PG & RESEARCH DEPARTMENT OF BOTANY

M.Sc., BOTANY

Syllabus

(2020 – 2023 onwards)

JAMAL MOHAMED COLLEGE (Autonomous)
College with Potential for Excellence
Accredited (3rd Cycle) with 'A' Grade by NAAC
DBT Star College Scheme & DST-FIST Funded
(Affiliated to Bharathidasan University)
Tiruchirappalli – 620020, Tamil Nadu, India

PROGRAMME OUTCOMES – SCIENCE

Postgraduates will be able to

- Describe advanced and contemporary concepts, principle and theories in the appropriate field to solve real problems.
- Apply skill of observation for scientific experiments, draw logical conclusions and present it as a report.
- Employ intellectual, personal, interpersonal and societal skills in professional career to maximize professional growth.
- Prepare themselves as capable administrators, educators, researchers and pursue higher education as lifelong learner.
- Develop scientific attitude not only with respect to science subjects but also in all aspects related to life imbibing ethical, moral and social values in personal and social life.

PROGRAMME SPECIFIC OUTCOMES

M.Sc. Botany

Students will be able to

- Identify various group of plants, their functions, utilization, and conservation aspects and give scientific explanation for the unity and diversity on earth.
- Demonstrate knowledge on primary and modern techniques in terms of theory and practical application and also handling of laboratory equipment's for biological research.
- Combine the knowledge of interdisciplinary subjects such as molecular biology, Biotechnology, Bioinformatics and Biostatistics for the mitigation of biodiversity and environmental issues.
- Apply the cultivation of sea weeds, floriculture and plant tissue culture for entrepreneurship and commercialization.
- Appraise various analytical techniques for planning and execution of biological experiments, and drafting them as a report.

M.Sc. Botany

SEM	Course Code	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
							CIA	ESE	
I	20PBO1CC1	Core – I	Plant Diversity I (Thallophytes and Bryophytes)	6	5	3	25	75	100
	20PBO1CC2	Core– II	Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	6	5	3	25	75	100
	20PBO1CC3	Core– III	Microbiology, Plant Pathology and Immunology	6	4	3	25	75	100
	20PBO1CC4P	Core– IV	Laboratory course for core I, II and III– Practical	6	4	3	20	80	100
	20PBO1DE1A/B	DSE – I#		6	4	3	25	75	100
		TOTAL		**30**	**22**	-	-	-	**500**
II	20PBO2CC5	Core– V	Cell and Molecular Biology	6	5	3	25	75	100
	20PBO2CC6	Core– VI	Anatomy, Embryology and Forensic Botany	6	5	3	25	75	100
	20PBO2CC7	Core– VII	Genetics and Plant Breeding	6	4	3	25	75	100
	20PBO2CC8P	Core– VIII	Laboratory course for coreV, VI and VII – Practical	6	4	3	20	80	100
	20PBO2DE2A/B	DSE – II#		6	4	3	25	75	100
		TOTAL		**30**	**22**	-	-	-	**500**
III	20PBO3CC9	Core– IX	Plant Systematics and Ethnobotany	6	5	3	25	75	100
	20PBO3CC10	Core– X	Plant Physiology	6	5	3	25	75	100
	20PBO3CC11	Core– XI	Biomolecules, Bioenergetics and Analytical Instrumentation	6	4	3	25	75	100
	20PBO3CC12P	Core– XII	Laboratory course for coreIX, X and XI – Practical	6	4	3	20	80	100
	20PBO3DE3A/B	DSE – III#		6	4	3	25	75	100
	20PBO3EC1	Extra Credit Course – I	Online Course (MOOC)	-	1*	-	-	-	-
		TOTAL		**30**	**22**	-	-	-	**500**
IV	20PBO4CC13	Core– XIII	Plant Ecology and Conservation Biology	6	5	3	25	75	100
	20PBO4CC14	Core– XIV	Plant Biotechnology	6	5	3	25	75	100
	20PBO4CC15P	Core– XV	Laboratory Course for Core XIII and XIV – Practical	6	5	3	20	80	100
	20PBO3DE4A/B	DSE – IV#		6	4	3	25	75	100
	20PBO4PW	Project	Dissertation Work	6	4	-	-	100	100
	20PCNOC	Online Course (Compulsory)		-	1	-	-	-	-
	20PBO4EC2	Extra Credit Course – II	Botany for Career Examination	-	5*	3	-	100	100*
		TOTAL		**30**	**24**	-	-	-	**500**
			GRAND TOTAL	**-**	**90**	**-**	**-**	**-**	**2000**

***Not considered for grand total and CGPA**

#Discipline Specific Elective

SEM	Course Code	Course Title
I	20PBO1DE1 A/B	**A. Applied Marine Botany** (or) B. Agricultural Microbiology
II	20PBO2DE2 A/B	**A. Floriculture for Entrepreneurship and Export** (or) B. Horticulture and Greenhouse Technology
III	20PBO3DE3 A/B	**A. Biostatistics and Bioinformatics** (or) B. Biodiversity and Conservation
IV	20PBO4DE4 A/B	**A. Plant Tissue Culture and Secondary Metabolites Production** (or) B. Marine Ecology

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1CC1	Core– I	Plant Diversity – I (Thallophytes and Bryophytes)	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Describe the characteristic features of non-flowering plants.
2. Identify the morphology, organization and reproduction stages of thallophytes and bryophytes.
3. Interpret their interrelationships and evolutionary trends.
4. List the economic importance of Algae, Fungi and Bryophytes.
5. Identify and preserve them in their natural environment.

Unit I: Phycology **18 Hours**

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.

Unit II: Phycology **18 Hours**

Study of the structure, reproduction and life cycle of the following genera – #*Gloeocapsa*#, *Spirulina, Vaucheria, Pinnularia* (Diatom), *Padina, Sargassum, Batrachospermum* and *Gelidium*.

Unit III: Mycology **18 Hours**

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.

Unit IV: Mycology **18 Hours**

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 and #economic importance of lichens#.

Unit V: Bryophytes **18 Hours**

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#.

#.....# Self-Study portion

Text Books:

1. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Bryophyta, 9th Edition, Chand and Company Pvt Ltd, New Delhi, India, 2004.
2. Sharma OP, A Text Book of Algae, 1st Edition, Tata McGrew Hill Education Pvt Ltd, New Delhi, India, 2011.
3. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Fungi, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2016.

