

**M.Sc. Botany**

SEM	Course Code	Course	Course Title	Ins. Hrs / Week	Credit	Exam Hrs	Marks		Total
							CIA	ESE	
I	20PBO1CC1	Core Course – I	Plant Diversity I (Thallophytes and Bryophytes)	6	5	3	25	75	100
	20PBO1CC2	Core Course – II	Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	6	5	3	25	75	100
	20PBO1CC3	Core Course – III	Microbiology, Plant Pathology and Immunology)	6	4	3	25	75	100
	20PBO1CC4P	Core Course – IV	Laboratory Course for Core I, II and III	6	4	3	25	75	100
	20PBO1DE1	DSE – I#		6	4	3	25	75	100
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
II	20PBO2CC5	Core Course – V	Cell and Molecular Biology	6	5	3	25	75	100
	20PBO2CC6	Core Course – VI	Anatomy, Embryology and Forensic Botany	6	5	3	25	75	100
	20PBO2CC7	Core Course – VII	Genetics and Plant Breeding	6	4	3	25	75	100
	20PBO2CC8P	Core Course – VIII	Laboratory Course for Core V, VI and VII	6	4	3	25	75	100
	20PBO2DE2	DSE – II#		6	4	3	25	75	100
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
III	20PBO3CC9	Core Course – IX	Plant Systematics and Ethnobotany	6	5	3	25	75	100
	20PBO3CC10	Core Course – X	Plant Physiology	6	5	3	25	75	100
	20PBO3CC11	Core Course – XI	Biomolecules, Bioenergetics and analytical instrumentation	6	4	3	25	75	100
	20PBO3CC12P	Core Course – XII	Laboratory Course for Core IX, X and XI	6	4	3	25	75	100
	20PBO3DE3	DSE – III#		6	4	3	25	75	100
	20PBO3EC1	Extra Credit Course – I	Online Course (MOOC)	-	1*	-	-	-	-
	<b>TOTAL</b>				<b>30</b>	<b>22</b>			
IV	20PBO4CC13	Core Course – XIII	Plant Ecology and Conservation Biology	6	5	3	25	75	100
	20PBO4CC14	Core Course – XIV	Plant Biotechnology	6	5	3	25	75	100
	20PBO4CC15P	Core Course – XV	Laboratory Course for Core XIII and XIV	6	5	3	25	75	100
	20PBO3DE4	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*
	<b>TOTAL</b>				<b>30</b>	<b>24</b>			
<b>GRAND TOTAL</b>					<b>90</b>				<b>2000</b>

\*Not considered for grand total and CGPA

**#Discipline Specific Elective**

SEM	Course Code	Course Title
I	20PBO1DE1 A/B	<b>A. Applied Marine Botany (or)</b> B. Agricultural Microbiology
II	20PBO2DE2 A/B	<b>A. Floriculture for Entrepreneurship and Export (or)</b> B. Horticulture and Greenhouse Technology
III	20PBO3DE3 A/B	<b>A. Biostatistics and Bioinformatics (or)</b> B. Biodiversity and Conservation
IV	20PBO3DE4 A/B	<b>A. Plant Tissue Culture and Secondary Metabolites Production (or)</b> 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:

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, thalloganization, 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 andclassification 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. Sharma OP, A Text Book of Algae, 1<sup>st</sup> Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, India, 2011.
2. Vashishta BR, Sinha AK and Kumar A, Botany for Degree Students: Bryophyta, 9<sup>th</sup> Edition, Chand and Company Pvt Ltd, New Delhi, India, 2004.
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, 4<sup>th</sup> Edition, Wiley Publishers Pvt Ltd, New Delhi, India, 2007.
2. Arthur Jonathan S, Bryophyte Biology, 2<sup>nd</sup> Edition, Cambridge University Press Pvt Ltd, United Kingdom, 2008.

**Web Reference:**

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:**

DR. M. KAMARAJ

**Checked by:**

DR. A. ASLAM

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:

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*#.

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

**Books for Reference:**

1. Rashid A, An Introduction to Pteridophytes, Diversity, Development and Differentiation, 2<sup>nd</sup> Edition, Vikas Publishing House Pvt Ltd, Noida, UP, India, 2013.
2. Bhatnagar SP and Moitra A, Gymnosperms, 5<sup>th</sup> Edition, New Age International Publishers Pvt Ltd, New Delhi, India, 2013.

