction	
	Plant Reactome	
	Bioinformatics as a tool in Taxonomy studies	
UNIT III	**pH and Buffers; Electrophoresis**	**15 Lectures**
	pH and buffer solutions, acids and bases, strong acids and bases, hydrogen ion concentration, dissociation of acids and bases, measurement of pH, titration curves.	
	Physiological Buffers.	
	Electrophoresis: Theory and application	

	PAGE (Native & SDS) and AGE , 2D Electrophoresis	
UNIT IV	**Centrifugation**	**15 Lectures**
	Basics principle of Sedimentation	
	Types of rotors	
	Differential & density gradient centrifugation	
	Preparative centrifugation & Applications; Analytical centrifugation & applications.	
PRACTICALS		
RPSBOTP 301	**Techniques and Instrumentation I**	**Credits - 2**
1	Hypothesis testing, Normal deviate test.	
2	ANOVA- one way & two way	
3	Randomized block Design and Latin square	
4	HMM for protein structure prediction	
5	Plant Reactome	
6	Bioinformatics as a tool in Taxonomy studies	
7	Preparation of buffers (phosphate and acetate)	
8	Determination of pKa	
9	Density gradient centrifugation	

References:

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Course Code: RPSBOT 302
Course Title:Molecular Biology I
Academic year 2019 - 20

Learning objectives:

- Understanding the concept of Central dogma and the similarity and variation in prokaryotes and Eukaryotes
- Life processes at sub-cellular and molecular levels, to create awareness regarding the recent advances in molecular biology

Learning Outcomes: The students will be able to: build a career in genetic engineering, genomics and proteomics, understand molecular mechanisms and develop basic understanding of cellular and molecular biology.

Detailed Syllabus

RPSBOT 302	**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 302	**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.

References:

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2. Alberts, B., Bray, D Lewis, J., Raff, M., Roberts, K and Walter 1999. Molecular Biology of the Cell. Garland Publishing, Inc., New York.
3. Wolfe S.L 1993 Molecular and Cellular Biology, Wadsworth Publishing Co., California, USA.
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6. Sybenga. J. 1973. General Cytogenetics. American Elsevier Pub. Co., New York.
7. Swanson, Merz& Young. 1967. Cytogenetics. Prentice Hall India.
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12. Kleinsmith. L.J. & Kish. V.M. 1995. Principles of Cell and Molecular Biology. 2nd Edition. Harper Collins College Publishes., New York, USA.
13. William. K., Cummings. S., Spencer. M.R.,& Charlotte. A. 2013. Essentials of Genetics. Pearson Books, Delhi.
14. Hartwell L. 2011. Genetics: From Genes to Genomes, Study Guide and Solution Manual. 4th Edition. Nero.
15. Bass. H. &Birchler. J. 2011. Plant Cytogenetics: Genome Structure and Chrmosome Function. Springer, New York.
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Course Code: RPSBOT 303
Course Title:PlantBiotechnologyI
Academic year 2019 - 20

Learning objectives:

- The benefits of somaclonal variations in crop improvement, to know the basic experimental designs required for a successful transfer of plantlets from labs to farms.
- Familiarization with the advanced methods of biotransformation and bioprocesses, appreciation of the use of bioreactors and to understand details of bioreactors designfor large scale production of useful products.
- Comprehension of the requirement of processing and recovery of pure products and to understand different industrial applications of bioreactors.

Learning Outcomes: The students will be able to: Develop a skill base for working in industries like pharmaceuticals, food industries, fermentation units etc. Understand the baseline requirements to set upan enterprise based on fermentation technology, developing efficient methods for product recovery. Develop the ability to understand, exploreand address problems associated with current tissue culture techniques.

Detailed Syllabus

RPSBOT 303	**Plant Biotechnology I**	**Credits – 4**
UNIT I	**Plant Tissue Culture I**	**15 Lectures**
	Plant improvement through somaclonal 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	
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 *Capsicum* cell cultures.	
UNIT III	**Plant Tissue Culture III**	**15 Lectures**
	In vitro storage of Germplasm, Cryopreservation	
	Studies on *Agrobacterium* mediated transformed root cultures.	
	Transgenic plants in phytoremediation	
	Scale –up of secondary metabolites from hairy roots	
	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 *Lithospemum erythrorhizon* cell cultures.	
PRACTICALS		
RPSBOTP 303	**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	*Agrobacterium* mediated transformed root cultures	
10	Study of mitotic index.	
11	Blood group testing.	
12	Identification of genetic diseases by chemical tests.	
13	Karyotypes of genetic disorders.	

References:

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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.
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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.
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9) ShuklaYM,PatelNJ,JithendraJD,BhatnagarR,Talati JG ,Kathiria KB 2009, Plant Secondary Metabolites, New India Publishing Agency, Gujarat.
10) Vasil. I.K. & Thorpe. T.A. 1994. Plant Cell and Tissue Culture. Kluwer Academic Publishers, Dordrecth, Netherlands.