Books for Reference:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**			**Hours**			**Credits**	
I	20PBO1CC1		Plant Diversity – I (Thallophytes and Bryophytes)			6			5	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓	✓	✓		✓	
CO2	✓			✓		✓	✓		✓	
CO3	✓			✓		✓	✓		✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓			✓	✓	✓	✓	✓	✓	
Number of Matches = 32, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. M. Kamaraj DR. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
I	20PBO1CC2	Core – II	Plant Diversity – II (Pteridophytes, Gymnosperms and Paleobotany)	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Describe the major groups of non-flowering and naked seeded plants.
2. Appraise the life histories of embryophytes, tracheophytes and seed plant.
3. Correlate their classification, anatomy, reproduction and life cycles.
4. Recognize geological time periods, types and methods of fossilization.
5. Acquire knowledge on different fossil genera of pteridophytes and gymnosperms.

Unit I: Pteridophytes **18 Hours**

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#.

Unit II: Pteridophytes **18 Hours**

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*#.

Unit III: Gymnosperms **18 Hours**

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#.

Unit IV: Gymnosperms **18 Hours**

Study of the structure, reproduction and life cycle of the following genera – *Cupressus*, *Podocarpus*, *Araucaria*, *Ephedra*, *Ginkgo* and #*Gnetum*#.

Unit V: Paleobotany **18 Hours**

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*.

#.....# Self-Study portion

Text Books:

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. Wilson N and Rothwell Stewart GW, Paleobotany and the evolution of plants, 2nd Edition, Cambridge University Press Pvt Ltd, United Kingdom, 2013.
3. Sharma OP and Shivani D, Gymnosperms, 5th Edition, Pragati Prakashan Pvt Ltd, Meerut, India, 2016.

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**	**Title of the Paper**							**Hours**	**Credits**
I	20PBO1CC2	Plant Diversity – II (Pteridophytes, Gymnosperms and Paleobotany)							6	5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓		✓	
CO2	✓	✓		✓	✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓	✓			
CO4	✓			✓	✓	✓		✓		
CO5	✓			✓	✓	✓		✓		
Number of Matches= 30, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. M. Kamaraj Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1CC3	Core – III	Microbiology, Plant Pathology and Immunology	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Classify the bacteria and viruses based on their characters and structures.
2. Justify the role of microorganisms in food processing, industrial production of beverages, antibiotics and waste water treatment.
3. Recognize plant defence mechanism against pathogens at molecular and genetical level.
4. Describe the common plant diseases caused by bacteria, fungi and viruses.
5. Compose the mechanism of immune system, properties and role of antigens, antibodies and different assays for diagnosis.

Unit I: Bacteria and Viruses **18 Hours**

Bacteria – Size, shape, arrangement and anatomy of bacteria. 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 (LHT system and Dimmock *et al.,* 2014) and replication (Lytic and Lysogenic cycle).

Unit II: Applied microbiology **18 Hours**

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 and microbial fuel cells: batteries powered by microbes.

Unit III: Plant pathogen interaction **18 Hours**

Pathogenesis, enzymes and toxins in plant diseases. Plant pathogen interaction – photosynthesis, respiration and #plant growth#. Defense mechanism (morphological and detoxification of pathogen toxin), pathogen derived genes and RNA silencing by pathogen derived genes. Genetics of plant pathogen interaction – hostparasite interaction, resistance and susceptibility.

Unit IV: Plant diseases **18 Hours**

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. 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 and #plant disease assessment methods#.

Unit V: Immunology **18 Hours**

Immunity – Innate: factors affecting innate immunity and mechanism of innate immunity. Acquired immunity: types and measurements. 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#. Structure and function of the immune system: Primary and Secondary lymphoid organs, lymphocytes, T-cell and B-cell maturation, null cells and MHC.

#.....# Self-Study portion

Text Books:

1. Chakravarty AK, Immunology and Immunotechnology, 1st Edition, Oxford University PressPvt Ltd, New Delhi, India, 2006.
2. Dubey RC and Maheshwari DK, A Text Book of Microbiology, Revised Edition, Chand and Company LimitedPvt 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.

Books for Reference:

1. Anathanarayan R and Jayaram Paniker CK, Text Book of Microbiology, 10th Edition, 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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
I	20PBO1CC3			Microbiology, Plant Pathology and Immunology			6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓		✓	✓			
CO2	✓	✓		✓	✓	✓	✓	✓	✓	
CO3	✓		✓	✓		✓	✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches = 35, Relationship: High										

Prepared by: **Checked by:**

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

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1CC4P	Core – IV	Laboratory course for core I, II and III – Practical	6	4	100	20	80

Course Outcomes:

At the end of the course, students will be able to

1. Explain the internal structures of unicellular and multicellular algal specimens.
2. Compare the organization of thallus among various plant groups.
3. Describe and identify fossil specimens of plant.
4. Isolate, culture & study of microbes for various applications.
5. Demonstrate basic techniques of microbiology and immunology

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 three 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.

Text Books:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
I	20PBO1CC4P			Laboratory course for core I, II and III – Practical				6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓			✓
CO2	✓	✓		✓	✓	✓	✓			✓
CO3	✓	✓		✓	✓	✓	✓			✓
CO4	✓	✓		✓	✓	✓	✓			✓
CO5	✓	✓		✓	✓	✓	✓			✓
Number of Matches =35,Relationship:High										

Prepared by: **Checked by:**

Dr. H. Syed Jahangir Dr. A. Aslam

Dr. M. Kamaraj

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1DE1A	DSE – I#	Applied Marine Botany	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Recognize marine based analytical methods and remote sensing applications.
2. Apply the methods of collection, cultivation and mass production of seaweeds and sea grasses.
3. Appraise the utilization of marine algae for human consumption.
4. Distinguish various coastal bio-resources for commercial application.
5. Discover marine based products for human welfare.

Unit I: Analytical methods and remote sensing **18 Hours**

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#.

Unit II: Collection, cultivation and mass production **18 Hours**

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.*

Unit III: Utilization of marine algae **18 Hours**

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.

Unit IV: Marine bioresources **18 Hours**

Costal Bioresources – Bioresource profile, wild bioresources – food, feed, fodder, fire wood, timber, medicinal products, potential genetic resources and #ornamentals#.

Unit V: Marine based products **18 Hours**

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, emulsifier and marine toxins. Household products – cosmetics, masks, body gels, creams and shampoos, hair conditioner, shaving products and skin cleaner.

#.....# Self-Study portion

Text Books:

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.

