DEPARTMENT OF BOTANY

COURSE STRUCTURE & SYLLABI
(For the students admitted from year 2023-2024 onwards)

Programme : M.Sc. Botany

Since 1951

JAMAL MOHAMED COLLEGE (AUTONOMOUS)
Accredited with A++ Grade by NAAC (4th Cycle) with CGPA 3.69 out of 4.0
(Affiliated to Bharathidasan University)
TIRUCHIRAPPALLI – 620 020

M.SC. BOTANY

Sem	Course Code	Course	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
						CIA	ESE	
I	23PBO1CC1	Core - I	Thallophytes	6	5	25	75	100
	23PBO1CC2	Core - II	Archegoniatae and Paleobotany	6	5	25	75	100
	23PBO1CC3	Core - III	Microbiology, Plant Pathology and Immunology	6	5	25	75	100
	23PBO1CC4P	Core - IV	Laboratory Course for Core I, II and III – Practical	6	4	20	80	100
	23PBO1DE1A/B	Discipline Specific Elective - I		6	4	25	75	100
			Total	**30**	**23**			**500**
II	23PBO2CC5	Core - V	Cell and Molecular Biology	6	5	25	75	100
	23PBO2CC6	Core - VI	Anatomy, Embryology and Forensic Botany	6	5	25	75	100
	23PBO2CC7	Core - VII	Genetics and Plant Breeding	6	5	25	75	100
	23PBO2CC8P	Core - VIII	Laboratory Course for Core V, VI and VII – Practical	6	4	20	80	100
	23PBO2DE2A/B	Discipline Specific Elective - II		6	4	25	75	100
	23PCN2CO	Community Outreach	JAMCROP	-	@	-	-	@
	@Only grades will be given		**Total**	**30**	**23**			**500**
III	23PBO3CC9	Core - IX	Systematics of flowering plants and Ethnobotany	6	6	25	75	100
	23PBO3CC10	Core - X	Plant Physiology	6	6	25	75	100
	23PBO3CC11	Core - XI	Biomolecules, Bioenergetics and Analytical Instrumentation	6	5	25	75	100
	23PBO3CC12P	Core - XII	Laboratory Course for Core IX, X and XI – Practical	6	4	20	80	100
	23PBO3DE3A/B	Discipline Specific Elective - III		6	4	25	75	100
	23PBO3EC1	Extra Credit Course - I*	Online Course	-	*	-	100	100
			Total	**30**	**25**			**500**
IV	23PBO4CC13	Core - XIII	Plant Ecology and Conservation Biology	6	6	25	75	100
	23PBO4CC14	Core - XIV	Plant Biotechnology	6	6	25	75	100
	23PBO4CC15P	Core - XV	Laboratory Course for Core XIII and XIV – Practical	6	4	20	80	100
	23PBO4DE4A/B	Discipline Specific Elective - IV		6	4	25	75	100
	23PBO4PW	Project Work	Project Work	6	4	-	100	100
	23PCNOC	Mandatory online course**	Online Course	-	1	-	100	100
	23PBO4EC2	Extra Credit Course - II*	Online Course	-	*	-	-	-
	23PCN4EC3	Extra Credit Course – III+	Innovation and Intellectual Property Rights	-	+	-	-	-
	*** Programme Specific Online Course for Advanced Learners** **** Any Online Course for Enhancing Additional Skills** **+ Course for Enhancing IPR Skills**		**Total**	**30**	**25**			**600**
					Grand Total	**96**		**2100**

DISCIPLINE SPECIFIC ELECTIVES

Semester	Course Code	Course Title
I	23PBO1DE1A	Applied Marine Botany
	23PBO1DE1B	Agricultural Microbiology
II	23PBO2DE2A	Floriculture for Entrepreneurship and Export
	23PBO2DE2B	Horticulture and Greenhouse Technology
III	23PBO3DE3A	Biostatistics and Bioinformatics
	23PBO3DE3B	Biodiversity and Conservation
IV	23PBO4DE4A	Plant Tissue Culture and Secondary Metabolites Production
	23PBO4DE4B	Marine Ecology

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1CC1	Core - I	6	5	25	75	100

Course Title	THALLOPHYTES

SYLLABUS		
Unit	**Contents**	**Hours**
I	General characters and classification of algae (Fritsch, 1985). Habit, habitats, thallus organization, salient features and pigmentation of algae. Life cycle patterns and evolutionary trends in algae. Economic importance of algae. *Algal blooms and toxins*.	**18**
II	Study of the structure, reproduction and life cycle of the following genera – **Gloeocapsa**, *Spirulina*, *Vaucheria*, *Pinnularia*(Diatom), *Padina*, *Sargassum*, *Batrachospermum* and *Gelidium*.	**18**
III	General Characters and classification of fungi (Alexopoulos, 1979). Ultrastructure of cell, cell wall composition, nutrition, unicellular and multicellular organization of fungi, reproduction, lifecycle patterns, heterothallism and parasexuality. Salient features and evolutionary trends among Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.	**18**
IV	Study of the structure, reproduction and life cycle of the following genera – *Taphrina*, *Lycoperdon*, *Colletotrichum*, *Plasmodiophora* and *Fusarium*. Lichens – Occurrence, types, morphology, anatomy and reproduction. *Economic importance of lichens*.	**18**
V	General characters and classification of bryophytes (Watson, 1963). Origin, phylogeny, evolution of gametophytes and sporophytes, ecological and economic importance of bryophytes. Study of the structure, reproduction and life cycle of the following genera – *Targionia*, *Reboulia*, *Notothylas*, *Sphagnum* and *Pogonatum*. *Brief account of fossil bryophytes*.	**18**
VI	**Current Trends (For CIA only) –** Siderophores, Bioluminescence, Hydrogen fuel cells and value added products from Algae and Fungi.	

…… Self Study

Text Book(s):

1. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Bryophyta, Chand and Company Pvt Ltd, New Delhi, India, 9th Edition, 2004.
2. Sharma OP, A Text Book of Algae, Tata McGrew Hill Education Pvt Ltd, New Delhi, India, 1stEditionm, 2011.

3. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Fungi, Chand and Company Pvt Ltd, New Delhi, India, Revised Edition, 2016.

Reference Book(s):

1. Alexopoulos CJ, Mims CW and Blackwell M, Introductory Mycology, Wiley Publishers Pvt Ltd, New Delhi, India, 4th Edition, 2007.
2. Arthur Jonathan S, Bryophyte Biology, Cambridge University Press Pvt Ltd, United Kingdom, 2nd Edition, 2008.
3. Lee RE, Phycology, Cambridge University Press Pvt Ltd, United Kingdom, 4thEdition, 2008.

Web Resource(s): Nil

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Summarize the characteristic features of non-flowering plants.	**K2**
CO2	Identify the morphology, organization and reproduction stages of thallophytes and bryophytes.	**K3**
CO3	Interpret their interrelationships and evolutionary trends.	**K4**
CO4	Appraise the economic importance of Algae, Fungi and Bryophytes.	**K5**
CO5	Generalize the role of Plant diversity in natural environment.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**03**	**01**	**02**	**02**	**02**	**03**	**02**	**02**	**02**	**02**	**2.1**
CO2	**02**	**03**	**02**	**01**	**01**	**02**	**03**	**02**	**02**	**01**	**1.9**
CO3	**01**	**02**	**02**	**02**	**03**	**02**	**02**	**02**	**02**	**02**	**2.0**
CO4	**02**	**02**	**01**	**03**	**01**	**02**	**03**	**02**	**03**	**02**	**2.0**
CO5	**02**	**01**	**03**	**02**	**02**	**02**	**02**	**03**	**03**	**02**	**2.2**
										Mean Overall Score	**2.4**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. N. Ahamed Sherif

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1CC2	Core – II	6	5	25	75	100

Course Title	ARCHEGONIATAE AND PALEOBOTANY

SYLLABUS

Unit	Contents	Hours
I	**Pteridophytes:** General characters and classification of Pteridophytes (Sporne, 1967). Origin and evolution of sporophytes. Telome theory, stelar and soral evolution. Sporangial organization – eusporangium and leptosporangium. Homospory, heterospory and seed habit. Apospory, apogamy and apomixes. *Ecological and economic importance of Pteridophytes*.	18
II	**Pteridophytes:** Study of the structure, reproduction and evolution of the gametophyte and sporophyte of the following genera – *Isoetes*, *Gleichenia*, *Ophioglossum*, *Pteris*, *Angiopteris*, *Osmunda*,*Salvinia* and *Azolla*.	18
III	**Gymnosperms:** General characters and classification of gymnosperms (Sporne, 1967). Evolutionary trends in gymnosperms. Salient features of Pteridospermales, Bennettitales, Pentaxylales, Cycadales, Cordaitales, Coniferales and Gnetales. Economic importance of gymnosperms.	18
IV	**Gymnosperms:** Study of the structure, reproduction and life cycle of the following genera – *Cupressus*, *Podocarpus*, *Araucaria*, *Ephedra*, **Ginkgo* and *Gnetum**.	18
V	**Paleobotany:** Geological time scale, fossils and fossilization, types of fossil and radiocarbon dating. Detailed study of the following fossil forms – *Lepidodendron, Lepidocarpon, Calamites*, **Williamsonia* and *Lyginopteris**.	18
VI	**Current Trends (For CIA only) –** Current research in Archigoniatae with reference to medicinal field.	

…… Self Study

Text Book(s):

1. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Pteridophytes, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2010.
2. Sharma OP and Shivani D, Gymnosperms, 5th Edition, Pragati Prakashan Pvt Ltd, Meerut, India, 2016.
3. Wilson N and Rothwell Stewart GW, Paleobotany and the evolution of plants, 2nd Edition, Cambridge University Press Pvt Ltd, United Kingdom, 2013.

Reference Book(s):

1. Rashid A, An Introduction to Pteridophytes, Diversity, Development and Differentiation, 2nd Edition, Vikas Publishing House Pvt Ltd, Noida, UP, India, 2013.
2. Bhatnagar SP and Moitra A, Gymnosperms, 5th Edition, New Age International Publishers Pvt Ltd, New Delhi, India, 2013.
3. Sporne K. R., Gymnosperms, 6th Edition, New Age International Publishers Pvt Ltd, New Delhi, India, 2015.