**Web Reference:**

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:**

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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:

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 9<sup>th</sup> 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. Phytopathological 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. Immunodiffusion: 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, 1<sup>st</sup> Edition, Oxford University Press Pvt Ltd, New Delhi, India, 2006.
2. Dubey RC and Maheshwari DK, A Text Book of Microbiology, Revised Edition, Chand and Company Limited Pvt Ltd, New Delhi, India, 2017.
3. Mehrotra RS and Aggarwal A, Plant Pathology, 3<sup>rd</sup> Edition, McGraw Hill Education (India) Company Pvt Ltd, New Delhi, India, 2017.

**Books for Reference:**

1. Anathanarayan R and Jayaram Paniker CK, Text Book of Microbiology, 10<sup>th</sup> Edition, Universities Press (India) Pvt Ltd, New Delhi, India, 2017.
2. Willey JM, Sherwood LM and Woolverton CJ, Prescott's Microbiology, 10<sup>th</sup> Edition, McGraw Hill Education Pvt Ltd, New York, 2017.
- 3.

**Web Reference:**

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:**

1. DR. H. SYED JAHANGIR

**Checked by:**

1. DR. A. ASLAM



Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20PBO1CC4	Core – IV	LABORATORY COURSE FOR CORE I, II, AND III	6	4	100	25	75

### Course Outcomes:

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

### 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).

### 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.

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

Semester	Code	Title of the Paper					Hours	Credits			
I	20PBO1CC4	LABORATORY COURSE FOR CORE I, II, AND III					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:**

DR. H. SYED JAHANGIR

DR. M. KAMARAJ

**Checked by:**

DR. A. ASLAM

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:**

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 HomePvt Ltd, Delhi, India, 1987.
2. Swaminathan MS, Bio-resources status in selected coastal locations, 1<sup>st</sup> Edition, National Bioresource Development Board, Department of Biotechnology, Government of India, 2003.
3. Tiwary B and Troy D, Seaweed sustainability, 1<sup>st</sup> Edition, Academic Press BooksPvt Ltd, Elsevier, United States, 2015.

**Books for Reference:**

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

**Web Reference:**

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

Semester	Code		Title of the Paper			Hours	Credits			
I	20PBO1DEA1		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:**

1. DR. M. GHOUSE BASHA

**Checked by:**

DR. A. ASLAM

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:

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*, *Azospirillum* and arbuscular mycorrhizal fungi. Microorganism aiding plant phosphorous nutrients. #Cyanobacteria as fertilizers#. Brief account on organic fertilizers, integrated nutrients management and supply system.

Bacterial pesticides – *Bacillus popilliae*, *Bacillus lentimopus* and *Bacillus thuringiensis*<sup>#</sup>. Fungal pesticides – Entomopathogenic fungi: *Metarhiziumanisopliae*, *Verticilliumlecanii*, *Hirsutellathompsonii* and *Nomuraearileyi*. 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*, *Azospirillum*, Phosphobacteria, cyanobacteria, *Bacillus thuringiensis* and *Trichoderma*<sup>#</sup>. Criteria for strain selection, steps for preparing bioinoculants (Seed pelleting, inoculant carriers and quality standard for inoculants).

**#.....# Self-Study portion****Text Books:**

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

**Books for Reference:**

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

**Web Reference:**

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:**

1.DR. M. GHOUSE BASHA

**Checked by:**

1. DR. A. ASLAM

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:

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 *Vicia faba*), 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—Transcriptional gene 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. Paul A, Text Book of Cell and Molecular Biology, 4<sup>th</sup> Edition, Books and Allied Pvt Ltd, Kolkatta, India, 2011.
2. Hancock JT, Cell Signalling, 4<sup>th</sup> Edition, Oxford University Press Pvt Ltd, New Delhi, India 2016.
3. Verma PS and Agarwal VK, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, Revised Edition, Chand and Company Pvt Ltd, New Delhi, India, 2004.