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
I	20PBO1DE1A			Applied Marine Botany			5		5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓			✓	✓
CO2	✓	✓	✓		✓	✓			✓	✓
CO3	✓	✓	✓		✓	✓		✓	✓	✓
CO4	✓	✓	✓		✓	✓		✓	✓	✓
CO5	✓	✓	✓		✓	✓		✓	✓	✓
Number of Matches = 38, Relationship: High										

Prepared by: **Checked by:**

1. Dr. M. Ghouse Basha Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1DE1B	DSE – I#	Agricultural Microbiology	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Appraise the significance of microorganisms in agriculture.
2. Recognize the nitrogen assimilation, phosphate mobilization and microbial growth hormones for plant growth promotion.
3. Identify the different forms of biofertilizers and their application.
4. Formulate biofertilizers and biopesticides based on choice of selection for commercialization.
5. Evaluate the biocontrol of phytopathogens through siderophores, antibiotics and enzymes produced by growth promoting microorganisms.

Unit I: Role of microbes in agriculture **18 Hours**

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. #Commercialization of microbes: present and future prospects#.

Unit II: Plant growth promotion by microbes **18 Hours**

#Nitrogen cycle#, biological nitrogen fixation – Endophytic nitrogen fixer's, facultative and obligate endophytic diazotrophs. 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.

Unit III: Microbial inoculants **18 Hours**

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.

Unit IV: Microbial pesticides **18 Hours**

Bacterial pesticides – *Bacillus popilliae*, *Bacillus lentimopus* and #*Bacillus thuringiensis*#. Fungal pesticides –Entomopathogenic fungi: *Metarhizium anisopliae*, *Verticillium lecanni*, *Hirsutella thompsonii* and *Nomurae arileyi*. Viral pesticides – Granulosis, nuclear polyhedrosis, cytoplasmic polyhedrosis and genetically engineered viruses. Biocontrol of plant pathogens – Mycoherbicides, siderophores, antibiotics and enzymes.

Unit V: Mass production of bioinoculants **18 Hours**

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).

#.....# Self-Study portion

Text Books:

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.

Books for Reference:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
I	20PBO1DE1B			Agricultural Microbiology			6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓			✓	✓
CO2	✓	✓	✓		✓	✓			✓	✓
CO3	✓	✓	✓		✓	✓		✓	✓	✓
CO4	✓	✓	✓		✓	✓		✓	✓	✓
CO5	✓	✓	✓		✓	✓		✓	✓	✓
Number of Matches = 38, Relationship: High										

Prepared by: **Checked by:**

1.Dr. M. Ghouse Basha 1.Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBO2CC5	Core – V	Cell and Molecular Biology	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Identify the structural organization and function of organelles of a cell.
2. Appraise the structure, function and transport mechanism of cell membrane.
3. Summarize the genetic material of an organism and replication process in prokaryotes and eukaryotes.
4. Analyse the signalling, communication and mechanism of a cell.
5. Systematize the mechanism of transcription, translation in prokaryotes and eukaryotes.

Unit I: Cell and cellular organelles **18 Hours**

Cell wall – architecture, macromolecules, biosynthesis and assembly of cell wall, cell wall changes during fruit ripening. #Cell wall as food, feed and fibres#. Cytoplasm matrix, ER system, Golgi-stack (CGN,TGN) network, Dynamics structure and function of nucleus, nuclear pore complex, semiautonomous organelles of the cell, genetic machinery of chloroplast and mitochondria. Biogenesis of 70s, 80s ribosomes. Cytoskeleton and its role in motility.

Unit II: Cell membrane structure and function **18 Hours**

Structure of plasma membrane, Physical and chemical properties, membrane models (unit and fluid mosaic model), FRAP technique, membrane synthesis, membrane protein, diffusion, osmosis, ion channels, active, passive and bulk transport of membrane, membrane pumps, mechanism of sorting and regulation of intracellular transport, electrical properties of membranes. Basement membrane, tight and gap junctions. Protein trafficking and secretion. #Exocytosis and Endocytosis#.

Unit III: Nucleic Acid **18 Hours**

#Structure and types of chromosomes#, heterochromatin and euchromatin. Nucleosome and histone. Molecular structure of DNA, 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 (Messelson and Stahl's experiment on *E.coli*) and Eukaryotes (Taylor's experiment on *Viciafaba*), uni and bi-directional replication. Mechanism of proof reading. Biochemical mechanism of DNA damage and repair. Structure of RNA, genetic and non-genetic RNA (mRNA, tRNA, rRNA).

Unit IV: Cell communication and signalling **18 Hours**

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 signalling pathways, mechanism and cellular response to environmental and hormonal and light signalling in plants. #Programmed cell death (PCD)#.

Unit V: Regulation of gene action **18 Hours**

Regulation of gene expression in prokaryotic genome, transcription level, operon hypothesis, principles of *lac*, *ara* and *trp* operon in *E.coli*, translation and post translation level (feedback inhibition). Regulation of gene expression in eukaryotes at the level of genome. Gene silencing– Transcription algene silencing (TGS), post transcriptional gene silencing (PTGS), RNA interference (RNAi). Translation level and post translation modification of protein. Brief account of transcriptomics, Hormonal control of gene expression.

#.....# Self Study Portion

Text Books:

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.

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**			**Hours**		**Credits**	
II	20PBO2CC5		Cell and Molecular Biology			6		5	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓	✓	✓		✓	✓		
CO2	✓	✓	✓	✓	✓		✓	✓		
CO3	✓	✓	✓	✓	✓		✓	✓		
CO4	✓	✓	✓	✓	✓		✓	✓		
CO5	✓		✓	✓	✓		✓	✓		
Number of Matches = 33, Relationship: Moderate										

Prepared by: **Checked by:**

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

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBO2CC6	Core – VI	Anatomy, Embryology and Forensic Botany	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Analyze different type of tissue systems and its organization.
2. Review the physical and chemical properties, types and preservation of wood for the better utilization.
3. Systematize male and female gametophyte development and their sexual incompatibilities.
4. Recognize forensic importance of different parts of a plant.
5. Collect, preserve and analyze botanical evidences for forensic science.

Unit I: Anatomy **18 Hours**

#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.

Unit II: Wood anatomy **18 Hours**

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, sandwich and board, compressed, impregnated and compregnated wood, chemically modified and densified wood.

Unit III: Embryology **18 Hours**

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 sacs (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#.

Unit IV: Introduction of forensic botany **18 hours**

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.

Unit V: Application of forensic botany **18 hours**

Various types of Planktons, diatoms, pollen grains and their forensic importance. Poisonous plants (*Aconitum*, *Atropa* and *Cinchona*), 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. Protection of illegal exports of rare, endangered and threatened medicinal plants and their dried powders by using fluorescent, DNA sampling analysis and drug enforcement.