Web Resource(s):

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Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO Number	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Identify the salient features and general characters of Pteridophytes and Gymnosperms.	**K2**
CO2	Understand the various trends of classification and internal structures and life cycle patterns of Pteridophytes and Gymnosperms.	**K3**
CO3	Illustrate the economic importance of Pteridophytes and gymnosperms for the production of various industrial based products.	**K4**
CO4	Analyse the fossil, fossilization methods and geological time scale of evolutionary features in Pteridophytes, Gymnosperms and paleobotany.	**K5**
CO5	Evaluate and generalize various modes of structure, reproduction and life history of Pteridophytes and Gymnosperms.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	03	02	01	02	02	03	01	01	02	03	**2.0**
CO2	02	03	02	02	02	01	03	02	02	01	**2.1**
CO3	02	02	03	02	02	02	02	03	02	02	**2.2**
CO4	01	01	02	01	01	02	02	02	01	02	**1.5**
CO5	02	03	01	02	01	01	02	01	02	01	**1.7**
										Mean Overall Score	**2.3**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. Kamaraj

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1CC3	Core – III	6	5	25	75	100

Course Title	MICROBIOLOGY, PLANT PATHOLOGY AND IMMUNOLOGY

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Bacteria and Viruses:** **Bacteria** – Size, shape, arrangement and anatomy of bacteria. Sterilization techniques, Culture media, culture methods (aerobic and anaerobic) and nutrition. *Bacterial growth curve*. Outline of bacterial classification (Bergey's manual of systematic bacteriology 9th edition). **Viruses** – Origin, occurrence and morphology of viruses. General characteristics of bacterial and plant viruses. Outline of virus classification and replication (Lytic and Lysogenic cycle).	**18**
II	**Applied microbiology:** **Food Microbiology:** Fermented dairy products – Microbes involved in fermentation. Starter lactic acid culture – butter milk, cream, yoghurt, cheese production and its types. **Industrial Microbiology:** Industrial production of beverages – Wine and alcohol; microbial production of organic acids (vinegar, lactic acid and citric acid), enzymes (amylase and protease) antibiotics (penicillin and streptomycin) and *probiotics*. **Environmental Microbiology:** Water purification, sanitary analysis of water, waste water treatment processes, measuring treated waste water quality, home treatment systems.	**18**
III	**Plant diseases:** Study of the following plant diseases – bacterial blight of paddy, black rot of crucifers, stem or foot rot of papaya, white rust of crucifers, bunchy disease of banana, yellow vein mosaic of bhindi, *Cuscuta*, early and late blight of potato, tip burn of paddy, Koch's Postulate. Modes of infection and dissemination. Modelling and disease forecasting and plant quarantine. Phyto-pathological techniques: Isolation of pathogen, requirements for the isolation of pathogens, maintenance and *preservation of microbial cultures*.	**18**
IV	**Plant pathogen interaction** Pathogenesis, enzymes and toxins in plant diseases. Plant pathogen interaction – photosynthesis, respiration and Defense mechanism (morphological and detoxification of pathogen toxin), pathogen derived genes and RNA silencing by pathogen derived genes. Genetics of plant pathogen interaction – host parasite interaction, *resistance and susceptibility*.	**18**
V	**Immunology:** **Immunity** – Innate immunity: factors affecting innate immunity and mechanism of innate immunity. Acquired immunity: types and measurements. **Structure and function of the immune system:** Primary and Secondary lymphoid organs, lymphocytes, T-cell and B-cell maturation, null cells and MHC. **Antigens:** types and biological classes of antigen. **Antibodies:** structure, immunoglobulin classes, abnormal immunoglobulins and antibody diversity. **Antigen–Antibody reaction:** general features of antigen and antibody reactions, measurement of antigen and antibody. Serological reaction: precipitation reaction and applications. **Immunidiffusion:** Radial Immunodiffusion and Ouchterlony procedure. **Agglutination reaction:** slide and tube agglutination. **Enzyme immune assay:** ELISA and *Immunofluorescence*.	**18**
VI	**Current Trends (For CIA only) – Microbial fuel cells:** Batteries powered by microbes.	

…… Self Study

Text Book(s):

1. Chakravarty AK, Immunology and Immunotechnology, 1st Edition, Oxford University Press Pvt Ltd, New Delhi, India, 2006.
2. Dubey RC and Maheshwari DK, A Text Book of Microbiology, Revised Edition, Chand and Company Limited Pvt Ltd, New Delhi, India, 2017.
3. Mehrotra RS and Aggarwal A, Plant Pathology, 3rd Edition, McGrew Hill Education (India) Company Pvt Ltd, New Delhi, India, 2017.

Reference Book(s):

1. Anathanarayan R and Jayaram Paniker CK, Text Book of Microbiology, 10thEdition, Universities Press (India) Pvt Ltd, New Delhi, India, 2017.
2. Willey JM, Sherwood LM and Woolverton CJ, Prescott's Microbiology, 10th Edition, McGrew Hill Education Pvt Ltd, New York, 2017.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Generalized the bacteria and viruses based on their characters and structures.	**K2**
CO2	Apply the role of microorganisms in food processing, industrial production of beverages, antibiotics and waste water treatment.	**K3**
CO3	Illustrate plant defence mechanism against pathogens at molecular and genetical level.	**K4**
CO4	Distinguish the common plant diseases caused by bacteria, fungi and viruses.	**K5**
CO5	Express the mechanism of immune system, properties and role of antigens, antibodies and different assays for diagnosis.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	03	02	02	01	02	03	02	02	02	02	**2.1**
CO2	02	03	02	02	02	02	03	02	01	02	**2.1**
CO3	01	02	03	02	02	02	01	03	02	02	**2.0**
CO4	02	02	02	03	01	02	02	01	02	02	**1.9**
CO5	02	01	02	02	03	01	02	02	02	03	**2.0**
										Mean Overall Score	**2.2**
										Correlation	**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. H. Syed Jahangir

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1CC4P	Core – IV	6	4	20	80	100

Course Title	Laboratory Course For Core I, II and III – Practical

SYLLABUS

Unit	Contents	Hours
	List of Practical's **A. Plant Diversity I and II:** 1. Micropreparation and observation of vegetative and reproductive parts of the following algal specimens – *Gloeocapsa, Spirulina, Vaucheria, Pinnularia* (Diatom), *Padina, Sargassum, Batrachospermum* and *Gelidium.* 2. Micropreparation and observation of the following fungal specimens – *Taphrina, Lycoperdon, Colletotrichum, Plasmodiophora* and *Fusarium*. 3. Lichens: observation of permanent slides and live specimens. 4. Micropreparation and observation of the following bryophytes specimens – *Targionia, Reboulia, Notothyllas, Sphagnum* and *Pogonatum.* 5. Micropreparation and observation of vegetative and reproductive parts of the following algal specimens – *Isoetes, Gleichenia, Ophioglossum, Pteris, Angiopteris, Osmunda, Salvinia* and *Azolla*. 6. Micropreparation and observation of vegetative and reproductive parts of the following algal specimens – *Cupressus, Podocarpus, Araucaria, Ephedra, Gnetum* and *Gingko*. 7. Study of the fossil forms – *Lepidodendron, Calamites* and *Williamsonia*. 8. Botanical tour to witness the specimens in their natural habitats (not exceeding for five days). **B. Microbiology, Plant pathology and Immunology:** 1. Isolation of microorganisms (serial dilution technique) and culture methods. 2. Gram's staining of bacteria. 3. Determination of growth curve of bacteria. 4. Enzymatic test of milk by methylene blue reductase test. 5. Test for antibiotic sensitivity by Kirby-Bauer method. 6. Demonstration of agglutination reactions by means of antigen and antibody (Demo). 7. Detection of specific antigen by using ELISA technique (Demo). 8. Widal test using tube agglutination reaction (Demo). 9. Collection and submission of locally available diseased plant materials during the course of field study.	**90**

Text Book(s):

1. Santra SC, Chatterjee TP and Das AP, College Botany Practical (Volume II), 1st Edition (Reprinted), New Central Book Agency Pvt Ltd, Kolkata, India, 2001.
2. Dubey RC and Maheshwari DK, Practical microbiology, 1st Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.

Reference Book(s):

1. Pandey BP, Modern Practical Botany, 1st Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.

Web Resource(s):

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO Number	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Distinguish the internal structures of unicellular and multicellular algal specimens.	**K2**
CO2	Correlate the micro preparation of vegetative and reproductive parts of thallophytes, pteridophytes and gymnosperms	**K3**
CO3	Observe and identify the fossil specimens of plants.	**K4**
CO4	Evaluate the culture characterization and antibiotic sensitive test of bacteria.	**K5**
CO5	Appraise the basic techniques of microbiology and immunology.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	03	02	01	02	02	03	01	02	02	02	**2.0**
CO2	01	03	02	01	02	02	03	02	02	02	**2.0**
CO3	02	02	03	02	02	01	02	03	02	02	**2.1**
CO4	02	02	02	02	02	02	02	02	02	02	**2.0**
CO5	02	02	02	02	03	02	02	01	02	03	**2.1**
Mean Overall Score											**2.4**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. H. Syed Jahangir & Dr. M. Kamaraj

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1DE1A	DISCIPLINE SPECIFIC ELECTIVE – I	6	4	25	75	100

Course Title	APPLIED MARINE BOTANY

SYLLABUS

Unit	Contents	Hours
I	**Unit I: Measurement methods and remote sensing:** Primary productivity measurement – biomass harvesting, litter fall, gas exchange, modelling technique, standing crop, species diversity index and similarity index. Applicability of remote sensing in costal studies. Use of remote sensing technique in mapping of seaweeds, seagrasses and *mangroves*.	**18**
II	**Unit II: Collection, cultivation and mass production:** Collection, chemical preservation, herbarium technique and storage of specimens. Use of natural and synthetic culture media, difficulties in getting axenic culture and mass cultivation. Traditional and recent methods of cultivation of (Mariculture) *Porphyra*, *Laminaria*, *Undaria*, *Gracilaria*, *Eucheuma*, *Kappaphycus* and **Sargassum**.	**18**
III	**Unit III: Utilization of marine algae:** Utilization of sea weeds as food and fodder, application to soil as a fertilizer or manure, medicinal uses, source for iodine and industrial application of seaweeds. Utilization of phytoplanktons and *Diatoms* in medicine, *industries and fuel*.	**18**
IV	**Unit IV: Marine bioresources:** Costal Bioresources – Bioresource profile, wild bioresources – food, feed, fodder, fire wood, timber, medicinal products, potential genetic resources and *ornamentals*.	**18**
V	**Unit V: Marine based products:** Industrial production of agar-agar, carrageenan, agarose and alginate. Edible seaweed products- bakery products, candies, salad dressing, ice creams, jellies, meat processing, sausages, single cell protein and fertilizers. Pharmaceuticals – binders, stabilizer and emulsifier. Household products – cosmetics, masks, body gels, creams and shampoos, hair conditioner, *shaving products and skin cleaner*.	**18**
VI	**Current Trends (For CIA only) –** Role of Marine Microbes in degradation of Plastics	

…… Self Study

Text Book(s):

1. Santhanam R, Ramanathan N, Venkataraman K and Jegathanam G, Phytoplankton of Indian Seas: An Aspects of Marine Botany, Daya Publication Home Pvt Ltd, Delhi, India, 1987.
2. Swaminathan MS, Bio-resources status in selected coastal locations, 1st Edition, National Bioresource Development Board, Department of Biotechnology, Government of India, 2003.
3. Tiwary B and Troy D, Seaweed sustainability, 1st Edition, Academic Press Books Pvt Ltd, Elsevier, United States, 2015.

Reference Book(s):

1. Stein JR, Handbook of Phycological Methods: Culture methods and growth, Cambridge University Press Pvt Ltd, United Kingdom, 1980.
2. Chapman VJ, Coastal Vegetation, 2nd Edition, Pergamon International Library of Science, Technology, Oxford University Press Pvt Ltd, Elsevier, United Kingdom, 2016.