Course Code: RPSBOT 304
Course Title:Molecular Biology and Cytogenetics I
Academic year 2019 - 20

Learning Objectives: To familiarize the students about the intricacies of cellular processes with respect to permeability, cell cycle and non-nuclear genomes. To study principles and finer aspects of cancer biology, immune system and genetic disorders

Learning Outcomes: The students will be able to : Understand the structure of the cell membrane to its function, regulatory aspects of cell division and PCD, along with non-nuclear genomes, the nature, development and causes of cancer. They will also be able to acquire knowledge about the components of the immune system and applications in health care, application of the study of genetic disorders for genetic counseling and therapy.

Detailed Syllabus

RPSBOT 304	**Molecular Biology and 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, protoncogenes 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	**Genetic Diseases**	**15 Lectures**
	Genetic disorders, genetic counselling and gene therapy	
	Biochemical disorders, sex linked disorders	
	Cardiovascular disorders.	
PRACTICALS		
RPSBOTP 304	**Molecular Biology and Cytogenetics I**	**Credits - 2**
1	Projects will be allotted in third semester and students will submit project work having introduction, review of literature, well defined material and methods, expected results and references	

References:

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3) Swanson, Merz& Young. 1967. Cytogenetics. Prentice Hall India.
4) Lewis. K.R. & John. B. 1963. Chromosome Marker. J & A Churchill Co., London.
5) Alberts. B., Breyer. D., Hopkin. K., Johnson. A.D., Lewis. J., Raff M., Roberts. K. &Watter. P. 2014. Essential Cell Biology. 4th Edition. Garland Publishers, New York.
6) Karp. G. 2013. Cell and Molecular Biology – Concepts and Experiments. 7th Edition. Wiley Global Education, 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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10) LodishEtal 2004 (Fifth Edition). Molecular Cell Biology, W H Freeman and company, New York.
11) Powar C.B 2005 (Third Edition). Cell Biology, Himalaya Publishing, Mumbai.
12) Roy S.C and KKDe 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
13) Verma P.S and Agarwal V.K 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
14) Gerald Karp 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and ScneIne., USA.
15) Swanon. M. & Young. 1982. Cytogenetics. Prentice Hall, India
16) Snustad. P & Simmons. M.J. 2003. Principles of Genetics. 3rd Ed. John Wiley & Sons Inc., USA

Semester IV

Course Code: RPSBOT 401
Course Title:Techniques and Instrumentation II
Academic year 2019 - 20

Learning Objectives:

- The basics principles of microscopy, spectroscopy and chromatography, tracer techniques and PCR.
- The basic concepts of membrane biophysics and plant growth in microgravity.

Learning Outcomes: The students will be able to: understand the techniques and application ofmicroscopy, spectroscopy and chromatography, and PCR. They will be able to understand role of membrane biophysicsin human disease research and they will also gather knowledge about plant research in microgravity.

Detailed Syllabus

RPSBOT 401	**Techniques and Instrumentation II**	**Credits – 4**
UNIT I	**Microscopy and Spectroscopy**	**15 Lectures**
	Principles, instrumentation, working and applications of Fluorescence microscope, TEM, SEM.	
	Biological sample preparation for electron microscopy.	
	IR, GC MS, AAS , Plasma Emission spectroscopy, NMR, MS	
UNIT II	**Chromatography**	**15 Lectures**
	General Principle of chromatography.	
	Techniques and applications of Ion exchange, Affinity Chromatography&HPLC	
	Application / validation of herbal drugs using HPTLC.	
UNIT III	**Tracer techniques & PCR**	**15 Lectures**
	Radioactive isotopes and autoradiography	
	Principle, instrumentation &technique: Geiger-Muller counter, Liquid scintillation counters	
	Applications of isotopes in biology: Tracer techniques	
UNIT IV	**Membrane biophysics and plant growth in Microgravity**	**15 Lectures**
	Conformational properties of membranes.	
	Modification of cell membrane and Biophysical importance.	
	Isolation and characterization of plant membranes.	
	Effect of microgravity on plant growth.	
PRACTICALS		
RPSBOTP 401	**Techniques and Instrumentation**	**Credits - 2**
1	Separation of proteins by Ion exchange chromatography	
2	Separation of phytochemicals using column chromatography.	

3	Separation of amino acids/ Plant pigments by two dimensional chromatography.
4	DNA Amplification using PCR (Demonstration)
5	Viscosity studies of proteins: standard BSA and varying concentrations of urea
6	Isolation of plasma membrane
7	Industrial visit and report submission.