#.....# Self-Study portion

Text Books:

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

Books for Reference:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**		**Hours**			**Credits**	
II	20PBO2CC6			Anatomy, Embryology and Forensic Botany		6			5	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓			✓	✓			
CO2	✓	✓	✓			✓	✓	✓		
CO3	✓	✓	✓			✓	✓			
CO4	✓	✓	✓		✓	✓		✓		✓
CO5	✓	✓	✓		✓	✓		✓		✓
Number of Matches = 30, Relationship: Moderate										

Prepared by: **Checked by:**

1. Dr. A. Aslam 1. Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBO2CC7	Core – VII	Genetics and Plant Breeding	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Describe the principles of genetics and their interaction.
2. Analyse the changes occurs in chromosomes correlate with disease syndrome.
3. Calculate the modifications of alleles and genotype change over time within and between populations.
4. Recognize the fundamentals of crop improvement through plant breeding.
5. Practice the biotechnological techniques for crop improvement.

Unit I: Transmission Genetics **18 Hours**

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 and pedigree analysis, linkage and mapping in eukaryotes.

Unit II: Cytogenetics **18 Hours**

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.

Unit III: Population and conservation genetics **18 Hours**

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.

Unit IV: Plant breeding **18 Hours**

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.

Unit V: Ploidy breeding **18 Hours**

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.

#.....# Self-Study portion

Text Books:

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.

Books for Reference:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
II	20PBO2CC7			Genetics and Plant Breeding				6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓	✓	✓			✓
CO2	✓			✓	✓	✓	✓			✓
CO3	✓			✓	✓	✓	✓	✓		✓
CO4	✓			✓	✓	✓	✓			✓
CO5	✓			✓	✓	✓	✓	✓		✓
Number of Matches = 32, Relationship: Moderate										

Prepared by: **Checked by:**

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

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
II	20PBO2CC8P	Core – VIII	Laboratory course for core V, VI and VII – Practical	6	4	100	20	80

Course Outcomes:

At the end of the course, students will be able to

1. Examine various stages of cells in specimens.
2. Demonstrate basic experiments related to DNA.
3. Systematize internal organization of plant.
4. Appraise various reproductive features & their uses.
5. Solve problems related to genetics and able to demonstrate techniques related to plant breeding.

List of Practicals

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.

Text Books:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**	**Credits**
II	20PBO2CC8P			Laboratory course for core V, VI and VII– Practical				6	4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓		✓	✓		✓
CO2	✓	✓			✓		✓	✓		✓
CO3	✓	✓			✓		✓	✓		✓
CO4	✓	✓			✓		✓	✓		✓
CO5	✓	✓			✓		✓	✓		✓
Number of Matches = 30, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. H. Syed Jahangir Dr. A. Aslam

Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
II	20PBO2DE2A	DSE – II#	Floriculture for Entrepreneurship and Export	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Recognize the fundamentals of floriculture.
2. Employ various cultivation practices for flowering plants in commercial scale.
3. Generate quality planting material of ornamentals and flowering plants
4. Standardize and practice production, preparation, and packaging of the commercially important cut flowers and flower based decorative products.
5. Validate commercial floriculture as competent filed to start their own enterprise and turn into job creators instead of becoming job seekers.

Unit 1: Fundamentals of Floriculture **18 Hours**

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. #Nursery management#.

Unit 2:Cultivation methods **18 Hours**

Sexual and vegetative propagation methods of commercial flowering plants. Cultivation of flowers – rose, marigold, chrysanthemum, jasmine, dahlia, orchid and crossandra. #Training and pruning of flowering plants#. Ornamental bulbous plant – Cacti, succulents, palms, cycads, ferns and *Selaginella*. Bonsai – Importance and methods of making bonsai.

Unit 3: Cut flower technology **18 Hours**

Cut flowers – Production, packaging, drying and preservation. #Post-harvest technology of cut flowers#. 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.

Unit 4: Floral arrangements and decorations **18 Hours**

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. #Flower arrangements for horticulture shows#.

Unit 5: Entrepreneurship in Floriculture **18 Hours**

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 and #export strategies#.

#.....# Self-Study portion

Text Books:

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.

Books for Reference:

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 Source:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**		**Title of the Paper**		**Hours**		**Credits**			
II	20PBO2DE2A		Floriculture for Entrepreneurship and Export		6		4			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓		✓		✓	✓			✓	
CO2	✓		✓		✓	✓			✓	
CO3	✓		✓		✓	✓	✓		✓	
CO4	✓		✓	✓	✓	✓		✓	✓	
CO5	✓		✓	✓	✓	✓		✓	✓	✓
Number of Matches= 32, Relationship: Moderate										

Prepared by: **Checked by:**

1. Dr. A. Shajahan 1. Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. Marks	Internal marks	External marks
II	20PBO2DE2B	DSE – II#	Horticulture and Greenhouse Technology	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Acquire knowledge about the fundamentals of horticulture.
2. Demonstrate various plant propagation techniques for vegetables, flowers and fruit plants.
3. Employ protected commercial production of vegetables.
4. Design, construct and maintain a greenhouse.
5. Solve problems related to horticultural diseases, nutrition and post-harvest management of vegetable crops and their produce.

Unit I: Fundamentals of horticulture **18 Hours**

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. #Plant protection#.

Unit II: Greenhouse technology **18 Hours**

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 a typical glass house, poly house and net house#. Construction of floors and layout. Automated green houses, microcontrollers, waste water recycling, heating and cooling sources. Environmental control – air, temperature, sunlight, carbon dioxide and relative humidity.

Unit III: Plant propagation **18 Hours**

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. #Induction of rooting, flowering, fruit set and fruit development#.

Unit IV: Greenhouse media and plant protection **18 Hours**

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. #Integrated Pest Management (IPM)#.

Unit V: Commercial horticulture **18 Hours**

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, #packing and logistics#. Processing of fruits for grading, value addition and preservation.

#.....# Self-Study portion

Text Books:

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

Books for Reference:

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.2nd Edition.Agrobios Publishers Pvt Ltd, Rajasthan,India, 2017.

Web Source:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper		Hours			Credits	
II	20PBO2DE2B			Horticulture and Greenhouse Technology		6			4	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓		✓				
CO2	✓			✓		✓	✓		✓	
CO3	✓		✓	✓		✓	✓	✓	✓	
CO4	✓		✓	✓	✓	✓	✓	✓	✓	
CO5	✓		✓	✓	✓	✓	✓	✓	✓	
Number of Matches = 31, Relationship:Moderate										

Checked by:

Prepared by:

1. Dr. A. Shajahan

1. Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max marks	Internal marks	External marks
III	20PBO3CC9	Core – IX	Plant Systematics and Ethnobotany	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Impart knowledge on plant systematics and its applications.
2. Realize the concepts of biosystematics and ICBN.
3. Learn the striking affinities of different families.
4. Familiarize the students with plants having immense economic importance.
5. Recognize the theory and practices involved in ethnobotany.