Web Resource(s):
1. https://www.cambridgescholars.com/resources/pdfs/978-1-5275-8702-1-sample.pdf 2. https://www.seamester.com/pdf/student-academic-materials/OCB-student-handbook-v3.6.pdf 3. Manual of Seaweed cultivation: file:///C:/Users/ASUS/Downloads/Marine-Biology-Basics-ebook.pdf

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	To estimate the productivity and apply remote sensing methods to map various marine plant groups.	**K2**
CO2	To apply different tools and techniques for mapping, monitoring and cultivation of seaweeds.	**K3**
CO3	To evaluate the applications of marine botanical resources for human wellbeing and to create entrepreneurship skills.	**K5**
CO4	To organize different methods for cultivation and mass production of seaweeds	**K4**
CO5	To appraise the coastal bioresources and to propose their industrial production.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	03	03	02	01	03	03	03	01	02	03	**2.4**
CO2	02	02	03	02	01	02	02	03	01	02	**2.0**
CO3	01	02	01	02	03	01	02	01	02	03	**1.8**
CO4	02	01	03	02	02	02	03	02	02	02	**2.1**
CO5	02	02	01	03	02	02	02	02	03	01	**2.0**
										Mean Overall Score	**2.6**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. M. Ghouse Basha

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23PBO1DE1B	DISCIPLINE SPECIFIC ELECTIVE – I	6	4	25	75	100

Course Title	AGRICULTURAL MICROBIOLOGY

SYLLABUS

Unit	Contents	Hours
I	**Role of microbes in agriculture:** The importance of microbiology in sustainable agriculture. Life of microbes in the Rhizosphere, aerial and inside the plant parts. Microbial cell surfaces and secretion system. Microbial biofilms and quorum sensing. Bacterial volatiles as airborne signals for plants.	18
II	**Plant growth promotion by microbes:** *Nitrogen cycle*, biological nitrogen fixation – Endophytic nitrogen fixer's, facultative and obligate endophyticdiazotrophs. Genetics of nitrogen fixation, *nod*, *nif* genes of *Klebsiella pneumonia*, *Azotobacter* and *Anabaena*. Phosphate mobilization by soil microorganisms. Stress control and ACC deaminase. Microbial production of auxins, gibberellins and cytokinins.	18
III	**Microbial inoculants:** Concepts, benefits and limitations of bioinoculants. Field application and crop response to *Rhizobium*, *Azotobacter*, *Azospirillium* and arbuscular mycorrhizal fungi. Microorganism aiding plant phosphorous nutrients. *Cyanobacteria as fertilizers*. Brief account on organic fertilizers, integrated nutrients management and supply system.	18
IV	**Microbial pesticides:** Bacterial pesticides – *Bacillus popilliae*, *Bacillus lentimopus* and **Bacillus thuringiensis**. Fungal pesticides – Entomopathogenic fungi: *Metarhizium anisopliae*, *Verticillium lecanni*, *Hirsutella thompsonii* and *Nomuraea rileyi*. Viral pesticides – Granulosis, nuclear polyhedrosis, cytoplasmic polyhedrosis and genetically engineered viruses. Biocontrol of plant pathogens – Mycoherbicides, siderophores, antibiotics and enzymes.	18
V	**Mass production of bioinoculants:** Isolation, selection and mass production of *Rhizobium, Azotobacter, Azospirillium*, Phosphobacteria, cyanobacteria, *Bacillus thuringensis* and **Trichoderma**. Criteria for strain selection, steps for preparing bioinoculants (Seed pelleting, inoculant carriers and quality standard for inoculants).	18
VI	**Current Trends (For CIA only) –** Commercialization of microbes: present and future prospects..	

…… Self Study

Text Book(s):

1. Satyanarayana U. Biotechnology. 1st Edition. Books and Allied Pvt Ltd. Kolkata, India, 2005.
2. Kumaresan V, Biotechnology, 6th Edition, Saras Publication Pvt Ltd, Tamil Nadu, India, 2010.
3. Dubey RC and Maheshwari DK, A Text Book of Microbiology, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2017.

Reference Book(s):

1. Ben L, Principles of Plant-Microbe Interaction: Microbes for sustainable Agriculture, 1st Edition, Springer International PublishingPvt Ltd, Switzcherland, 2015.
2. Bhoopander G, Ram P, Quang-Sheng W and Ajit V, Biofertilizers for Sustainable Agriculture and Environment, 1st Edition, Springer International PublishingPvt Ltd, Switcherland, 2019.

Web Resource(s):

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Appraise the significance of microorganisms in agriculture.	**K2**
CO2	Recognize the nitrogen assimilation, phosphate mobilization and microbial growth hormones for plant growth promotion.	**K3**
CO3	Identify the different forms of biofertilizers and their application.	**K4**
CO4	Formulate biofertilizers and biopesticides based on choice of selection for commercialization.	**K5**
CO5	Evaluate the biocontrol of phytopathogens through siderophores, antibiotics and enzymes produced by growth promoting microorganisms.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	01	02	01	02	02	03	02	**1.9**
CO2	01	02	02	02	02	02	01	02	02	03	**1.9**
CO3	01	02	03	01	02	02	01	01	02	01	**1.6**
CO4	02	01	02	03	01	01	02	02	01	03	**1.8**
CO5	02	01	02	02	01	02	03	02	01	01	**1.7**
Mean Overall Score											**1.7**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr. M. Ghouse Basha

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2CC5	Core – V	6	5	25	75	100

Course Title	Cell and Molecular Biology

SYLLABUS

Unit	Contents	Hours
I	**Cell and cellular organelles:** General account of cell and Cell wall – architecture, macromolecules, biosynthesis and assembly of cell wall, Biological activity of plant cell wall derivatives. Cytoplasm matrix, ER system, Golgi-stack (CGN, TGN) network, Dynamics structure and function of nucleus, semiautonomous organelles of the cell, genetic machinery of chloroplast and mitochondria. *Ribosome structure and Biogenesis of 70s and 80s ribosomes*.	18
II	**Cell membrane structure and function:** Structure of plasma membrane, Physical and chemical properties, membrane models (fluid mosaic model), FRAP technique, membrane synthesis, membrane protein, active and passive, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. *Protein trafficking and secretion*.	18
III	**Nucleic Acid:** Structure and types of chromosomes, heterochromatin and euchromatin. DNA packaging. Molecular structure of DNA and RNA, direct evidences for DNA as a genetic material, different forms of DNA (A-DNA, B-DNA, C-DNA, D-DNA, Z-DNA), renaturation and denaturation of DNA, DNA replication in prokaryotes. Mechanism of proofreading. Biochemical mechanism of DNA damage and repair. Structure of RNA, genetic and non-genetic RNA *(mRNA, tRNA, rRNA)*.	18
IV	**Cell communication and signalling** General principles of cell communication, signalling molecules, Receptors types - Cell surface receptors, Ligand-gated ion channel linked receptors, G-protein coupled receptors (GPCRs), Tyrosine-kinase linked receptors (RTK) and second messengers. Signal transduction pathways, regulation of signaling pathways, mechanism and cellular response to environmental and *hormonal signalling in plants*.	18
V	**Regulation of gene action** Regulation of gene expression in prokaryotic genome, operon hypothesis, principles of *lac* and *trp* operon in *E.coli*, translation and post translation level (feedback inhibition). Regulation of gene expression in eukaryotes at the level of genome. Translation mechanism of Genes, post translational modifications of proteins. Gene silencing–Transcriptional gene silencing (TGS), post-transcriptional gene silencing (PTGS), *RNA interference (RNAi)*.	18
VI	**Current Trends (For CIA only) –** Cell wall metabolism during maturation, ripening and senescence. Isolation of proteins and their quantification.	

…… Self Study

Text Book(s):

1.Verma PS and Agarwal VK, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2004.
2.Paul A, Text Book of Cell and Molecular Biology, 4th Edition, Books and Allied Pvt Ltd, Kolkatta, India, 2011.
3.Hancock JT, Cell Signalling, 4th Edition, Oxford University Press Pvt Ltd, New Delhi, India 2016.

Reference Book(s):
1.Buchanan BB, Gruisem W and Jones RL, Biochemistry and Molecular biology of Plants, 2nd Edition, Wiley-Blackwell Pvt Ltd, New Delhi, India, 2015. 2.Rastogi VB, Principles of Molecular Biology, 2ndEdition, Scientific International Pvt Ltd, New Delhi, India, 2016. 3.Harshad S Kapare, Karishma M, Rathi, Vrushali V, Neve, Cell and molecular biology, 1st edition, Technical Publications, Pvt Ltd, India, 2022.
Web Resource(s):
1.https://rwu.pressbooks.pub/bio103/chapter/cell-communication/ 2.https://bio.libretexts.org/Learning_Objects/Worksheets/Biology_Tutorials/Transcription

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Describe the structural organization and function of organelles of a cell.	**K2**
CO2	Illustrate the structure, function and transport mechanism of the cell membrane.	**K3**
CO3	Analyze the genetic material of an organism and the replication process in prokaryotes.	**K4**
CO4	Correlate the signalling and communication mechanism of a cell.	**K5**
CO5	Justify the mechanism of transcription, translation in prokaryotes and eukaryotes.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	03	02	02	01	02	03	02	01	02	02	**2.0**
CO2	02	03	02	03	02	02	03	02	01	02	**2.2**
CO3	02	01	03	02	03	01	02	03	02	02	**2.1**
CO4	01	02	02	03	02	02	01	02	03	02	**2.0**
CO5	03	02	01	02	02	02	02	03	02	01	**2.0**
										Mean Overall Score	**2.6**
										Correlation	**High**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr. R. SATHISH KUMAR

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2CC6	Core – VI	6	5	25	75	100

Course Title	ANATOMY, EMBRYOLOGY AND FORENSIC BOTANY

SYLLABUS

Unit	Contents	Hours
I	**Anatomy:** General account on meristems, classification, types of tissues and functions. Structural diversity and phylogeny of xylem and phloem. Nodal anatomy – uni, tri and multilacunar nodes. Root and stem transition. Procambium and vascular cambium: origin, development, storied and non-storied types, cambial modification. Role of cambium in wound healing and grafting, seasonal activity of *cambium and abscission*.	18
II	**Wood anatomy:** Components of wood – distribution and arrangement of vessels (diffuse & ring porous), wood parenchyma (axial & ray), apotracheal type (diffuse & paratracheal) and reaction of wood (compression & tension wood). Ultra-structure of wood. Scope of bamboo, canes, coconut, palm and other fibrous lignocelluloses materials. Biotic and abiotic agents causing wood deterioration, wood preservation. Wood technology – plywood, laminated wood, core wood, sandwich and board, compressed, impregnated and compregnated wood, chemically modified and densified wood. *Dendrochronology*.	18
III	**Embryology:** Microsporangium, male gametophyte development. Formation of vegetative and generative cells. Pollen features and development, pollen kit. Scope of palynology, pollen morphology and abnormal features. Megasporangium, female gametophyte development and types of embryo sac (monosporic, bisporic and tetrasporic). Mature embryo sac, types of endosperms, haustorial behaviour and nutrition of embryo sac. Sexual incompatibility – factors and methods to overcome incompatibility. *Parthenogenesis and seedless fruits*.	18
IV	**Introduction of forensic botany:** Introduction to forensic botany –Definition, fundamentals and importance. General plant classification schemes: plant morphology, architecture, anatomy, systematic, palynology and limnology. Collection, analysis and preservation of botanical evidence. Legal and criminal investigation and report preparation. Protection against illegal exports of rare, endangered and threatened medicinal plants and their dried powders by using fluorescence, DNA sampling analysis and *drug enforcement*.	18
V	**Application of forensic botany:** Various types of Planktons, diatoms, pollen grains and their forensic importance. Poisonous plants (*Aconitum*, *Atropa*, *Cinchona* and *Amanita*), types of plant derived drugs and abuse (*Cannabis*, Tobacco and *Psilocybin*). Classic forensic botany cases – Case histories by using plant anatomy and systematics. Identification and matching of various types of wood, timber varieties, seeds and leaves.	18
VI	**Current Trends (For CIA only) –** Forensic palynology and Forensic archaeology	

…… Self Study

Text Book(s):

1. Pandey SN and Chandha A, Plant anatomy and Embryology, Vikas Publishing House Pvt Ltd, New Delhi, India, 1st Edition, 2009.
2. Coyle HM, Forensic Botany: Principles and applications to criminal casework, CRC PressPvt Ltd, Taylor and Francis Group, United Kingdom, 1st Edition, 2004.
3. Wilson K and White DJB, The Anatomy of Wood: Its diversity and Variability, Stobart and Davies Pvt Ltd, Ammanford, United Kingdom, 2nd Edition,2006.

Reference Book(s):

1. Lersten Nels R. Flowering Plant Embryology. Lowa State University Press Pvt Ltd, Lowa, United State, 1st Edition, 2004.
2. Evert RF, Esau's Plant Anatomy, Wiley Publishers Pvt Ltd, New Delhi, India, 3rd Edition, 2005.
3. James HS, Jon JJ, Bell S and Lana JW. Forensic Science: A introduction to scientific and investigative techniques, CRC Press Pvt Ltd, Taylor and Francis Group, United Kingdom, 1st Edition, 2014.