References:

1) Berlyn GP and Miksche JP. 1976. Botanical micro-techniques and cytochemisty
2) Chang R (1971). Basic principles of spectroscopy. McGraw Hill.
3) Garry D Christian, James E O'reilvy (1986). Instrumentation analysis. Alien and Bacon, Inc.
4) Gordon MH and Macrae M. 1987. Instrumental analysis in the biological sciences.
5) Henry B Bull (1971). An Introduction to physical biochemistry. F A Devis Co.
6) Stanford J R (1975). Foundation of Biophysics. Academic press.
7) Wilson K and Walker JM.1994. Principles and techniques of practical biochemistry.
8) Allan peacock, H. 1966. Elementary Microtechnique. Edward Arnold Publ.
9) Duddington, C.L, 1960. Practical microscopy. Pitman publ.
10) Perkampus H (1992). UV-VIS Spectroscopy and its applications. Springer-Verlag.
11) Pesce A J, Rosen C G, Pasty T L. Fluorescence Spectroscopy: An introduction for Biology

Course Code: RPSBOT 402
Course Title:Molecular Biology II
Academic year 2019 - 20

Learning Objectives:
To study gene location and structure.To understand the expression of gene regulation and to understand the various techniques used to study gene expression and regulation

Learning Outcomes: Awareness regarding various processes of cell signaling and mechanism ofsignaling and development of knowledge of gene regulation mechanism and gene expression

Detailed Syllabus

RPSBOT 402	**Molecular Biology II**	**Credits – 4**
UNIT I	**Gene Regulation I**	**15 Lectures**
	Regulations of gene expression in bacteria – trp operon, ara operon, histidine 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 *Drosophila* Developmental stages in *Drosophila* – 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 signalling (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 *E. coli* cell by plasmid DNA	
7	β-galactosidase expression and assay	
9	Culturing of Drosophila and study of genetic traits.	

References:

1) De Robertis& De Robertis, 2004. Cell and Molecular Biology. Lippincott. Williams and Wilkins. USA.
2) Freifelder, 1990. Molecular Biology, Narosa Publishing House, New Delhi.
3) Jain, H.K. 2000. Genetics, Oxford & IBH, New Delhi 13. Jocelyn E Krebs, Elliott S Goldstein, Stephen T Kilpatrick (2011). Lewin's Genes X. Jones and Bartlett Publishers
4) Mary A. Schuler Raymond and E.Zrelinski, 2005. Methods in Plant Molecular Biology, Academic Press an imprint of Elsevier
5) Peter Porella, 1998. Introduction to Molecular Biology, McGraw – Hill, New York
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7) Robert J Brooker (2009). Genetics: analysis and principles (III Edn). McGraw Hill.
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9) David A Micklos, Greg A Freyer with David A Crotty (2003). DNA Science: A first course (II Edn).
10) Swanson, C.P. 1972. Cytology and Cytogenetics. Mac Millan. New York.
11) Goodenough U, 1990. Genetics. Armugam N, 1992. Organic evolution.
12) Basu.S.B. and M.Hossain.2004. Principles of Genetics. Books and Allied (P). Ltd, Kolkatta.
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14) Benjamin Lewin (2000). Genes VII. Oxford university press. Blackwell Science Ltd.
15) Daniel L Hartl, Elizabeth W Jones (2009). Genetics: Analysis of genes and genomes (VII Edn). Jones and Bartlett publishers.
16) Gardner, E.J. 1972. Principles of genetics. Willey Eastern Pvt.Ltd.
17) George Ledyard Stebbins (1971). Process of Organic evolution.

18) Gupta, P.K, 2000. Gentics.Rasatogi publications, Meerut.
19) Gurbachan and S. Miglani, 2000. Basic Genetics, Narosa Publishing House, New Delhi.
20) Strickberger (2005). Genetics (III Edn). Prentice Hall of India Pvt. Ltd.

Course Code: RPSBOT 403
Course Title:Plant Biotechnology II
Academic year 2019 - 20

Learning Objectives:

- Study bio-absorption using various biological sources,
- Understand the importance and requirement of alternate fuels such as biomass and to study the production of biogas.
- Understand the placement of GMOs in global scenario,
- Study the importance of security in case of intellectual properties and to understand the Indian patent law and standards of patent protection.
- The need and importance of protection of traditional knowledge,
- The concept of nanotechnology, synthesis of nanoparticles and its applications and to understand the various fields of application for Nano sciences
- The techniques and application in the field of quality control in food technology.

Learning Outcomes: The students will be able to:Create awareness regarding the need of alternate source of energy, develop ideas and technologies to increase production and use of biofuels and biological sources of energy, develop interest among students in patent filing, patent law and related fields, understand the rapidly developing field of nanotechnology and developing skill base for advanced research endeavors in nanotechnology, understand the pros and cons of nanotechnology and applicability of the same in various industries, and understand the requirement and technologies involved in food biotechnology and implementation of quality control parameters.