Unit I: Classification of Angiosperms **18 Hours**

Historical account - classification of angiosperms (classification of Bentham and Hooker, Engler and Prantl, Takhtajan) – outline classification of APG III and APG IV - chemotaxonomy and #numerical taxonomy# – cyber taxonomy (concept and scope) – applications of DNA barcoding.

Unit II: Biosystematics and taxonomical techniques **18 Hours**

Biosystematics – aim, scope, and categories - Principles of ICBN – typification, Principles of priority and their limitations, author citation, #key for identification of plants (indented and bracket key)#, monographs, periodicals, floras and manuals, data banks, molecular tools in taxomomy, cladistics and cladogram, field and herbarium techniques, e- flora and e- herbaria

Unit III: Families of Angiosperms **18 Hours**

Vegetative, floral and economic importance of the following families: Ranunculaceae, Magnoliaceae, Menispermaceae, Caryophyllaceae, Portulacaceae, Rosacea, #Meliaceae#, Sapindaceae, Combretaceae and Aizoaceae.

Unit IV: Families of Angiosperms **18 Hours**

Vegetative, floral and economic importance of the following families: Boraginaceae, Convolvulaceae, Scrophulariaceae, Bignoniaceae, Pedaliaceae, Verbinaceae, Amaranthaceae, Nyctaginaceae, Commelinaceae and #Cyperaceae#.

Unit V: Ethnobotany **18 Hours**

Introduction - Ethnobotany as an emerging science and its scope - basic knowledge of tribes with special reference to Tamil Nadu (kanikkars, kurumbas, irulas, badagas, kothas and todas) – sources and forms of tribal medicines. Outline of Dr. Duke's phytochemical and ethnobotanical database #ethnoveterinary medicines#.

#----------# Self Study Portion

Text Books:

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.

Books for Reference:

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 Source:

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper			Hours			Credits
III	20PBO3CC9			Plant Systematics and Ethnobotany			6			5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓		✓		✓		
CO2	✓	✓	✓	✓		✓		✓		
CO3	✓	✓	✓	✓		✓		✓		
CO4	✓	✓	✓			✓		✓	✓	
CO5	✓	✓	✓			✓		✓	✓	
Number of Matches = 30, Relationship: Moderate										

Prepared by: Dr. A. Shajahan

Checked by: Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PBO3CC10	Core – X	Plant Physiology	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Recognize the transport process of water by the plant.
2. Understand the photophysical and photochemical phase of photosynthesis.
3. Distinguish the various phases of cellular respiration in plants.
4. Analyzes the importance and significances of nitrogen fixation and physiological effect of plant growth hormones.
5 Identify the responses of plants to biotic and abiotic stress.

Unit I: Plant water relations **18 hours**

Water- Structure and properties. Water transport process - diffusion, osmosis, chemical potential, water potential and absorption of water. Mechanism of water transport – Apoplast and symplast concept, Theories of ascent of sap. Transpiration and its types, mechanism of stomatal movement. Transport of nutrients-Membrane permeability, Nutrient uptake and transport mechanism - ion pumps and carriers, active and passive transport, #mechanism of phloem translocation#.

Unit II: Photosynthesis **18 hours**

Photophysical and photochemical phase, Mechanism of electron transport, photoprotective mechanisms; proton transport and ATP synthesis. Light reactions - sequence of photosynthetic pathway, Electron Transport Chain, Photophosphorylation. Photosynthetic carbon reduction cycles - C3, C4 and #CAM pathway#, Classification of C4 plants and their significance.

Unit III: Respiration **18 hours**

Glycolysis, gluconeogenesis and their regulation. Oxidation of pyruvate and TCA cycle. Pasteur effect, anaplerotic reactions, amphibolic nature of the Citric Acid cycle. Respiratory chain complexes and oxidative phosphorylation, unique electron transport enzymes of plant mitochondria, alternate electron pathways in plants and their significance. Pentose phosphate pathway and its importance.

Unit IV: Nitrogen Metabolism and Plant hormones **18 hours**

#Nitrogen cycle#, assimilation of nitrate and ammonium. Nitrogen fixation- asymbiotic and symbiotic. Biosynthesis, storage, breakdown and transport of plant hormones, physiological effects and mechanisms of action of auxins, gibberellins and cytokinins. Physiology of growth retardants - ethylene and abscisic acid. Biological rhythm - circadian rhythm, #photoperiodism#-phytochrome mediated processes.

Unit V: Stress physiology **18 hours**

Responses of plants to biotic and abiotic stress. Mechanisms of resistance to biotic stress and tolerance to abiotic stress #heat stress and adaptation# osmotic adjustment, metal toxicity, chilling and freezing stress, oxygen deficiency and acclimatization, free radicals and oxidative stress, antioxidative defence mechanism, stress proteins and hormones. #Mitigation of oxidative stress#.

#----------# Self Study Portion

Text Books:

1. Taiz L and Zeiger E. Plant Physiology 4th Edition, Sinauer Associates Inc., USA, 2006.
2. Mukherji S and Ghosh AK, Plant Physiology, 1st Central Edition, New Central Book Agency Pvt Ltd, Kolkatta, India, 2009.
3. Pandey SN and Sinha, Plant Physiology 4th Edition, Vikas Publishing Pvt Ltd, New Delhi, India, 2013.

Books for Reference:

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, Chand & Company Pvt Ltd, New Delhi, India, 2012.

Web Source:

1. https://study.com/academy/lesson/what-is-plant-physiology-definition-experiments.html

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**			**Credits**
III	20PBO3CC10			Plant Physiology			6			5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓	✓	✓			✓
CO2	✓	✓			✓	✓	✓			✓
CO3	✓	✓			✓	✓	✓			✓
CO4	✓	✓			✓	✓	✓			✓
CO5	✓	✓			✓	✓	✓			✓
Number of Matches = 30, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. R. Sathish Kumar Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PBO3CC11	Core – XI	Biomolecules, Bioenergetics and Analytical Instrumentation	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Identify the structure, properties and formulation of carbohydrates.
2. Realize the different structure, properties and different configuration of proteins.
3. Summarize the concept of enthalpy, entropy, free energy and standard free energy.
4. Systemize the metabolism of carbohydrates, lipids and proteins.
5. Analyse the various bioinstrumentation which are used detect different biomolecules.

Unit I: Carbohydrates **18 Hours**

Introduction, classification, nomenclature, asymmetry, isomerism and mutarotation. General structure, properties and formulation of monosaccharides - Linear form, Ring form, Fisher's projection and Haworth perspective formula of glucose, fructose and galactose. Oligosaccharaides - Conformation of pyranose and furanose ring, structure and properties of sucrose, maltose, lactose and cellobiose. #Polysaccharides - starch, glycogen, inulin, cellulose, pectin, chitin and hemicellulose#.