Web Resource(s):

1. https://oinlinecourses.nptel.ac.in/noc20_bt36/preview online course on Plant Developmental Biology.
2. https://aboutforensics.co.uk/forensic-palynology/ United kingdom Forensic Science page on Forensic Palynology.
3. https://www.wsl.ch/land/products/dendro/ a web based wood identification key for European woody species.

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Distinguish different type of tissue systems and its organization.	**K2**
CO2	Illustrate the physical and chemical properties, types and practices and preservation of wood for the better utilization.	**K3**
CO3	Evaluate the male and female gametophyte development and their sexual incompatibilities.	**K4**
CO4	Appraise forensic importance of different parts of a plant.	**K5**
CO5	Speculate methods to collect, preserve and analyze botanical evidences for forensic science.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	03	01	02	02	02	02	02	**2.0**
CO2	01	03	02	02	02	02	03	01	02	02	**2.0**
CO3	02	01	02	02	02	03	02	03	02	02	**2.1**
CO4	02	02	03	01	02	03	01	02	01	03	**2.0**
CO5	03	02	01	02	03	02	02	02	03	02	**2.0**
										Mean Overall Score	**2.2**
										Correlation	**Medium**

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr. A. ASLAM

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2CC7	Core – VII	6	5	25	75	100

Course Title	GENETICS AND PLANT BREEDING

SYLLABUS

Unit	Contents	Hours
I	**Transmission Genetics:** Mendelian principles – Dominance, segregations, independent assortment. Genetic interaction – codominance, incomplete dominance, multiple alleles, lethal genes, penetrance, expressivity and pleiotropism, cytoplasmic inheritances, linkage and crossing over, sex determination, sex linkage, pedigree analysis and cytoplasmic inheritance, *linkage and mapping in eukaryotes*.	18
II	**Cytogenetics:** Variation in chromosomal structure – single breaks, two breaks in the same chromosome, two breaks in non-homologous chromosomes, Centromeric breaks, duplications, chromosomal rearrangements in human beings. Variation in chromosome number – aneuploidy, mosaicism, aneuploidy in human beings and euploidy.	18
III	**Population and conservation genetics:** Population genetics – Hardy-Weinberg equilibrium and its extensions, non-random mating. Mutation – Mutational and stability of mutational equilibrium. Migration, small population size and natural selection. Conservation genetics – Genetic diversity, population size, genetic effects, genetic erosion and *conservation of genetic diversity*.	18
IV	**Plant breeding:** Plant breeding – Principles, objectives and scope of plant breeding, Indian Agricultural Research Institute (IARI) and achievements in plant breeding. Crop improvement – objectives of crop improvement, methods of crop improvement – acclimatization, mass, pure line and clonal selection. Objectives of hybridization, hybridization technique. *Heterosis – Genetic and physiological causes of Heterosis*.	18
V	**Ploidy breeding:** Ploidy breeding – Types of polyploidy, application and limitation. Mutation breeding – Types of mutation. Types of mutagen (Physical and chemical), dose and treatment, factors affecting mutation, methods, limitations and achievements of mutation breeding. Resistance breeding methods and its advantages and disadvantages. Biotechnology in breeding - anther culture, ovule and embryo culture, somoclonal variation, somatic embryogenesis and high yielding varieties. Commercial release of varieties – Evaluation, identification, release and notification.	18
VI	**Current Trends (For CIA only) –** Plant phenotyping for a sustainable feature.	

…… Self Study

Text Book(s):

1. Verma PS and Agarwal VK, Genetics, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2009.
2. Iqbal H, Fundamentals of Plant Breeding, 1st Edition, Oxford Book Company Pvt Ltd, New Delhi, India, 2009.
3. Robert W Allard, Principles of Plant Breeding, 2nd Edition, Wiley Pvt Ltd, New Delhi, India, 2018.

Reference Book(s):

1. Klug WS and Cummings MR, Essentials of Genetics, 5th Edition, Pearson Education Pvt Ltd, London, England, 2005.
2. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM and Veres RC, Genetics from Genes to Genomes, 3rd Edition, McGraw Hill Education (India) Pvt Ltd, New Delhi, India, 2015.

Web Resource(s):

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Describe the principles of genetics and their interaction.	**K2**
CO2	Discover the changes occurs in chromosomes correlate with disease syndrome.	**K3**
CO3	Calculate the modifications of alleles and genotype change over time within and between populations.	**K4**
CO4	Predict the fundamentals of crop improvement through plant breeding.	**K5**
CO5	Construct the biotechnological techniques for crop improvement.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	03	01	02	02	02	01	03	02	**2.0**
CO2	01	03	02	02	01	02	03	02	01	02	**1.9**
CO3	03	02	01	02	02	01	02	02	02	03	**2.0**
CO4	02	01	02	02	03	02	01	03	02	02	**2.0**
CO5	03	02	02	02	02	02	02	01	02	03	**2.1**
Mean Overall Score											**2.6**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

Dr. H. Syed Jahangir

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2CC8P	Core – VIII	6	4	20	80	100

Course Title	LABORATORY COURSE FOR CORE V, VI AND VII – PRACTICAL

SYLLABUS

Unit	Contents	Hours
	A. Cell and Molecular Biology: 1. Observation of cells in onion peeling. 2. Observation of cell division in onion root tip and Rheo flower buds. 3. Differential staining methods for characterization of cells. 4. Isolation of total DNA from onion bulbs by using salt and detergent method. 5. Isolation of plasmid DNA from bacteria by using alkaline lysis method. 6. Demonstration of agarose gel electrophoresis of plasmid and genomic DNA. 7. Construction of restriction map of plasmids using geometric method. **B. Anatomy, Embryology and Forensic Botany:** 1. Observation of stomatal types in dicot and monocot leaves. 2. Nodal anatomy – uni, tri and multilocular nodes. 3. Observation of anomalous secondary growth in Aristolochia, Begnonia, Bougainvillea and Dracaena through their transfer section (T.S). 4. Wood structure (T.S, L.S, T.L.S and R.L.S.) observation for variation in vessel elements and fibers. 5. Hand lens features of sap and heart wood specimens. 6. Testing of pollen viability using tetrazolium test. 7. In vitro pollen germination using different concentration of sucrose solution. 8. Analysis of different pollen grains for their architecture. **C. Genetics and plant breeding:** 1. Genetic problems related to genetic interaction, linkage and chromosome mapping, cytogenetics, molecular and population genetics. 2. Study of aneuploidy: Down's, Klinefelter's and Turner's syndromes. 3. Performance of the breeding techniques: emasculation, crossing and bagging.	**90**

Text Book(s):

1. Debajit B, Biotechnology Lab Practices, 1 st Edition, Global Academic Publishers & Distributors, New Delhi, India, 2012.
2. William Stansfield D, Theory and Problems of Genetics, 3rd Edition, McGrew Hill Pvt Ltd, New Delhi, India, 1991.
3. Pandey BP, Modern Practical Botany, 1st Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.

Reference Book(s):

Web Resource(s):

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-Level)**
CO1	Examine various stages of cells in specimens.	**K2**
CO2	Demonstrate basic experiments related to DNA.	**K3**
CO3	Systematize internal organization of plant.	**K4**
CO4	Appraise various reproductive features & their uses.	**K5**
CO5	Solve problems related to genetics and able to demonstrate techniques related to plant breeding.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	**02**	**01**	**02**	**02**	**03**	**02**	**01**	**02**	**03**	**02**	**2.0**
CO2	**01**	**03**	**02**	**02**	**02**	**02**	**03**	**01**	**02**	**02**	**2.0**
CO3	**01**	**02**	**03**	**02**	**02**	**02**	**02**	**02**	**01**	**02**	**1.9**
CO4	**02**	**02**	**01**	**03**	**02**	**02**	**02**	**02**	**03**	**01**	**2.0**
CO5	**03**	**02**	**02**	**02**	**02**	**01**	**02**	**02**	**01**	**03**	**2.0**
Mean Overall Score											**2.0**
Correlation											**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator:

1. **Dr. H. Syed Jahangir**
2. **Dr. A. Aslam**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2DE2A	Discipline Specific Electives – II	6	4	25	75	100

Course Title	FLORICULTURE FOR ENTREPRENEURSHIP AND EXPORT

SYLLABUS

Unit	Contents	Hours
I	**Fundamentals of Floriculture** Importance, scope and divisions of floriculture. Soil and climate limiting factors. Irrigation types – surface, sub and special irrigation – Manures, fertilizers and herbicides – Bioinoculants. Pest control practices and plant protection. *Plant growth regulators in floriculture*.	18
II	**Cultivation methods** Sexual and vegetative propagation methods of commercial flowering plants. Cultivation of flowers – rose, marigold, chrysanthemum, jasmine, dahlia, orchid and crossandra. Ornamental bulbous plant – Cacti, succulents, palms, cycads, ferns and **Selaginella**. Bonsai – Importance and methods of making bonsai.	18
III	**Cut flower technology** Cut flowers – Production, packaging, drying, short and long term preservation. Cut flower production techniques for domestic and export market with special reference to rose, marigold, chrysanthemum, anthurium, gladiolus, jasmine, dahlia, tuberose, gerbera, *orchid and crossandra*.	18
IV	**Floral arrangements and decorations** Vase life – prolonging the vase life of flowers. Flower arrangements - Practices and preparation of floral bouquets. Dry decorations – preservation of plant materials for dry decorations, design for dried arrangements – Preparation of floral rangoli, veni and ikebana. *Nursery management*.	18
V	**Entrepreneurship in Floriculture** Marketing of floriculture products – methods, publicity and marketing mix. Schemes and supporting agencies for entrepreneurship of floriculture– APEDA, DIC, SIDA, SISI, NSIC, SIDO. Polices, programs and financing ideas. Investment procurement – project formation, feasibility, legal formalities, shop act, estimation and costing, investment procedure, loan procurement, banking processes.	18
VI	**Current Trends (For CIA only) –** Knowledge on export and import strategies of floriculture. Environmental impact on cut flower industry.	

…… Self Study

Text Book(s):

1. Edmond M and Andres A, Fundamentals of Horticulture, 2nd Edition, Tata McGrew Hill Education Pvt Ltd, New Delhi, India, 1994.
2. Bose TK and Mukherjee D. Gardening in India,11th Edition, Oxford & IBH Publishing Co. PvtLtd, New Delhi, India, 2002.
3. Kumar N, Introduction to Horticulture, 8th Edition, Rajalakshmi Publication Pvt Ltd, Nagercoil, Tamil Nadu, India, 2017.

Reference Book(s):

1. Sampson L. The Complete Guide to Successful Gardening, 1st Edition, Berkshire House Pvt Ltd, London, 1978.
2. Brain M, Flowering Bulbs for the Garden (The Royal Botanical Gardens, KEW in association with COLLINGRIDE), 8th Edition, The Himalayan Publishing Group Pvt Ltd, Kew, London, 2013.
3. Chadha KL and Choudhury B, Ornamental Horticulture in India, 6th Edition, ICAR, New Delhi, India, 2014.