Detailed Syllabus

RPSBOT 403	**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.	
	Biocomposting	
	Ethanol from biomass and Ligno-cellulosic residue	
	GMO's	
UNIT II	**Traditional Knowledge & IPR**	**15 Lectures**
	Different property rights & IPR in India	
	IPR: Objectives, process & scope	
	TRIPS & Patent laws: Introduction & standards for patent protection	
	WTO& Indian Patent Laws	
	Protection of traditional knowledge– objective, concept of traditional knowledge, holders, issue concerning, bio-prospecting and biopiracy; Advantages of IPR , some case studies	
	International Depository authority ,Gene patenting, plant variety protection, trade secrets & plant breeders right	

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**	**15 Lectures**
	History and development of biotechnology , Application of genetics to food production.	
	Methods of molecular cloning, immobilization of microbial and cultured plant cells.	
	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.	
	Factors affecting spoilage	
	Quality control of food	
PRACTICALS		
RPSBOTP 403	**Plant Biotechnology II**	**Credits - 2**
1	Biogas production from food processing waste	
2	Patent search and patent filing	
3	Biocomposting (pH, conductivity and organic matter content)	
4	Synthesis of nanoparticles	
5	Characterization of nanoparticles by UV spectroscopy.	
6	Market survey on the availability of Genetically modified foods (GMF).	
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:

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2) Bernhardsen, T. 1999. Geographic Information System: An Introduction. 02nd Edition, John Wiley and Sons.
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14) 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.
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16) Katsilambros, K. 2011. Clinical nutrition in practice. John Wiley & Sons, New York. USA.
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18) Pathak, Y.V. (Ed.) 2010.Handbook of nutraceuticals. vol. 1: Ingredients, formulations, and applications. CRC Press, Boca Raton, Florida, USA.
19) Shahidi, F. and Naczk, M. (EDs.) 2003. Phenolics in food and nutraceuticals. 2nd edition. CRC Press, Boca Raton, Florida, USA.
20) J. Draper 1988. Plant Genetic Transformation and Gene Expression Blackwell Scientific Publications, Oxford.
21) R.W. Old, S.B. Primrose. 2004. Principles of Gene Manipulation. An Introduction to Genetic Engineering. Fifth Edition, Blackwell Science Publications.

Course Code: RPSBOT 404
Course Title:Molecular Biology and Cytogenetics II
Academic year 2019 - 20

Learning Objectives:

- Basic principles and techniques of plant breeding
- The techniques of transgenic plant production
- The use of molecular markers in plant improvement.

Learning Outcomes: The students will be able to:apply principles of plant breeding and hybridization along with latest molecular techniques for the production of high yielding, abiotic and biotic stress resistant plants in agriculture and horticulture**.**

Detailed Syllabus

RPSBOT 404	Molecular Biology and Cytogenetics II	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 (*Agrobacterium* 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	
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 404	**Molecular Biology and Cytogenetics II**	**Credits - 2**
1	Research methodology will be discussed andwell defined material and methods, discussion, results and conclusions, references and itspresentation based on some advancedtechniques in Botany	

References:

1) Al Chaudhari, H.K. (1984). Elementary principles of plant breeding Oxford IBH..New Delhi lards 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.
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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,).

MODALITY OF ASSESSMENT

Theory Examination Pattern:

C) Internal Assessment - 40%: 40 marks.

Sr No	Evaluation type	Marks
1	Seminar presentation/ Short Project presentation / Photo documentation report of field visit/ Industry Visit Report /Presentation based on Research papers and references/Class Tests	30
2	Continuous assessment on the basis of participation in departmental activities	10

D) External examination - 60 %

Semester End Theory Assessment - 60 marks

iii. Duration - These examinations shall be of **2½ hours** duration.

iv. Paper Pattern:

3. There shall be **05** questions each of **12** marks and **01** question of **12** marks. On each unit there will be one question & last question will be based on all the **04** units.
4. All questions shall be compulsory with internal choice within the questions.

Questions	Options	Marks	Questions on
Q.1)A)	Any 1 out of 2	06	Unit I
Q.1)B)	Any 1 out of 2	06	
Q.2)A)	Any 1 out of 2	06	Unit II
Q.2)B)	Any 1 out of 2	06	
Q.3)A)	Any 1 out of 2	06	Unit III
Q.3)B)	Any 1 out of 2	06	
Q.4)A)	Any 1 out of 2	06	Unit IV
Q.4)B)	Any 1 out of 2	06	
Q.5)	Any 3 out of 6	12	All Units

Practical Examination Pattern:

(A) External (Semester end practical examination):

Particulars	Practical 1
Laboratory work	45
Viva	5
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 and IV

Course	301/401		302/402		303/403		304/404		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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