Unit II: Protein and Lipids **18 Hours**

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, kinetic analysis of enzyme catalysed reactions, regulation of enzyme activity by nongenetic mechanisms. #Lipids – Classification, structure and properties#. Fatty acids - saturated and unsaturated fatty acids biosynthesis and degradation.

Unit III: Metabolism **18 Hours**

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. Metabolism of triglyceride, phospholipids and cholesterol. Biosynthesis of saturated and unsaturated fatty acids. Protein Metabolism – Catabolism of amino acids - transamination, oxidative and non-oxidative deamination.

Unit IV: Bioenergetics **18 Hours**

Laws of Thermodynamics – first and second law. Concept of enthalpy, entropy, free energy and standard free energy. Endergonic, exergonic reactions and #Coupled reactions#. Determination of ΔG for a reaction. Biological standard state and standard free energy change in coupled reactions. 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.

Unit V: Analytical Bioinstrumentation **18 Hours**

pH and buffers, Measurement of pH - Types of electrodes and their applications. Chromatographic method- Principles and applications of #Thin layer#, HPLC, Gas chromatography. Electrophoresis - Agarose gel electrophoresis, SDS-PAGE, 2D-PAGE and capillary electrophoresis. Spectrophotometry - Principles and applications of UV-VIS, Fluorescence, IR and FTIR, Raman spectroscopy and NMR spectroscopy.

#----------# Self Study Portion

Text Books:

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, USA, 2019.

Books for Reference:

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

Web Source:

1. http://www.unm.edu/~rrobergs/426L4Bioen.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper				Hours		Credits
III	20PBO3CC11			Biomolecules, Bioenergetics and Analytical Instrumentation				6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓	✓	✓	✓		✓
CO2	✓	✓		✓	✓	✓	✓	✓		✓
CO3	✓	✓		✓	✓		✓	✓		✓
CO4	✓	✓		✓	✓		✓	✓		✓
CO5	✓	✓		✓	✓		✓	✓		✓
Number of Matches = 37, Relationship: High										

Prepared by: **Checked by:**

Dr. R. Sathish Kumar Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PBO3CC12P	Core – XII	Laboratory course for core IX, X and XI – Practical	6	4	100	20	80

Course Outcomes:

At the end of the course, students will be able to

1. Identify the family, genus, species, and morphology of the useful parts and uses of the tribal medicinal plants.
2. Understand the water potential determination, physical and chemical treatments on membrane permeability.
3. Estimate the content of chlorophyll, carotenoids and their absorption spectra in C3 and C4 plants.
4. Analyses the preparation methods of molal, molar, normal and percentage solutions and their dilutions.
5. Interpret the Rf values of amino acids/pigments by paper/thin layer chromatography.

List of Practical's

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.

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
Ficu sbenghalensis – Aal
Catharanthus roseus– Suddukattumalli
Cissusqua drangularis– Perandai
Cassia auricualta– Avarai
Chloroxylon swietenia- Mamarai
Boerhaavia diffusa– Mookirattai
Asparagus racemosus– Thaneervitankilangu
Tribulus terrestris- Sirinerinji
Enicostemma littorale- Vellarugu

C. Plant Physiology:

1. Determination of water potential by gravimetric method.
2. Effect of various physical and chemical treatments on membrane permeability.
3. Determination of stomatal index
4. Estimation of chlorophyll, carotenoids and their absorption spectra in C3 and C4 plants.
5. Separation and identification of amino acids/pigments by paper/thin layer chromatography and calculating the Rf values
6. Assay of nitrate reductase activity.
7. Estimation of phenols in plant tissues.
8. Assay of peroxidase activity in plant tissues.

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
6. Determination of km-value, V-max, Michael's constant for amylase
7. Determination of dissociation constant of weak acids
8. Protein profile study by SDS-PAGE in plant materials.

Text Books:

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
III	20PBO3CC12P			Laboratory course for core IX, X and XI - Practical			6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓			✓	✓	✓	✓	✓		✓
CO2	✓			✓	✓	✓	✓	✓		✓
CO3	✓			✓	✓	✓	✓	✓		✓
CO4	✓			✓	✓	✓	✓	✓		✓
CO5	✓			✓	✓	✓	✓	✓		✓
Number of Matches = 35, Relationship: High										

Prepared by: **Checked by:**

Dr. A. Shajahan Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
III	20PBO3DE3A	DSE – III#	Biostatistics and Bioinformatics	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Demonstrate various numerical and graphic description of statistical data.
2. Identify the patterns and types of data distribution in biological world.
3. Make inference about the validity of the data collected in various surveys and experiments to support the decision-making process.
4. Appraise the organization and usage of various biological databases.
5. Develop analytical skills in biostatistics and bioinformatics.

Unit I: Descriptive statistics **18 Hours**

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#.

Unit II: Probability distribution **18 Hours**

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).

Unit III: Inferential statistics **18 Hours**

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.

Unit IV: Biological databases **18 Hours**

Bioinformatics - an overview, role of internet. Primary nucleotide sequence databases- Gene 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#, PDB and GBIF. Data retrieval using Entrez and SRS. #Biodiversity database – Mangrove® and Biotik® (brief account)#. Big data management in biology.

Unit V: Biological sequence data analysis **18 Hours**

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 - #RNA secondary structure#. Pair wise sequence comparison - Scoring matrix, Dynamics programming,

Heuristic methods – FASTA, BLAST. Multiple sequence alignments –Phylogenetic alignment. #Protein structure visualization tools –RasMol#, Swiss PDB Viewer.

#.....# Self-Study portion

Text Books:

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.

Books for Reference:

1. Misra BN and Misra MK, Introductory Practical Biostatistics, 1st Edition, Naya Prokash Pvt Ltd, Calcutta, India, 1983.
2. David W, Mount, Bioinformatics - Sequence and genome analysis, 1st Edition, Cold Spring Harbor Laboratory Press, New York, 2001.

Web source:

1. https://www.who.int/ihr/lyon/surveillance/biostatistics/en/
2. https://www.ncbi.nlm.nih.gov/
3. https://www.rcsb.org/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	Code			Title of the Paper				Hours		Credits
III	20PBO3DE3A			Biostatistics and Bioinformatics				6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓	✓			✓		✓
CO2	✓	✓		✓	✓			✓		✓
CO3	✓	✓		✓	✓			✓		✓
CO4	✓	✓		✓	✓			✓		✓
CO5	✓	✓		✓	✓			✓		✓
Number of Matches = 30, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. A. Aslam Dr. M. Ghouse Basha

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max marks	Internal marks	External marks
IV	20PBO3DE3B	DSE – III#	Biodiversity and Conservation	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Explain the Evolutionary mechanisms and Speciation concepts.
2. Describe the fundamentals of biodiversity.
3. Recognize the values of biodiversity.
4. Evaluate the impact of biodiversity and its causes.
5. Identify the different methods of conservations.