Web Resource(s):

1. http://www.apeda.gov.in/apedawebsite/SubHead_Products/Floriculture.htm.
2. https://agriexchange.apeda.gov.in/indexp/Product_description_32head.aspx?gcode=0101
3. https://agriexchange.apeda.gov.in/FTP/ftp2015-20E.
4. www.Anilrana13014.webbly.com.
5. https://www.zauba.com/export-INDIAN+FRESH+FLOWERS-hs-code.html.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Recognize the fundamentals of floriculture.	**K2**
CO2	Employ various cultivation practices for flowering plants in commercial scale.	**K3**
CO3	Construct quality planting material of ornamentals and flowering plants	**K4**
CO4	Standardize and practices for production, preparation, and packaging of the commercially important cut flowers and flower based decorative products.	**K5**
CO5	Explain the personal finance, entrepreneurship and manage/organize related task in day-to-day work for personal & societal growth.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	02	02	03	02	01	02	02	03	02	01	**2.0**
CO2	01	03	02	02	02	02	03	01	02	02	**2.0**
CO3	02	02	02	03	02	02	01	03	02	02	**2.1**
CO4	02	01	02	03	02	01	02	02	03	02	**2.0**
CO5	03	02	02	02	03	02	02	02	02	03	**2.2**
										Mean Overall Score	**2.6**
										Correlation	**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A. Shajahan

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23PBO2DE2B	Discipline Specific Electives – II	6	4	25	75	100

Course Title	HORTICULTURE AND GREENHOUSE TECHNOLOGY

SYLLABUS

Unit	Contents	Hours
I	**Unit I: Fundamentals of horticulture:** Importance, scope and classification of horticulture. Soil types, physical and chemical composition of soil, soil fertility and its maintenance. Manures and fertilizers. Irrigation – surface, sub and *special irrigation methods*.	18
II	**Unit II: Greenhouse technology:** Importance, scope and status of producing horticultural crops in green house. Structure and construction of a greenhouse – location, frame work for various types of greenhouse, covering material. Construction of floors and layout. Automated green houses, microcontrollers, heating and cooling sources. Environmental control – air, temperature, sunlight, *carbon dioxide and relative humidity*.	18
III	**Unit III: Plant propagation:** Propagation of sexual and specialized vegetative structures. Types of propagation – cutting, layering, grafting and budding. Limitations of grafting and budding, grafting incompatibility – Stock and scion relationships. *Role of plant growth regulators and their uses in horticulture*.	18
IV	**Unit IV: Greenhouse media and plant protection:** Properties of root medium for greenhouse and media handling. Media components – peat, bark, sawdust, coir, crop by product, composted garbage, perlite, vermiculite, sand, rock wool and polystyrene foam. Water quality and sanitation – Advanced protected agricultural systems and plastic mulches. Management of pest and diseases – physical, chemical and biological methods.	18
V	**Unit V: Commercial horticulture:** Cultivation, harvesting and pro-harvesting of important fruit crops (mango, banana, jackfruit and guava), Flowers (rose, jasmine and chrysanthemum) and vegetable crops (tomato, brinjal and drumstick). New avenues for self-employment in horticulture sector – Nursery management, export of horticultural crops, requirements, methodology. Processing of vegetables and fruits for grading, value addition, *preservation and storage*.	18
VI	**Current Trends (For CIA only) –** Advances in Integrated Pest Management (IPM), Packing and logistics.	

…… Self Study

Text Book(s):

1. Kumaresan V, Horticulture, 1st Edition. Saras publication Pvt Ltd, Nagercoil, Tamil Nadu, India, 2014.
2. Edmond S, Fundamentals of Horticulture, 4th Revised Edition, Tata McGrew Hill Education Pvt Ltd, New Delhi, India, 1975.
3. Kumar N, Introduction to Horticulture, 8th Edition, Rajalakshmi publication Pvt Ltd, Nagercoil, Tamil Nadu, India, 2004.

Reference Book(s):

1. Prasad S and Kumar U, Green House Management for Horticultural Crops, 2nd Edition. Agrobios Publishers Pvt Ltd, Rajasthan, India, 2012.
2. Gupta PK, A Handbook of Soil, Fertilizer and Manure. 2ndEdition. Agrobios Publishers Pvt Ltd, Rajasthan, India, 2017.
3. Brain M, Flowering Bulbs for the Garden (The Royal Botanical Gardens, KEW in association with COLLINGRIDE), 8th Edition, The Himalayan Publishing Group Pvt Ltd, Kew, London, 2013.
4. Chadha KL and Choudhury B, Ornamental Horticulture in India, 6th Edition, ICAR, New Delhi, India, 2014.

Web Resource(s):

1. http://www.agrimoon.com/wp-content/uploads/Introduction-to-Soil-Science.pdf.
2. http://www.apeda.gov.in/apedawebsite/SubHead_Products/Floriculture.htm.
3. https://agriexchange.apeda.gov.in/indexp/Product_description_32head.aspx?gcode=0101
4. https://agriexchange.apeda.gov.in/FTP/ftp2015-20E.
5. www.Anilrana13014.webbly.com.

Course Outcomes

Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Identify knowledge about the fundamentals of horticulture.	**K2**
CO2	Discover various plant propagation techniques for vegetables, flowers and fruit plants.	**K2**
CO3	Develop and protected commercial production of vegetables.	**K3**
CO4	Plan and persuade construct and maintain a greenhouse.	**K4**
CO5	Find errors and horticultural diseases, nutrition and post-harvest management of vegetable crops and their produce.	**K5**
CO6	Describe the commercial importance of horticulture plants.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	**03**	**01**	**02**	**02**	**02**	**03**	**02**	**02**	**01**	**02**	**2.0**
CO2	**02**	**03**	**01**	**02**	**02**	**02**	**03**	**01**	**02**	**02**	**2.0**
CO3	**01**	**02**	**03**	**01**	**02**	**02**	**01**	**01**	**02**	**01**	**1.6**
CO4	**02**	**01**	**02**	**03**	**01**	**01**	**02**	**02**	**01**	**03**	**1.8**
CO5	**01**	**02**	**03**	**01**	**01**	**02**	**03**	**02**	**01**	**01**	**1.7**
									Mean Overall Score		**1.8**
									Correlation		**Medium**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A. Shajahan

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3CC9	Core – IX	6	6	25	75	100
Course Title	**Systematics of Flowering Plants and Ethnobotany**						

Syllabus		
Unit	**Contents**	**Hours**
I	Historical account - classification of angiosperms (classification of Bentham and Hooker, Engler and Prantl, Takhtajan) – outline classification of APG III and APG IV. Taxonomy in relation with anatomy, embryology and phytochemistry. Numerical taxonomy, Chemotaxonomy, Sero taxonomy and Molecular taxonomy.	18
II	Biosystematics – aim, scope, and categories - Principles of ICBN – typification, Principles of priority and their limitations, Binomial nomenclature rules and regulation, *key for identification of plants (indented and bracket key)*, monographs, periodicals, floras and manuals, data banks, Phenetics, molecular tools in taxonomy, cladistics and cladogram, field and herbarium techniques, e-flora and e- herbaria.	18
III	Vegetative, floral and economic importance of the following families: Ranunculaceae, Magnoliaceae, Menispermaceae, Caryophyllaceae, Portulacaceae, Rosacea, *Meliaceae*, Sapindaceae, Combretaceae and Aizoaceae.	18
IV	Vegetative, floral and economic importance of the following families: Boraginaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Pedaliaceae, Verbinaceae, Amaranthaceae, Nyctaginaceae, Commelinaceae and *Cyperaceae*.	18
V	Introduction - Ethnobotany scope and branches - basic knowledge of tribes with special reference to Tamil Nadu (Kanikkars, Kurumbas, Irulas, Badagas, Kothas and Todas) – sources and forms of tribal medicines. *Folk medicines*, Outline of Dr. Duke's phytochemical and ethnobotanical database.	18
VI	Current Trends (for CIA only) - Ethnoveterinary medicines.	

…….. Self Study

Text Book(s):

1. Jain SK, Manual of Ethnobotany, 1st Edition, Scientific Publishers Journals Pvt Ltd, New Delhi, India, 1995.
2. Sigh G, Plant Systematics Theory and Practice, 3rd Edition, Oxford & IBH Publishing Pvt Ltd, New Delhi, 2018.
3. Sambamurty AVSS, Taxonomy of Angiosperms, 2nd Edition, Dreamtech Press Pvt Ltd, New Delhi, India, 2019.

Reference Book(s):

1. Walter SJ, Christopher SC, Elizabeth AK, Peter FS and Michael JD, Plant Systematics: A Phylogenetic Approach, 3rd Edition, Sinauer Associates, Inc., USA, 2007.
2. Ashima S, An Introduction to Ethnobotany, 1st Edition, Omega Publication Pvt Ltd, New Delhi, India, 2017.

Web Resource(s):

1. https://phytochem.nal.usda.gov/phytochem/search/list
2. http://francescofiume.altervista.org/taxa/APG.pdf

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	To provide an adequate knowledge on plant classification based on plant characteristics	K1
CO2	To get knowledge on biosystematics, molecular tools in taxonomy and herbarium techniques	K2
CO3	To acquire knowledge families of flowering plants	K3
CO4	To understand plant characteristics based on their family	K4
CO5	Students get detailed knowledge about ethnobotany, role of tribal medicine and ethnobotanical databases	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	02	02	03	02	02	02	02	2.1
CO2	02	03	03	02	03	03	03	02	03	03	2.7
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	02	02	03	03	03	03	02	02	02	03	2.5
CO5	02	03	03	03	03	03	03	02	03	03	2.8
									Mean Overall Score		2.6
									Correlation		High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3CC10	CORE – X	6	6	25	75	100
Course Title	**Plant Physiology**						

Syllabus

Unit		Hours
I	Physical and chemical properties of water. Absorption of water by root. Mechanism of water transport – Apoplast and symplast concept - Theories of ascent of sap. Transpiration and its types- mechanism of stomatal opening and closing- mineral nutrition - essential nutrients – macro and micronutrients – deficiencies and plant disorders. Transport of Nutrients-Membrane permeability, Nutrient uptake and transport mechanism of active and passive transport, *mechanism of phloem translocation*.	18
II	The physical nature of light – absorption and action spectra- photoreceptors- Ultrastructure and biochemical compartmentation of Chloroplast. Photosynthetic Electron Transport and Photophosphorylation (cyclic and noncyclic): Photosystems and reaction centres - Light Harvesting complexes - Photosystem I & II. Photosynthetic carbon reduction cycles - C3, C4 and CAM pathway, Classification of C4 plants and their significance.	18
III	Glycolysis, gluconeogenesis and their regulation, Oxidation of pyruvate and TCA cycle. Electron Transport – oxidative phosphorylation and ATP synthesis - unique electron transport enzymes of plant mitochondria, alternate electron pathway. Pentose phosphate pathway and its importance. Respiratory quotient of aerobic and anaerobic respiration.	18
IV	Nitrogen cycle, assimilation of nitrate and ammonium. Nitrogen fixation- asymbiotic and symbiotic. Phases of plant growth -Biosynthesis transport of plant growth regulators - Auxins, gibberellins, cytokinins, Abscisic acid, ethylene and physiological effects and mechanisms – Photoperiodism - Biological rhythm.	18
V	Plant response to environmental stress - Biotic and Abiotic stress. Adaptive mechanism to various stresses (avoidance, escape, tolerance). osmotic adjustment, metal toxicity, chilling and freezing stress, oxygen deficiency and acclimatization, free radicals and oxidative stress, antioxidative defence mechanism, *stress proteins and hormones*.	18
VI	Current Trends (for CIA only) - Mitigation of oxidative stress	

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Text Book(s):

1. Taiz L and Zeiger E. Plant Physiology 4th edition, Sinauer Associates Inc., U.S. 2006.
2. Mukherji s and Ghosh AK, Plant Physiology, 1st central edition, New central Book Agency (p) Ltd, Kolkatta, 2009.
3. Pandey SN and Sinha, Plant Physiology 4th edition, Vikas Publishing, New Delhi, 2013.
4. Pandey, N.S and Pandey, P. Textbook of Plant Physiology. Daya Publishing House, New Delhi, 2016.

Reference Book(s):

1. Salisbury FB and Ross CW, Plant physiology. 4th Edition, Wadsworth Publishing Company, Beverly, 1991.
2. Jain VK. Fundamentals of plant physiology, 14th revised edition, S. Chand & Company Ltd., New Delhi, 2012.