**Books for Reference:**

1. Buchanan BB, Gruissem W and Jones RL, Biochemistry and Molecular biology of Plants, 2<sup>nd</sup> Edition, Wiley-Blackwell Pvt Ltd, New Delhi, India, 2015.
2. Freifelder D, Molecular Biology, 4<sup>th</sup> Edition, Narosa Publishing House Pvt Ltd, New Delhi, India, 2004.
3. Rastogi VB, Principles of Molecular Biology, 2<sup>nd</sup> Edition, Scientific International Pvt. Ltd, New Delhi, India, 2016.

**Web Reference:**

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:**

1. DR. H. SYED JAHANGIR

**Checked by:**

1. Dr. A. ASLAM

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:

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#.

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, 1<sup>st</sup> Edition, CRC Press Pvt Ltd, Taylor and Francis Group, United Kingdom, 2004.
2. Pandey SN and Chandha A, Plant anatomy and Embryology, 1<sup>st</sup> Edition, Vikas Publishing House Pvt Ltd, New Delhi, India, 2009.
3. Wilson K and White DJB, The Anatomy of Wood: Its diversity and Variability, 2<sup>nd</sup> Edition, Stobart and Davies Pvt Ltd, Ammanford, United Kingdom, 2006.

**Books for Reference:**

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

**Web Reference:**

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:**

1. DR. A. ASLAM

**Checked by:**

1. DR. A. ASLAM

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:

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, #hybridizationtechnique#.Heterosis – Genetic and physiological causes of heterosis.

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, 1<sup>st</sup> Edition, Oxford Book Company Pvt Ltd, New Delhi, India, 2009.
3. Robert W Allard, Principles of Plant Breeding, 2<sup>nd</sup> Edition, Wiley Pvt Ltd, New Delhi, India, 2018.

### Books for Reference:

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

### Web Reference:

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:

1. DR. H. SYED JAHANGIR

Checked by:

1. DR. A. ASLAM

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	6	4	100	25	75

### Course Outcomes:

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.

### 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.

### 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*, *Begonia*, *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.



## 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.
- 4.
5. 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					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:**

DR. H. SYED JAHANGIR

DR. A. ASLAM

**Checked by:**

DR. A. ASLAM

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:

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

**Books for Reference:**

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

**Web Reference:**

1. [http://www.apeda.gov.in/apedawebsite/SubHead\\_Products/Floriculture.htm](http://www.apeda.gov.in/apedawebsite/SubHead_Products/Floriculture.htm).
2. [https://agriexchange.apeda.gov.in/index/Product\\_description\\_32head.aspx?gcode=0101](https://agriexchange.apeda.gov.in/index/Product_description_32head.aspx?gcode=0101)
3. <https://agriexchange.apeda.gov.in/FTP/ftp2015-20E>.
4. [www.Anilrana13014.webbly.com](http://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:**

1. DR. A. SHAJAHAN

**Checked by:**

1. DR. A. ASLAM

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:

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 byproduct, 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 vegetables and fruits for grading, value addition and preservation.

#.....# Self-Study portion

**Text Books:**

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

**Books for Reference:**

1. Prasad S and Kumar U, Green House Management for Horticultural Crops, 2<sup>nd</sup> Edition. Agrobios Publishers Pvt Ltd, Rajasthan, India, 2012.
2. Gupta P.K. A Handbook of Soil, Fertilizer and Manure. 2<sup>nd</sup> Edition. Agrobios Publishers Pvt Ltd, Rajasthan, India, 2017.

**Web Reference:**

1. <http://www.agrimoon.com/wp-content/uploads/Introduction-to-Soil-Science.pdf>.
2. [http://www.apeda.gov.in/apedawebsite/SubHead\\_Products/Floriculture.htm](http://www.apeda.gov.in/apedawebsite/SubHead_Products/Floriculture.htm).
3. [https://agriexchange.apeda.gov.in/index/Product\\_description\\_32head.aspx?gcode=0101](https://agriexchange.apeda.gov.in/index/Product_description_32head.aspx?gcode=0101)
4. <https://agriexchange.apeda.gov.in/FTP/ftp2015-20E>.
5. [www.Anilrana13014.webbly.com](http://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												

**Prepared by:**

1. DR. A. SHAJAHAN

**Checked by:**

1. DR. A. ASLAM