Unit I: Evolution and Speciation: 18 Hours

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#.

Unit II: Biodiversity 18 Hours

Definition, Plant, Animal and Microbial Diversity; Types – Genetic, Species and Ecosystem diversity; Benefits, Importance and Loss of Biodiversity – centres of Diversity - Mega diversity canters, centres of Origin of Diversity, Hotspots. #Concepts of Endemism#.

Unit III: Importance of Biodiversity 18 Hours

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#.

Unit IV: Threats to Biodiversity 18 Hours

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.

Unit V: Conservation of Biodiversity 18 Hours

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. Forest Management Techniques - sustainable utilization. Organizations involved for conservation - CBD, #IUCN#, UNESCO, NBPGR, WWF, FAO, CITS, and TKDL.

#.....# Self-Study portion

Text Books:

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 Edition, Oxford & IBH Publishing Pvt Ltd, New Delhi, India, 2018.

Books for Reference:

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, 1oth Edition, Springer, 2012.

Web Reference:

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/

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**			**Credits**
IV	20PBO3DE3B			Biodiversity and Conservation			6			4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓	✓		✓		✓
CO2	✓	✓			✓	✓		✓		✓
CO3	✓	✓			✓	✓		✓		✓
CO4	✓	✓			✓	✓		✓		✓
CO5	✓	✓			✓	✓		✓		✓
Number of Matches = 30, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. B. Balaguru Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max marks	Internal marks	External marks
IV	20PBO4CC13	Core – XIII	Plant Ecology and Conservation Biology	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Understand and describe the fundamentals and components in Ecology.
2. Explain and reflect about the different characteristic of populations and ecological niche concepts.
3. Demonstrate concepts of biogeography, diversity and distribution of plants in various geographical regions.
4. Apply ways to minimise and avoid major threats to biodiversity and impact of climate change on it.
5. Identify the different approaches conservation methods and adopt to implement.

Unit I: Basics of Ecology **18 Hours**

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#.

Unit II: Population Ecology **18 Hours**

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#.

Unit 3: Biogeography **18 Hours**

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, centers 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#.

Unit 4: Climate change and Global Biodiversity Patterns **18 Hours**

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#.

Unit 5: Approaches in Conservation **18 Hours**

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.

#.....# Self-Study portion

Text Book:

1. Shukla RS and Chandel PS, A Textbook of Plant Ecology. 3rd Edition, Chand & Company Pvt Ltd, New Delhi, India, 2005.
2. Das PC, Plant Ecology, 1st Edition, AITBS Pvt Ltd, New Delhi, India, 2007.
3. Ambasht RS and Ambasht NK, A Textbook of Plant Ecology, 15th Edition, CBS Publishers & Distributors Pvt Ltd, New Delhi, India, 2017.

Books for Reference:

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 Source:

1. https://open.oregonstate.education/rangeland/chapter/chapter-3-population-ecology/
2. https://sangu.ge/images/EssentialsofEcology.pdf

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**		**Hours**			**Credits**	
IV	20PBO4CC13			Plant Ecology and Conservation Biology		6			5	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓		✓		✓
CO2	✓	✓	✓		✓	✓		✓		✓
CO3	✓	✓			✓	✓		✓		✓
CO4	✓	✓		✓	✓	✓		✓		✓
CO5	✓	✓		✓	✓	✓		✓		✓
Number of Matches = 34, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. B. Balaguru Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max marks	Internal marks	External marks
IV	20PBO4CC14	Core – XIV	Plant Biotechnology	6	5	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Describe the scope and importance of biotechnology.
2. Choose and design desired enzymes and cloning vehicles for genetic engineering.
3. Recognize different gene transfer methods and analysing techniques.
4. Utilize and develop plant-based products for social welfares.
5. Distinguish about biosafety, IPR and patents of biological products.

Unit I: Plant Tissue Culture **18 Hours**

Brief history of plant tissue culture, cell culture, culture of isolated single cells, clonal propagation, protoplast culture and somatic hybridization, cybrids, production of haploid plants, #somaclonal variation#, germplasm conservation and cryopreservation.

Unit II: Molecular scissors and cloning vehicles **18 Hours**

Restriction endonuclease, ligase, phosphonucleotide kinase, terminal deoxynucleotidyl transferase, S1 nuclease, DNA polymerase I holenzyme and I klenow fragment, T4 and Taq DNA polymerase, RHase H, reverstranscriptase, poly-A polymerase, deoxyribonuclease, exonuclease III. Bacteriophage, cosmids, phagmids #Ti and Ri plasmid#, caulimoviruses, minichromosomes, shuttle and expression vectors. Gene cartridges and synthetic regulator sequences.

Unit III: Gene transfer techniques **18 Hours**

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 imbibitions. Chloroplast transformation. Marker genes for plant transformations, Promotors and terminators.

Unit IV: Molecular pharming **18 Hours**

Metabolic engineering of carbohydrates – starch, cyclodextrins, polyfructans, trehalose. Lipids – improvement of plant oils, production of shorter and longer fatty acids. Bioplastics. Molecular pharming of proteins – Hirudin production from Brassica napus and therapeutic important proteins. Industrial enzymes – Trypsin, cellulose and α-amylase. #Plant derived vaccines#.

Unit V: Regulatory issues in biotechnology **18 Hours**

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. Ecological and environmental impact risk assessment of transgenic crops and safety assessment of recombinant organisms.

#.....# Self-Study portion

Text Books:

1. Satyanarayana U, Biotechnology. 1st Edition. Books and Allied Pvt Ltd. Kolkata, India, 2008.
2. Verma PS and Agarwal VK, Genetic engineering, 1st Edition, Chand & Company Pvt Ltd, New Delhi, India, 2009.
3. Dubey RC, A text book of biotechnology, 5th Edition, Chand & Company Pvt Ltd, New Delhi, India, 2014.