Web Resource(s):

1. https://aggie-horticulture.tamu.edu/ornamental/economic-fact-sheets/plan-for-improved-marketing/
2. https://www.slideshare.net/AnubhaRastogi/role-of-agencies-assisting-entrepreneurship

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	Understand the properties and importance of water in biological system, nutrients and its translocation.	K2
CO2	Demonstrate the importance of light in plant growth and the harvest of energy.	K3
CO3	Explain the energy requirement and nitrogen metabolism.	K4
CO4	Compare the various growth regulators that influence plant growth.	K5
CO5	Discuss the senescence and plant response to environmental stress.	K6

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	03	03	03	03	02	03	03	03	03	**2.8**
CO2	02	03	03	02	03	03	03	02	03	03	**2.8**
CO3	03	02	03	03	03	03	03	03	02	03	**2.9**
CO4	03	03	03	03	02	03	02	03	03	03	**2.8**
CO5	03	03	02	03	03	03	03	03	03	03	**2.9**
Mean Overall Score											**2.8**
Correlation											**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. R. Sathish Kumar

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3CC11	CORE – XI	6	5	25	75	100
Course Title	**Biomolecules, Bioenergetics and Analytical Instrumentation**						

Syllabus		
Unit		**Hours**
I	Introduction, classification, nomenclature, asymmetry, isomerism and mutarotation. General structure, properties and formulation of monosaccharaides - Linear form, Ring form, Fisher's projection and Haworth perspective formula of glucose, fructose and galactose. Oligosaccharides - sucrose, maltose, lactose and cellobiose. Polysaccharides - starch, glycogen, inulin, cellulose, pectin, chitin and *hemicellulose*.	18
II	Importance, structure, physical, electrochemical properties and classification of proteins. Protein configuration - Primary, secondary, tertiary and quaternary structure of proteins, Ramachandran plot, super secondary structures, helix loop helix. Nature, classification and nomenclature of enzymes. Lipids – classification, structure, properties and functions of fatty acids, phospholipids, glycolipids, *lipoproteins and cholesterol*.	18
III	Carbohydrate metabolism - Metabolism of Glycolysis, Glycogen, TCA cycle energetic and its regulation, Gluconeogenesis pathway and their significance. Lipid Metabolism - oxidation of fatty acids - beta oxidation, alpha oxidation and omega oxidation. Biosynthesis of saturated and unsaturated fatty acids. Protein Metabolism - catabolism of amino acids - transamination, oxidative and non-oxidative deamination.	18
IV	Laws of Thermodynamics - first and second law. Concept of enthalpy, entropy, free energy and standard free energy. Biological oxidation-reduction reactions, redox potentials, relation between standard reduction potentials and free energy change. High energy compounds – structural features of ATP and its free energy change during hydrolysis, *other high energy compounds*.	18
V	pH and buffers, Measurement of pH - Types of electrodes and their applications. Chromatographic method- Principles and applications of TLC, HPLC, Gas chromatography. Electrophoresis - Agarose Gel Electrophoresis, SDS-PAGE, 2D-PAGE, capillary electrophoresis. Spectrophotometry - Principles and applications of UV-VIS, Fluorescence, IR and FTIR, Raman spectroscopy and NMR spectroscopy.	18
VI	Current Trends (for CIA only) - Endergonic, exergonic reactions and Coupled reactions	

…… Self Study

Text Book(s):

1. Chatwal GR and Anand SK, Instrumental methods of chemical Analysis, 5th edition, Himalaya publishing house, Mumbai, 2002.
2. Jain JL, Sunjay Jain and Nitin Jain, Fundamentals of Biochemistry, 6th revised and enlarged edition, Chand & Company, New Delhi, India, 2012.
3. Berg JM, Tymaczo JL, Gatto GJ and Stryer L, Biochemistry, 9th edition, W.H. Freeman & Company, New York, 2019.
4. Gurumani, N. Research Methodology: For Biological Sciences, MP. Publishers, 2019.

Reference Book(s):

1. Nicolls DG and Ferguson SJ, Bioenergetics, 4th edition, Elsevier science Publication, 2013.
2. Sathyanarayana U and Chakarapani U, Biochemistry, 5th edition (Revised), Elsevier Health Sciences, Elsevier Relx India Pvt. Ltd. & Books & Allied Pvt. Ltd, New Delhi, 2017.

Web reference:

1. http://www.unm.edu/~rrobergs/426L4Bioen.pdf
2. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
3. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
4. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW
5. https://en.wikipdia.org/wiki/bioinstrumentation

Course Outcomes

Course Outcomes: Upon successful completion of this course, the student will be able to:

CO No.	CO Statement	Cognitive Level (K-level)
CO1	Identify the structure, properties and formulation of carbohydrates.	**K2**
CO2	Realize the different structure, properties and different configuration of proteins.	**K3**
CO3	Summarize the concept of enthalpy, entropy, free energy and standard free energy.	**K4**
CO4	Systemize the metabolism of carbohydrates, lipids and proteins.	**K5**
CO5	Analyse the various bioinstrumentation which are used detect different biomolecules.	**K6**

Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	03	02	03	03	03	02	03	03	02	03	**2.8**
CO2	02	03	03	02	03	03	03	02	03	03	**2.8**
CO3	03	03	02	03	03	03	03	03	03	03	**2.9**
CO4	03	03	03	03	02	03	02	03	03	03	**2.8**
CO5	02	03	03	03	03	02	03	03	03	03	**2.8**
										Mean Overall Score	**2.7**
										Correlation	**High**

Mean Overall Score	Correlation
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. R. Sathish Kumar

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3CC12P	Core – XII	6	4	20	80	100
Course Title	**Laboratory Course for Core IX, X and XI – Practical**						

Contents	Hours
A. Plant Systematics: 1. Identification of binomial nomenclature for the available species from the local flora using Gamble's flora. 2. Detailed study of the plant families mentioned in the theory with two representative species from the local area. 3. Preparation of artificial key for any five families mentioned in the syllabus. 4. Study of various placentation types. 5. Solving the taxonomical problems 6. Each student has to submit 25 herbarium specimens of local flora. 7. Field study to familiarize the angiosperm plants (3 days) and submission of field notebook and report.	**90**
B. Ethnobotany: Identification of family, genus, species, morphology of the useful parts and uses of following tribal medicinal plants. *Abutilon indicum* — Tuthi *Achyranthus aspera* — Nayuruvi *Ficus benghalensis* — Aal *Catharanthus roseus* — Suddukattumalli *Cissus quadrangularis* — Perandai *Cassia auriculata* — Avarai *Chloroxylon swietenia* — Mamarai *Boerhaavia diffusa* — Mookirattai *Asparagus racemosus* — Thaneervitankilangu *Tribulus terrestris* — Sirinerinji *Enicostemma littorale* — Vellarugu	
C. Plant Physiology: 1. Determination of osmotic potential by plasmolytic method. 2. Determination of osmotic potential by using dye method (Chardakov's methods) 3. Effect of temperature and detergent on membrane permeability. 4. Determination of stomatal index 5. Estimation of chlorophyll, carotenoids and their absorption spectra in C3 and C4 plants. 6. Estimation of total organic carbon 7. Separation and identification of amino acids/pigments by paper/thin layer Chromatography and calculating the Rf values. 8. Effect monochromatic light on apparent photosynthesis. 7. Effect of solvent on the seed viability. 8. Assay of nitrate reductase activity.	
D. Biomolecules & Bioinstrumentation: 1. Preparation of molal, molar, normal and percentage solutions and their dilutions. 2. Extraction and estimation of total carbohydrates by Anthrone method 3. Extraction and estimation of proteins by Lowry's method 4. Extraction and estimation of lipids in seeds 5. Extraction of amylase and determination of its activity	

Text Book(s):
1. Metha AS and Verma AP, Experiments in plant physiology, S Chand & Company (Pvt) Ltd, New Delhi, India, 1987. 2. Sundara Rajan S, Practical manual of angiosperm taxonomy, Anmol Publications Pvt Ltd, Bengaluru, Karnataka, India, 2003. 3. Sadasivam S and Manickam A, Biochemical Methods, 3rd Edition, New Age International Publishers, New Delhi, India, 2018.

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	To acquire knowledge on bionomial nomenclature, classification of flowering plants and their scientific description	K2
CO2	To understand knowledge on ethnobotanical uses of plants	K3
CO3	To evaluate the knowledge on different concepts of physiology	K4
CO4	Analyses the preparation methods of molal, molar, normal and percentage solutions and their dilutions.	K5
CO5	To analysis biomolecules by conducting laboratory experiments	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	03	03	02	03	03	03	02	02	2.5
CO2	02	03	03	03	03	03	03	02	03	03	2.8
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	03	02	03	03	03	03	03	03	02	03	2.8
CO5	03	03	03	03	03	03	03	03	03	03	3.0
										Mean Overall Score	2.8
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru & Dr. R. Sathish Kumar

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3DE3A	Discipline Specific Elective - III	6	4	25	75	100
Course Title	**Biostatistics and Bioinformatics**						

Syllabus		
Unit	**Contents**	**Hours**
I	**Descriptive statistics:** Brief history, definition, scope of biostatistics in pandemic and sporadic pest attack; Sampling techniques - Data – types, collection, Classification, tabulation, diagrammatic and graphical presentation of data; Measures of central tendencies - mean, median and mode; Measures of dispersion - range, mean deviation, variance, standard deviation and standard error; *Skewness and Kurtosis*.	18
II	**Probability distribution:** Binomial, Poisson and normal distribution; *Correlation – types and methods of studying*; Regression (Simple and Linear) - Types, analysis and significance. Comparison tests: Tests of significance – t-Test, G-test, Chi-square test, F-test and ANOVA (one way and two-way).	18
III	**Inferential statistics:** Definition – rate, ratio and proportion. Calculation of incidence, prevalence, specific mortality, fatality and loss rate. False positives, false negatives, true positives, true negatives, Sensitivity and specificity and their predictive values, ROC-curves – comparison of two different methods for efficiency.	18
IV	**Biological database:** Bioinformatics - an overview, role of internet. Primary nucleotide sequence databases- Gen Bank, EMBL, DDBJ; Primary protein sequence databases – Uni Prot, PIR; secondary databases– Prosite, Prints, Pfam, CATH, SCOP, FSSP; structure database – PDB, Other relevant databases- KEGG, PQS; Literature databases - text mining, file formats of gen bank, *Swiss prot*, SPDB viewer and GBIF. Data retrieval using Entrez and SRS. *Biodiversity database – Mangrove® and Biotik® (brief account)*. Big data management in biology. A brief Introduction to R, SPSS and data Science.	18
V	**Biological sequence data analysis:** Amino acids- structure, classification; Peptide bonds, Levels of protein structure - helix, sheet and turns - Ramachandran plot - Super secondary structures - Domains - Quaternary structure. DNA and RNA structure - Watson and Crick model - A, B and Z forms of DNA.	18
VI	Current Trends (For CIA only) – RNA secondary structure	

..... Self-Study

Text Book(s):

1. Khan IA and Khanum A, Fundamentals of Biostatistics 2nd Edition, Vikas Publications Pvt Ltd, Hyderabad, India, 1994.
2. Gurumani N, An introduction to Biostatistics, 1st Edition, MJP Publication Pvt Ltd, Chennai, Tamil Nadu, India, 2005.
3. Prakash S. Lohar. Bioinformatics, 1st Edition, MJP Publishers Pvt Ltd, Chennai, Tamil Nadu, India, 2009.

