

# PG & RESEARCH DEPARTMENT OF BOTANY

## B.Sc., BOTANY

### Syllabus

(2020 – 2023 onwards)



### **JAMAL MOHAMED COLLEGE (Autonomous)**

College with Potential for Excellence

Accredited (3<sup>rd</sup> 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**

### **Undergraduates will be able to**

- Discuss current scientific facts, concepts, fundamental principles and scientific theories in solving societal problems and make informed decisions in scientific contexts.
- Transcribe scientific ideas, arguments and practical experiences and demonstrate laboratory skills in handling new scientific techniques and equipment's safely and ethically.
- Recognize the benefits and limitations of science and its application in technological developments.
- Demonstrate an ability to pursue higher education as an independent learner and becomes entrepreneurs in the relevant discipline.
- Devise strategies to meet community requirements and serve as responsible citizens.

## **PROGRAMME SPECIFIC OUTCOMES**

### **B.Sc. Botany**

#### **Students will be able to**

- Recall the range of plant diversity in terms of structures, function, environment relationship and classification of plants.
- Develop basic knowledge to make a substantial contribution in environmental science for the biodiversity conservation and sustainable use of natural resources.
- Apply the practical skills of handling laboratory equipment's in the field and in the laboratory, safely.
- Generate employment opportunities through self-employed entrepreneurial skill and competitive exams.
- Construct multidisciplinary and interdisciplinary knowledge for the promotion of communities, population and ecosystems.
- 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.

## B.Sc. Botany

SEM	COURSE CODE	PART	COURSE	COURSE TITLE	Hrs /Week	CREDIT	MARKS		TOTAL
							CIA	ESE	
I	20U1LT1/LA1/LF1/LH1/LU1	I	Language – I		6	3	25	75	100
	20UCN1LE1	II	English – I		6	3	25	75	100
	20UBO1CC1	III	<b>Core – I</b>	Plant Diversity (Algae, Fungi and Archegoniate)	5	5	25	75	100
	20UBO1CC2P		<b>Core – II</b>	Laboratory course for core I - Practical	3	2	20	80	100
	20UCH1AC1:2		<b>Allied – I</b>	Inorganic, Organic and Physical Chemistry – I	5	4	25	75	100
	20UCH1AC2P		<b>Allied – II</b>	Volumetric Estimations – Practical I	3	2	20	80	100
	20UCN1AE1	IV	AEC – I	Value Education	2	2	100	-	100
			<b>TOTAL</b>		<b>30</b>	<b>21</b>	-	-	<b>700</b>
II	20U2LT2/LA2/LF2/LH2/LU2	I	Language– II		6	3	25	75	100
	20UCN2LE2	II	English– II		6	3	25	75	100
	20UBO2CC3	III	<b>Core– III</b>	Plant Anatomy and Embryology	6	5	25	75	100
	20UBO2CC4P		<b>Core– IV</b>	Laboratory course for core III - Practical	3	2	20	80	100
	20UCH2AC3: 2		<b>Allied – III</b>	Inorganic, Organic and Physical Chemistry – II	4	3	25	75	100
	20UCH2AC4P		<b>Allied – IV</b>	Organic Analysis – Practical II	3	2	20	80	100
	20UCN2SE1	IV	Skill Enhancement Course – I@	Soft Skills Development	2	2	100	-	100
			<b>TOTAL</b>		<b>30</b>	<b>20</b>	-	-	<b>700</b>
III	20U3LT3/LA3/LF3/LH3/LU3	I	Language– III		6	3	25	75	100
	20UCN3LE3	II	English – III		6	3	25	75	100
	20UBO3CC5	III	<b>Core – V</b>	Cytology and Genetics	4	4	25	75	100
	20UBO3CC6P		<b>Core – VI</b>	Laboratory course for core V – Practical	3	2	20	80	100
	20UZO3AC5		<b>Allied – V</b>	General Principles in Zoology	4	3	25	75	100
	20UZO3AC6P		<b>Allied – VI</b>	Practical – General Principles in Zoology	3	2	20	80	100
	20UBO3GE1	IV	Generic Elective–I#		2	2	-	100	100
20UCN3AE2	AEC – II		Environmental Studies	2	2	100	-	100	
			<b>TOTAL</b>		<b>30</b>	<b>21</b>	-	-	<b>800</b>
IV	20U4LT4/LA4/LF4/LH4/LU4	I	Language–IV		6	3	25	75	100
	20UCN4LE4	II	English– IV		6	3	25	75	100
	20UBO4CC7	III	<b>Core– VII</b>	Microbiology and Plant Pathology	5	5	25	75	100
	20UBO4CC8P		<b>Core– VIII</b>	Laboratory course for core-VII– Practical	3	2	20	80	100
	20UZO4AC7		<b>Allied– VII</b>	Commercial Zoology	5	3	25	75	100
	20UZO4AC8P		<b>Allied– VIII</b>	Practical – Commercial Zoology	3	2	20	80	100
	20UBO4GE2	IV	Generic Elective–II#		2	2	-	100	100
20UCN4EA	V	Extension Activities	NCC, NSS, etc.	-	1	-	-	-	
			<b>TOTAL</b>		<b>30</b>	<b>21</b>	-	-	<b>700</b>
V	20UBO5CC9	III	<b>Core– IX</b>	Plant Systematics and Economic Botany	6	5	25	75	100
	20UBO5CC10		<b>Core – X</b>	Plant Physiology	5	5	25	75	100
	20UBO5CC11		<b>Core – XI</b>	Biochemistry and Biophysics	5	5	25	75	100
	20UBO5CC12P		<b>Core – XII</b>	Laboratory course for core-IX, X and XI – Practical	5	5	20	80	100
	20UBO5DE1 A/B		<b>DSE – I**</b>		5	4	25	75	100
	20UBO5SE2 A/B	IV	Skill Enhancement Course – II@		2	2	-	100	100
	20UBO5SE3 A/B		Skill Enhancement Course – III@		2	2	-	100	100
20UBO5EC1		<b>Extra Credit Course – I</b>	General Intelligence for Competitive Examinations	-	<b>4*</b>	-	<b>100*</b>	<b>100*</b>	
			<b>TOTAL</b>		<b>30</b>	<b>28</b>	-	-	<b>700</b>
VI	20UBO6CC13	III	<b>Core – XIII</b>	Plant Ecology and Phytogeography	5	5	25	75	100
	20UBO6CC14		<b>Core – XIV</b>	Plant Molecular Biology and Biotechnology	5	5	25	75	100
	20UBO6CC15		<b>Core– XV</b>	Biological Techniques	5	5	25	75	100
	20UBO6CC16P		<b>Core– XVI</b>	Laboratory course for core-XIII, XIV and XV – Practical	5	5	20	80	100
	20UBO6DE2 A/B		<b>DSE – II**</b>		5	4	25	75	100
	20UBO6DE3 A/B		<b>DSE – III**</b>		4	4	25	75	100
	20UCN6AE3	IV	AEC – III	Gender Studies	1	1	100	-	100
20UBO6EC2		<b>Extra Credit Course –II</b>	Botany for Competitive Examinations	-	<b>4*</b>	-	<b>100*</b>	<b>100*</b>	
20UBOAECA		<b>Extra Credit Course for all</b>	Online Course	-	<b>1*</b>	-	-	-	
			<b>TOTAL</b>		<b>30</b>	<b>29</b>	-	-	<b>700</b>
			<b>GRAND TOTAL</b>		<b>180</b>	<b>140</b>	-	-	<b>4300</b>