Books for Reference:

1. Slater A, Scott WN and Fowler MR, Plant biotechnology: The genetic manipulation of plants, 2nd Edition, Oxford university press, New York, 2008.
2. Thieman WJ and Palladio MA, Introduction to Biotechnology, 4th Edition, Pearson College Division, New York, 2018.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
IV	20PBOCC14			Plant Biotechnology			**6**		**5**
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓		✓	✓		
CO2	✓	✓	✓				✓	✓		
CO3	✓	✓	✓		✓		✓	✓		
CO4	✓	✓	✓	✓	✓		✓	✓		
CO5	✓	✓	✓	✓	✓		✓	✓	✓	
Number of Matches = 33, Relationship: Moderate										

Prepared by: **Checked by:**

Dr. N. Ahamed Sherif Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max marks	Internal marks	External marks
IV	20PBO4CC15P	Core – XV	Laboratory course for core XIII and XIV – Practical	6	5	100	20	80

Course Outcomes:

At the end of the course, students will be able to

1. Comprehend different methods of analysis of vegetation and environmental samples.
2. Demonstrate knowledge of methods in plant ecology.
3. Evaluate the methods to interpret the data pertaining to plant ecology.
4. Exploit the knowledge on isolation and quantification of DNA.
5. Acquire knowledge in constructing map of cloning vectors.

List of Practical's

A. Plant Ecology and Conservation Biology

1. Analysis of vegetation – Quadrat, Line transect methods, Point frame method, Belt transect
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. Demonstration of PCR for amplification of DNA.
4. Demonstration for construction of partial genomic DNA library of *E.coli* chromosomal DNA (Size: 1.5 – 2.5 kbp) using Bam H1 to restrict the DNA and pUC 18 as a vector.

Text Books:

1. Trivedy RK, Gokul PK and Trisal CL, Practical methods in ecology and environmental science, 1st Edition, Environmental Publications, Karad, India, 1987.

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

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**				**Hours**		**Credits**
IV	20PBO4CC15P			Laboratory course for core XIII and XIV – Practical				6		5
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓			✓		✓	✓		✓
CO2	✓	✓			✓		✓	✓		✓
CO3	✓	✓			✓		✓	✓		✓
CO4	✓	✓			✓		✓	✓		✓
CO5	✓	✓			✓		✓	✓		✓
Number of Matches = 30, Relationship: Moderate										

Prepared by:

Dr. N. Ahamed Sherif

Dr. B. Balaguru

Checked by:

Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
IV	20PBO4DE4A	DSE – IV#	Plant tissue culture and secondary metabolites production	6	4	100	25	75

Course Outcomes:

At the end of the course, students will be able to

1. Gain the knowledge on important techniques about plant tissue culture.
2. Apply somatic embryogenesis techniques and cryopreservation.
3. Develop and apply genetic transformation protocols.
4. Gain fundamental knowledge of metabolic engineering of secondary metabolites.
5. Enumerate the types of bioreactors and its commercial application.

Unit I: Basic plant tissue culture **18 Hours**

Concept, Technique and applications of plant tissue culture. Explant preparation and sterilization, culture media, an appraisal of different media, selection of media and role of growth regulators - Auxins, Gibberellins, Cytokinins, Abscisic Acid and Ethylene. #Basic procedure for aseptic tissue transfer#.

Unit II: Micropropagation **18 Hours**

Micropropagation - methods and importance of plant regeneration - organogenesis and somatic embryogenesis. #Callus culture#, Meristem, shoot tip culture and virus elimination, synthetic seeds, germplasm conservation and cryopreservation. Application of micropropagation in agriculture and forestry.

Unit III: Transgenic production **18 Hours**

Strategies of transgenic production – Basic concepts of gene / DNA and traits, Identification and isolation of genes for specific traits, designing of gene constriction for transformation, selection and regeneration of plants. Herbicide and insect resistant transgenic plants. #Flavor saver tomato and Bt cotton#.

Unit IV: Fundamentals of metabolic engineering **18 Hours**

Application of cell culture systems in metabolic engineering-advantages of cell, tissue and organ culture as a source of secondary metabolites-hairy root culture, Upstream and downstream process #screening of high yielding cell lines# - procedures for extraction of high value industrial products.

Unit V: Bioreactors and biotransformation **18 Hours**

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 and #Edible vaccines#. Scale-up procedures in bioreactors. Commercial production of shikonin and vinblastine.

#----------# Self Study Portion

Text Books:

1. Dubey RC, A Textbook of Biotechnology, 3rd Edition, Chand & Company Pvt Ltd, New Delhi, 2006.
2. Kumar S, Sweta M and Mishra AP, Plant tissue culture: Theory and Techniques, 1st Edition, Scientific Publishers Journals Pvt Ltd, New Delhi, India, 2009.
3. Purohit SD, Introduction to plant cell, tissue and organ, 1st Edition, PHI Learning Pvt Ltd, New Delhi, India, 2013.

Books for Reference:

1. Satyanarayana U, Biotechnology. 1st Edition. Books and Allied Pvt Ltd. Kolkata, India, 2008.
2. Razdan MK, Introduction to plant tissue culture, 3nd Edition, Oxford & IBH Publishing Co Pvt Ltd, New Delhi, India, 2019.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**
IV	20PBO4DE4A			Plant tissue culture and secondary metabolites production			6		4
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓		✓		✓	✓	✓		✓
CO2	✓	✓		✓		✓	✓	✓		✓
CO3	✓	✓		✓		✓	✓	✓		✓
CO4	✓	✓		✓			✓	✓		✓
CO5	✓	✓		✓			✓	✓		✓
Number of Matches = 33, Relationship: Moderate										

Prepared by:
Dr. K. Mohamed Rafi

Checked by:
Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External Marks
IV	20PBO4DE4B	DSE – IV#	Marine Ecology	6	4	25	75	100

Course Outcomes:

At the end of the course, students will be able to

1. Describe the physical and biotic factors of ocean environment.
2. Enumerate the chemical processes in marine environment.
3. Understand and conserve the rich microbial bio-resources of marine ecosystem.
4. Relate the importance of mangroves to the coastal ecosystem stability.
5. Develop strategies to mitigate the marine pollution.

Unit I: Physical Oceanography and Biotic Factors **18 Hours**

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.

Unit II: Marine Chemistry **18 Hours**

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.

Unit III: Microbial Ecology **18 Hours**

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#.

Unit IV: Biodiversity of Mangroves **18 Hours**

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.

Unit V: Marine Pollution and Conservation of Mangrove Ecosystem **18 Hours**

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.

#.....# Self-Study portion

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.

Relationship Matrix for Course Outcomes, Programme Outcomes and Programme Specific Outcomes:

Semester	**Code**			**Title of the Paper**			**Hours**		**Credits**	
IV	20PBO4DE4B			Marine Ecology			6		4	
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓		✓	✓		✓	✓	✓
CO2	✓	✓	✓		✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓		✓	✓	
CO4	✓	✓	✓		✓	✓		✓	✓	
CO5	✓	✓	✓		✓	✓		✓	✓	✓
Number of Matches = 37, Relationship: High										

Prepared by: **Checked by:**

Dr. N. Ahamed Sherif Dr. A. Aslam

Note:

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very poor	Poor	Moderate	High	Very High