Reference Book(s):
1. Felix Bast Biostatistics and Mathematical Biology (1st Ed), Pearson India Private Ltd (2023).
Web Resource(s):
1. https://www.who.int/ihr/lyon/surveillance/biostatistics/en/ 2. https://www.ncbi.nlm.nih.gov/ 3. https://www.rcsb.org/

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	Demonstrate various numerical and graphical descriptions of statistical data.	K2
CO2	Identify the patterns and types of data distribution in biological world.	K3
CO3	Make inference about the validity of the data collected in various surveys and experiments to support the decision-making process.	K4
CO4	Appraise the organization and usage of various biological databases.	K5
CO5	Develop analytical skills in biostatistics and bioinformatics.	K6

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	2	1	3	3	1	1	1	1	1	1.7
CO2	2	2	1	3	3	1	1	1	1	1	1.7
CO3	2	2	1	3	2	1	1	2	1	2	1.8
CO4	1	2	1	3	2	1	1	3	1	3	1.9
CO5	1	2	1	3	1	1	1	3	1	3	1.7
										Mean Overall Score	1.7
										Correlation	Medium

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. A. Aslam

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23PBO3DE3B	Discipline Specific Elective - III	6	4	25	75	100
Course Title	**Biodiversity and Conservation**						

Syllabus		
Unit	**Contents**	**Hours**
I	Important events in Evolution. Evolutionary mechanisms; natural selection, artificial selection, adaptation, co-evolution. Microevolution - definition, Changes, Mechanisms. Speciation - Species, causes, reproductive isolation, evidence of speciation, co speciation. Macro evolution, its patterns. *Diversity in clades and trends in evolution*.	18
II	Definition, plant, animal and microbial diversity; types – genetic, species and ecosystem diversity; benefits, importance and loss of biodiversity – centres of diversity - mega diversity centres, centres of origin of diversity, hotspots. *Concepts of endemism*.	18
III	Global biodiversity distribution and its ecosystem services- amazon and himalayas. Values of biodiversity: instrumental/utilitarian value and their categories, direct use value; indirect/ non- consumptive, use value, introduction to ecological economics; monetizing the value of biodiversity; intrinsic value; ethical and aesthetic values, anthropocentrism, biocentrism, ecocentrism and religions. Intellectual value and *deep ecology*.	18
IV	Habitat destruction and invasive species: causes, introductory pathways of invasive species, *effect of pollutants on biodiversity*. Over exploitation, impact of climate change on biodiversity. Extinction: types of extinctions, processes responsible for species extinction, current and future extinction rates, sixth extinction/biological crisis.	18
V	Biodiversity legislation and conventions – international laws and policies for biodiversity conservation, CBD conventions and targets, TRIPS, CITES, Ramsar, IITA and IATO, environmental and forest acts. Organizations involved for conservation - CBD, *IUCN, IPR and biodiversity*, UNESCO, NBPGR, WWF, FAO, CITS, and TKDL.	18
VI	Current Trends (for CIA only) - Forest management techniques - sustainable utilization.	

*……*Self Study

Text Book(s):

1. Kumar S, Biodiversity and its conservation, 1st Edition, Pragun Publications Pvt Ltd, New Delhi, India, 2012.
2. Shukla M and Anjali Srivastva, Biodiversity and It's Conservation, 1st Edition, Disha International Publishing House Pvt Ltd, New Delhi, India, 2016.
3. Krishnamurthy KV, An Advanced Text Book on Biodiversity Principles and Practice, 1st Oxford & IBH Publishing Pvt Ltd, New Delhi, India, 2018.

Reference Book(s):

1. Hawksworth DL, Biodiversity, Measurement and Estimation, 1st Edition, Chapman and Hall Pvt Ltd, London, 1995.
2. Hawksworth DL, Management and the conservation of Biodiversity, 10th Edition, Springer, 2012.

Web Resource(s):
1. https://info.undp.org/docs/pdc/Documents/LKA/English%20Training%20Manual%20for%20ESA%2019%20May%20ewfmt_highres.pdf 2. https://www.cbd.int/convention/

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	To provide the knowledge on evolutionary mechanism and speciation	K1
CO2	To obtain knowledge on diversity and distribution of different organisms	K2
CO3	To gain knowledge on global biodiversity and their values	K3
CO4	To understand the factors, influence the destruction of biodiversity	K4
CO5	To apply the inculcate knowledge by implementing various laws and organizations involved in conservation of biodiversity	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	02	02	03	03	03	03	02	2.4
CO2	02	03	03	03	03	03	03	03	03	03	2.9
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	02	02	03	03	03	03	02	02	02	03	2.5
CO5	02	03	03	03	03	03	03	03	03	03	2.9
										Mean Overall Score	2.7
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PBO4CC13	Core – XIII	6	6	25	75	100
Course Title	**Plant Ecology and Conservation Biology**						

Syllabus		
Unit	**Contents**	**Hours**
I	**Plant Ecology:** definition, scope, branches, components, concept of habitat and niche, niche width and overlap; fundamental and realized niche, resource partitioning; character displacement. Plant succession: kinds and process types- hydrosere, xerosere (lithosere and psammosere), plant adaptations. Plants as ecological indicators, keystone species. Plant community: structure and development. Food chain and food web, ecological pyramids, energy flow in ecological system, *biogeochemical cycle – nitrogen and phosphorus cycle*.	18
II	**Ecosystem:** types, dynamics, measurement of productivity. Community ecology and characteristics. Population growth and dispersions, growth curves, population regulation, life history strategies (r and k selection). Concept of metapopulation – dynamics and models. Species distribution types, species birth and death rates, age –structure, survivorship curves demes and dispersal, inter-demic extinctions, age structured populations. Species interactions: types of interactions, interspecific competition, herbivory, carnivory, pollination and symbiosis. *Concept of climax- monoclimax and polyclimax theories*.	18
III	**Biogeography:** Definition, patterns theory of island biogeography, ecological geography- ecogeographic rules, biomes- ecosystem patterns, grasslands, tundra, forest, deserts, salt and freshwater; bio- geographical zones of India, conservation biogeography. Phytogeography: definition, principles of plant geography, types of dispersal and migration, floristic and phytogeographical regions of India, centres of origin of cultivated plants. Age and area hypothesis, Wegner's theory of continental drift. Endemism- theories of endemism, factors responsible for endemism, important characters of endemism. *Hotspots of world and India*.	18
IV	**Biodiversity:** Components of biodiversity, species richness over geological time, patterns of endemism. Major threats to biodiversity – habitat degradation and loss, habitat fragmentation, over exploitation, species invasions. Biological impacts of climate change- El Niño effect, current and future climate change, predicted biological impacts. Observed biological effects of climate change- evolutionary, morphological changes, phenological shifts, ranges shifts, abundance change and community reassembly, sea-level rise, *ecosystem process changes*.	18
V	**Conservation:** *In situ* and *Ex situ* conservation measures. Species, landscape approaches of conservation. Protected areas- goals, design and limitation, restoration of ecosystem and its importance, case studies on conservation/management strategy -project tiger, project rhinos, project elephant, and biosphere reserves. *IUCN Threatened Categories*, Geoinformation technologies – Principles of Remote Sensing, GIS and GPS. Application of Indian remote sensing satellites (Resource SAT, Ocean SAT & Megha-Tropiques) and GIS for bioresource conservation and management, ecological and conservation models – Ecological Niche Models (ENM), National Biodiversity Characterization Project in India.	18
VI	Current Trends (for CIA only) - Environmental awareness and education; environmental ethics.	

……. Self Study

Text Book(s):
1. Das PC, Plant Ecology, 1st Edition, AITBS Pvt Ltd, New Delhi, India, 2007. 2. Ambasht RS and Ambasht NK, A Textbook of Plant Ecology, 15th Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, India, 2017. 3. Shukla RS and Chandel PS, A Textbook of Plant Ecology (including ethnobotany and soil science), Chand & Company Pvt Ltd, New Delhi, India, 2022.
Reference Book(s):
1. Gary Meffe K and Ronald Carroll C, Principles of Conservation Biology, 3rd Edition, Sinauer Associates, Sunderland, USA, 2005. 2. Odum Eugene, Fundamentals of Ecology, 5th Revised Edition, Philadelphia Pvt Ltd, USA, 2017.
Web Resource(s):
1. https://open.oregonstate.education/rangeland/chapter/chapter-3-population-ecology/ 2. https://sangu.ge/images/Essentialsof Ecology.pdf

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	To enlight the knowledge on different concepts and components in ecology	K1
CO2	To obtain knowledge on ecosystem dynamics, community and population ecology concepts and method	K2
CO3	To gain knowledge on theory of biogeography pertaining to vegetation and plants	K3
CO4	To understand different components of biodiversity and threats to its loss	K4
CO5	To apply the knowledge on methods to conserve the nature	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	02	02	03	03	03	02	02	2.3
CO2	02	03	03	02	03	03	03	02	03	03	2.7
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	02	02	03	03	03	03	02	02	02	03	2.5
CO5	02	03	03	03	03	03	03	02	03	03	2.8
										Mean Overall Score	2.6
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PBO4CC14	Core - XIV	6	6	25	75	100
Course Title	**Plant Biotechnology**						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Plant Tissue Culture:** Brief history of plant tissue culture. Differentiation, Dedifferentiation and Redifferentiation of plant cells. Clonal propagation, protoplast culture and somatic hybridization, cybrids, production of haploid plants, *somaclonal variation*, germplasm conservation and cryopreservation.	18
II	**Molecular Scissors and Cloning Vehicles:** Restriction endonuclease, ligase, phosphor-nucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, DNA polymerase I holoenzyme and I klenow fragment, T4 and Taq DNA polymerase, RNAse H, reverse transcriptase, poly-A polymerase, deoxyribonuclease, exonuclease III. Bacteriophage, cosmids, phagemids *Ti and Ri plasmid*, caulimoviruses, minichromosomes, shuttle and expression vectors. Gene cartridges and synthetic regulator sequences.	18
III	**Gene Transfer Techniques:** Vector mediated gene transfer – Agrobacterium and virus mediated. Direct method of gene transfer – Physical methods: microinjection, electroporation, biolistics, liposomes and silica carbide fibre. Chemical method: *PEG*, DEAE, calcium phosphate and DNA imbibition. Chloroplast transformation. Marker genes for plant transformations, promotors and terminators.	18
IV	**Techniques in Plant Genetic Engineering:** PCR and its applications, DNA markers and its applications – RAPD, RFLP, SSR, ISSR and AFLP. Basic steps in gene cloning, Nucleic acid blotting techniques – Southern, Northern and Western blotting, *Colony and Plaque blotting* and Autoradiography. DNA sequencing – Maxam and Gilbert technique.	18
V	**Regulatory Issues in Biotechnology:** Intellectual property rights (IPR) – patents Indian and International scenario, IPP, WIPO, GATT, TRIPs. Biosafety – Principles of biosafety for microbiological and biomedical laboratories, guidelines, regulation and operations. *Role of ICGEB*, OECD. Biosafety risks and assessment in food and feed derived from GMC. Science based environmental concern on release of transgenic crops.	18
VI	Current Trends (For CIA only) – Ecological and environmental impact risk assessment of transgenic crops and safety assessment of recombinant organisms.	

…… Self Study

Text Book(s):

1. Slater A, Scott WN and Fowler MR, Plant Biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford university press, New York, 2008.
2. Satyanarayana U, Biotechnology. 1st Edition. Books and Allied Pvt Ltd. Kolkata, India, 2010.
3. Dubey RC, A text book of biotechnology, 5th Edition, Chand & Company Pvt Ltd, New Delhi, India, 2014.

Reference Book(s):

1. Verma PS and Agarwal VK, Genetic Engineering, 1st Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.
2. Thieman WJ and Palladio MA, Introduction to Biotechnology, 4th Edition, Pearson College Division, New York, 2018.