\* Not Considered for Grand Total and CGPA.

**#Generic Electives**

SEM	Course Code	Part	Course Title
III	20UBO3GE1	IV	Edible Mushroom Cultivation and Commercialization
IV	20UBO4GE2	IV	Nursery, Gardening for Entrepreneurship

**@ Skill Enhancement Course**

SEM	Course Code	Part	Course Title
V	20UBO5SE2A	IV	<b>Algal Cultivation Techniques for Entrepreneurship</b>
	20UBO5SE2B		Food Microbiology
V	20UBO5SE3A	IV	<b>Greenhouse Technology</b>
	20UBO5SE3B		Remote sensing

**\*\*Discipline Specific Elective**

SEM	Course Code	Course Title
V	20UBO5DE1A	<b>Biostatistics and Bioinformatics</b>
	20UBO5DE1B	Enzyme Technology
VI	20UBO6DE2A	<b>Industrial Botany</b>
	20UBO6DE2B	Seed Technology
VI	20UBO6DE3A	<b>Horticulture and Plant Breeding</b>
	20UBO6DE3B	Silviculture

**Allied Courses**

SEM	Course Code	Part	Course	Course Title
III	20UBO3AC5	III	Allied – V	Applied Botany – I
	20UBO3AC6P		Allied – VI	Laboratory Course for Applied Botany I – Practical
IV	20UBO4AC7		Allied – VII	Applied Botany – II
	20UBO4AC8P		Allied – VIII	Laboratory Course for Applied Botany II – Practical

**Value added Certificate Courses**

SEM	Course Code	Course	Course Title
III	20UBOVAC1	Value Added Course – I	Bioinoculants for Commercialization
V	20UBOVAC2	Value Added Course – II	Forensic Botany

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
I	20UBO1CC1	Core – I	Plant Diversity (Algae, Fungi and Archegoniate)	5	5	100	25	75

### Course Outcomes:

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

1. Describe the salient features of Algae, Fungi and Archegoniate.
2. Match the classification, structure, reproduction and life cycle of Algae, Fungi and Archegoniate.
3. Explain the evolutionary relationship between Algae, Fungi and Archegoniate.
4. Point out the economic importance of Algae, Fungi and Archegoniate based on their morphology.
5. Identify and preserve them in their natural environment.

### Unit I: Algae

15 Hours

General characteristics and outline classification of algae (F. E. Fritsch, 1985). Habit and habitats of freshwater, marine and soil algae. Thallus organization and food reserve in algae. A detailed study of structure, reproduction and life cycle of the following genera – *Oscillatoria*<sup>#</sup>, *Volvox*, *Oedogonium*, *Caulerpa*, *Dictyota* and *Polysiphonia*. Economic importance of algae with reference to industry, agriculture and medicine.

### Unit II: Fungi

15 Hours

General characteristics and outline classification of fungi (Alexopoulos and Mims, 1979). Detailed study of occurrence, morphology, reproduction and life cycle of the following genera – *Albugo*, *Aspergillus*, *Puccinia* and *Polyporus*. Economic importance of fungi with reference to medicine, agriculture and industry. <sup>#</sup>Lichens – General characters, types and economic importance<sup>#</sup>.

### Unit III: Bryophytes

15 Hours

General characteristics and classification of bryophytes (Rothmaler, 1951). A detailed study of the structure, anatomy, reproduction and life cycle of the following genera – *Marchantia*, *Porella*, *Anthoceros* and *Polytrichum*. <sup>#</sup>Economic importance of bryophytes<sup>#</sup>.

### Unit IV: Pteridophytes

15 Hours

General characteristics and classification of pteridophytes (Sporne, 1975). Morphology, anatomy, reproduction and life cycle of the following genera – *Lycopodium*, *Equisetum* and *Adiantum* (Excluding developmental stages). Stellar evolution and economic importance of pteridophytes. Paleobotany: Fossil types, methods of fossilization, Geological time scale, brief study of *Rhynia*, *Lepidodendron* and *Calamities*<sup>#</sup>.

### Unit V: Gymnosperms

15 Hours

General characters and classification of gymnosperms (Sporne, 1967). Morphology, anatomy, reproduction and life cycle of the following genera – *Cycas* and *Pinus*. Economic importance of gymnosperms with reference to wood, essential oils, resins and drugs. A brief study of the fossil gymnosperm – *Williamsonia*<sup>#</sup>.

**#.....# Self-Study portion**

**Text Books:**

1. Vasishta PC, Sinha AK and Kumar A, Botany for Degree Students, 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.
2. Hait G, Bhattacharya K and Ghosh AK, A Text Book of Botany, 5<sup>th</sup> Edition, New Central Book Agency Pvt Ltd, Kolkata, India, 2011.
3. Sharma OP, A Text Book of Algae, 1<sup>st</sup> Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, India, 2011.

**Books for Reference:**

1. Alexopoulos CJ, Mims CW and Blackwell M, Introductory Mycology, 4<sup>th</sup> Edition, Wiley Publishers, New Delhi, India, 2007.
2. Pandey BP, Botany for Degree Students, 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.

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

Semester	Code		Title of the Paper			Hours	Credits			
I	20UBO1CC1		Plant Diversity (Algae, Fungi and Archegoniate)			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= 34, Relationship: Moderate										

**Prepared by:**

1. Dr. M. Kamaraj

**Checked by:**

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	20UBO1CC2P	Core– II	Laboratory course for core I- Practical	3	2	100	20	80

### Course Outcomes:

At the end of the course, students will be to

1. Explain the internal structures of algae and fungi through microscopic observation.
2. Examine the morphology, anatomy and reproductive parts of bryophytes.
3. Observe the morphology, anatomy and reproductive parts of pteridophytes and gymnosperms.
4. Categorize fossil plants based on geological time period.
5. Realize the natural plant diversity through field visit.