Web Resource(s):
1. https://www.onlinebiologynotes.com/germplasm-conservation/ 2. https://microbenotes.com/restriction-enzyme-restriction-endonuclease/ 3. https://www.biologydiscussion.com/genetics/engineering/chloroplast-transformation-in-plants-with-diagram/10765 4. https://www.onlinebiologynotes.com/western-blotting-technique-principle-procedure-application/ 5. https://www.unr.edu/ehs/policies-manuals/biosafety-manual/chapter-4

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	Describe the scope and importance of biotechnology.	**K2**
CO2	Choose and design desired enzymes and cloning vehicles for genetic engineering.	**K3**
CO3	Recognize different gene transfer methods and analysing techniques.	**K4**
CO4	Utilize and develop plant-based products for social welfares.	**K5**
CO5	Distinguish about biosafety, IPR and patents of biological products.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of Cos**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3.0	3.0	2.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.6
CO2	3.0	3.0	2.0	1.0	3.0	1.0	3.0	2.0	3.0	3.0	2.4
CO3	3.0	3.0	2.0	2.0	3.0	2.0	3.0	1.0	3.0	3.0	2.5
CO4	3.0	3.0	1.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.5
CO5	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	2.6
										Mean Overall Score	2.5
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. N. Ahamed Sherif

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PBO4CC15P	Core – XV	6	4	20	80	100
Course Title	Laboratory Course for Core XIII and XIV - Practical						

Contents	Hours
A. Plant Ecology and Conservation Biology 1. Analysis of vegetation – Quadrat, Line transect methods, Point frame method. 2. Compare study of moderate and heavily disturbed grassland stands using community coefficients (Jaccard, Sorenson index). 3. Determination of dominant species for the assured stands by calculating the IVI (R-density + R frequency + R-dominance). 4. Study of Raunkier's life forms in the college campus. 5. Identify the methods to draw the profile of tree vegetation. 6. Identify the methods to map plant species distribution using GPS coordinates. 7. Estimation of the dissolved oxygen content in different water samples. 8. Estimation of carbonate and Bicarbonate in different water samples. 9. Estimation of chloride content in different water samples. 10. Estimation of total hardness of water. 11. Assess and retrieve distribution of plant species from GBIF database using R software. **B. Plant Biotechnology** 1. Isolation of total plant genomic DNA by CTAB method 2. Estimation of DNA by Diphenylamine method 3. Qualification of plant genomic DNA using agarose gel electrophoresis 4. Demonstration of PCR for amplification of DNA 5. Demonstration of protein separation by using SDS-PAGE 6. Construction of vector map (Demonstration)	**90**

Text Book(s):

1. Aneja KR, Laboratory manual of microbiology and biotechnology, 1st Edition, Medtech Pvt Ltd, New Delhi, India, 2014.
2. Girija S, Practical manual on plant molecular biology and analytical techniques, 1st Edition, AkiNik Publications Pvt Ltd, New Delhi, India, 2019.

Web Resource(s):

1. https://youtu.be/MILiO1XnuqQ?si=8V8NA0hgy_gRAVXJ
2. https://youtu.be/keRjfFSWaaY?si=t58L9369UufCdmvy
3. https://youtu.be/-rxLZRZ0DMQ?si=ibepf6Ce7Scr8lLy

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	Obtain knowledge on the measurement of vegetation	K4-k5
CO2	Understand the various ecological methods for analysis vegetation samples	K4
CO3	Evaluate the physio chemical and biological properties of water	K4
CO4	Exploit the knowledge on isolation and quantification of DNA.	K5
CO5	Acquire knowledge in constructing map of cloning vectors.	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	03	03	02	03	03	03	02	02	2.5
CO2	02	03	03	03	03	03	03	02	03	03	2.8
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	03	02	03	03	03	03	03	03	02	03	2.8
CO5	03	03	03	03	03	03	03	03	03	03	3.0
										Mean Overall Score	2.8
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. N. Ahamed Sherif & Dr. B. Balaguru

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PBO4DE4A	Discipline Specific Elective – II	6	4	25	75	100
Course Title	**Plant Tissue Culture and Secondary Metabolites Production**						

SYLLABUS		
Unit	**Contents**	**Hours**
I	**Basic Plant Tissue Culture:** Totipotency and concepts of plant tissue culture – laboratory organization – aseptic techniques - Plant culture media – inorganic nutrients – macronutrients – micronutrients - carbon and energy sources – organic supplements – growth regulators – solidifying agent – MS medium and B5 medium – explant preparation - methods of sterilization, *incubation of culture*.	18
II	**Micropropagation:** Different stages, technical problems, factors affecting and practical applications of micropropagation. Callus through regeneration advantages and disadvantages. Multiplication of plants using different types of explants (Apical bud, axillary bud, leaf and internode). Rooting, hardening and acclimatization techniques. An over view of organogenesis, somatic embryogenesis and synthetic seed technology. Determination of somoclonal variations in tissue culture raised plants.	18
III	**Transgenic Production:** Strategies of transgenic production – Basic concepts of gene / DNA and traits, Identification and isolation of genes for specific traits, designing of gene construct for transformation, selection and regeneration of plants. Herbicide and insect resistant transgenic plants. *Flavr Savr tomato and Bt cotton*.	18
IV	**Fundamentals of Metabolic Engineering:** Application of cell, tissue, organ and culture systems in metabolic engineering. Biosynthetic pathway of secondary metabolites – acetate, mevalonate, deoxy-xylose phosphate and shikimate. Hairy root culture. Upstream and downstream process screening of high yielding cell lines. Procedures for extraction of high value industrial products (cyclodextrins, hirudin, shorter and longer fatty acids and trypsin).	18
V	**Bioreactors and Biotransformation:** Types of bioreactors for plant cell cultures-manipulation in production profile by biotic and abiotic elicitation. Control mechanisms and manipulation of phenylproponoid pathway, Therapeutic proteins, plantibodies, plantigens and *Edible vaccines*. Scale-up procedures in bioreactors.	18
VI	Current Trends (For CIA only) – Commercial production of shikonin and vinblastine.	

…… Self Study

Text Book(s):

1. Dubey RC, A Textbook of Biotechnology, 4th Edition, Chand & Company Pvt Ltd, New Delhi, 2007.
2. Purohit SD, Introduction to plant cell, tissue and organ, 1st Edition, PHI Learning Pvt Ltd, New Delhi, India, 2013.
3. Kumar S, Sweta M and Mishra AP, Plant tissue culture: Theory and Techniques, 1st Edition, Scientific Publishers Journals Pvt Ltd, New Delhi, India, 2016.

Reference Book(s):
1. Satyanarayana U, Biotechnology. 1st Edition. Books and Allied Pvt Ltd. Kolkata, India, 2010. 2. Razdan MK, Introduction to plant tissue culture, 3rd Edition, Oxford & IBH Publishing Co Pvt Ltd, New Delhi, India, 2019.
Web Resource(s):
1. https://byjus.com/biology/plant-growth-regulators/ 2. https://www.tutorialspoint.com/what-is-synthetic-seed-technology#:~:text=Synthetic%20seed%20technology%20is%20a,culture%20in%20a%20protective%20coating. 3. http://www.ilsi-india.org/Conference-on-biotechnology-based-sustainable-agriculture/Session%202A/Dr.%20Jay%20G%20Varshney.pdf 4. https://www.studocu.com/in/document/sant-gadge-baba-amravati-university/plant-biotechnology/lecture-32-hairy-root-cultures/22916476 5. https://www.studocu.com/in/document/sant-gadge-baba-amravati-university/plant-biotechnology/lecture-37-manipulation-in-production-profile-by-abiotic-and-biotic-elicitation/22916675

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	Gain the knowledge on important techniques about plant tissue culture.	**K2**
CO2	Apply somatic embryogenesis techniques and cryopreservation.	**K3**
CO3	Develop and apply genetic transformation protocols.	**K4**
CO4	Gain fundamental knowledge of metabolic engineering of secondary metabolites.	**K5**
CO5	Enumerate the types of bioreactors and its commercial application.	**K6**

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.6
CO2	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.6
CO3	3.0	3.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	2.5
CO4	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	2.8
CO5	3.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	2.8
										Mean Overall Score	2.6
										Correlation	High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. N. Ahamed Sherif

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23PBO4DE4B	Discipline Specific Elective – IV	6	4	25	75	100
Course Title	**Marine Ecology**						

SYLLABUS

Unit	Contents	Hours
I	**Physical Oceanography and Biotic Factors:** Physical oceanography: the role and observations in oceanography. Oceans and seas, their dimension, physical properties, temperature-density in space and time, O_2, CO_2, nutrients, oceanic mixed layer and thermocline. Ocean currents and their movement, equatorial processes El Nino, Indian ocean circulation. Biotic factors – floral and faunal components. Role of phytoplanktons, *water blooms* and red tide phenomenon.	18
II	**Marine Chemistry:** Major and minor elements in sea water and chlorinity. Salinity – definition, significance and measurement. Solubility of gases in sea water – dissolved O_2, CO_2, pH, *alkalinity*, percentage composition of inorganic carbon, calcium carbonate precipitation. Micronutrient elements in sea water (P, N, Si), N:P ratios, stoichiometry and uptake and regeneration of nutrient elements.	18
III	**Microbial Ecology:** Microbial ecology of coastal ecosystem – mycorrhizal relations, coastal vegetation, nitrogen fixation and detritus-based food chain. Microbial ecology of coral reefs – occurrence, distribution and types. Calcification, reef algae, natural and anthropogenic stress, restoration and conservation of coral ecosystem and *concept of marine park*.	18
IV	**Biodiversity of Mangroves:** Brief introduction to creek, estuary, lagoon and delta formations. Definition of 'mangrove", distribution and biogeography of Indian mangroves, east and west coast mangroves, mangrove forests. Salient features of important mangrove families such as Rhizophoraceae, Sonneratiaceae, Avicenniaceae, Myrsinaceae, Acanthaceae. Salt marshes, *sea grasses* and sand dune vegetation.	18
V	**Marine Pollution and Conservation of Mangrove Ecosystem:** Marine pollution – types, sources and impact. Toxic metal pollution, oil, sewage, pesticide, radioactive pollution and effect of waste disposal on marine ecosystem. *biomagnification*. Conservation of mangrove ecosystem – need for conservation, human impact, role of global institutions and NGO's in India.	18
VI	Current Trends* (For CIA only) – Application of Remote Sensing and GIS for mangrove assessment and conservation	

..... Self-Study

Text Books:

1. Chaudhuri A, Biodiversity of Mangroves, 1st Edition, Daya Publishing House Pvt Ltd, New Delhi, India, 2005.
2. Rudra T and Gandhi G, Marine pollution control and management, 2nd Edition, Jnanada Prakashan Pvt Ltd, New Delhi, India, 2010.
3. Muhammad Saleem, Microbiome Community Ecology: Fundamentals and Applications, 1st Edition, Spirnger, 2015.

Books for Reference:

1. Satyanarayana D, Marine Chemistry, 1st Edition, Daya Publishing House Pvt Ltd, New Delhi,

India, 2020.
2. Ashley W, Marine Ecology: Concepts and Applications, 1st Edition, Syrawood Publishing House, United Kingdom, 2020.

Course Outcomes		
Course Outcomes: Upon successful completion of this course, the student will be able to:		
CO No.	**CO Statement**	**Cognitive Level (K-level)**
CO1	To provide an adequate knowledge on Physical oceanography and biotic factors	K1
CO2	To obtain knowledge on marine chemistry	K2
CO3	To acquire knowledge on ecological distribution of microbes in marine environment	K3
CO4	To understand the mangroves and their role in coastal regions	K4
CO5	To analysis impact of pollution in marine ecosystem and their mitation measures	K5

Relationship Matrix:

Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	02	02	02	02	02	03	03	03	03	02	2.4
CO2	02	03	03	02	03	03	03	02	03	03	2.7
CO3	02	03	03	03	03	03	03	03	03	03	2.9
CO4	02	02	03	03	03	03	02	02	02	03	2.5
CO5	02	03	03	03	03	03	03	02	03	03	2.8
									Mean Overall Score		2.6
									Correlation		High

Mean Overall Score	**Correlation**
< 1.5	Low
≥ 1.5 and < 2.5	Medium
≥ 2.5	High

Course Coordinator: Dr. B. Balaguru