### List of Practical's

1. Micropreparation and observation of vegetative and reproductive parts of the following algal specimens – *Oscillatoria*, *Volvox*, *Oedogonium*, *Caulerpa*, *Dictyota* and *Polysiphonia*.
2. Micropreparation and observation of the following fungal specimens – *Albugo*, *Aspergillus*, *Puccinia* and *Polyporus*.
3. Micropreparation and observation of the following bryophyte specimens – *Marchantia*, *Porella*, *Anthoceros* and *Polytrichum*.
4. Micropreparation and observation of the following pteridophyte specimens – *Lycopodium*, *Equisetum* and *Adiantum*.
5. Micropreparation and observation of the following gymnosperm specimens – *Cycas* and *Pinus*.
6. Observation of following permanent fossil slides – *Rhynia*, *Lepidodendron*, *Calamities* and *Williamsonia*.
7. Botanical tour to witness the specimens in their natural habitats (not exceeding three days).

### Practical Books:

1. Santra SC, Chatterjee TP and Das AP, College Botany Practical (Volume II), 1<sup>st</sup> Edition (Reprinted), New Central Book Agency Pvt Ltd, Kolkata, India, 2001.
2. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.
3. Sharma OP, Practical Botany, 7<sup>th</sup> Edition, Pragati Prakashan Educational Publishers Pvt Ltd, Meerut, India, 2014.

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

Semester	Code	Title of the Paper					Hours	Credits			
I	20UBO1CC2P	Laboratory course for core I - Practical					3	2			
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. M. Kamaraj

**Checked by:**

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	20UBO2CC3	Core– III	Plant Anatomy and Embryology	6	5	100	25	75

### Course Outcomes:

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

1. Outline the fundamental concepts of plant anatomy and embryology.
2. Distinguish different type of tissue system and their organization.
3. Recognize the anatomical features of plant organs and secondary growth.
4. Evaluate the structural organization of flower and the process of pollination and fertilization.
5. Categorize the plant relationships based on internal anatomy and reproductive system.

### Unit I: Meristematic and permanent tissues 18 Hours

Meristematic tissues – Definition, classification and types (Based on origin, position, function and plane of division). Apical organization theories of shoot and root – Apical cell, Histogen, Tunica-carpus and Korper-Kappe theory and concept of <sup>#</sup>Quiescent centre<sup>#</sup>. Origin, types, structure and function of simple and complex tissue.

### Unit II: Tissue system 18 Hours

Origin, structure and function of epidermal tissue system, special epidermal structures and hydathodes. Secretary tissue – glandular, resin ducts and laticiferous tissue. Ground tissue – extrastelar (cortex), intrastelar (pericycle, pith and medullary rays) and mesophyll.<sup>#</sup>Types of vascular bundles<sup>#</sup>.

### Unit III: Anatomical features of plant organs 18 Hours

Primary structures of leaf, stem and root of monocot and dicot. Normal secondary thickening in dicot stem and root. Development of periderm, phellem, phellogen, lenticels and tyloses. Types of wood – sap, heart, ring porous and diffused wood. <sup>#</sup>Brief account on dendrochronology<sup>#</sup>. Anomalous secondary thickening in *Boerhavia*, *Nyctanthes* and *Dracaena*.

### Unit IV: Structural organization and fertilization 18 Hours

Anther – structure, development of male gametophyte and microsporogenesis. Ovule –structure, types, development of female gametophyte and megasporogenesis. Pollination – Factors favour for pollination, types, advantages and disadvantages. Fertilization – Double fertilization and <sup>#</sup>triple fusion<sup>#</sup>.

### Unit V: Endosperm, embryo, apomixis and polyembryony 18 Hours

Endosperm and its types. Embryo development in dicot and monocot plants. Brief note on apomixis, parthenocarpy, polyembryony and its types. Seed – structure, development, <sup>#</sup>function and dispersal of seeds<sup>#</sup>.

### #.....# Self-Study portion

### Text Books:

1. Bhojwani SS and Bhatnagar SP, The embryology of Angiosperms, 5<sup>th</sup> Edition, Vikas Publishing House Pvt Ltd, New Delhi, India, 2009.
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. Pandey BP, Plant Anatomy, 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2012.

**Books for Reference:**

1. Lersten Nels R, Flowering Plant Embryology. 1<sup>st</sup> Edition. Iowa State University Press, Iowa, 2004.
2. Evert RF, Esau’s Plant Anatomy, 3<sup>rd</sup> Edition, Wiley Publishers India, 2005.

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

Semester	Code	Title of the Paper					Hours	Credits		
II	20UBO2CC3	Plant Anatomy and Embryology					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= 31, Relationship: Moderate										

**Prepared by:**

1. Dr. R. Ravikumar

**Checked by:**

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	20UBO2CC4P	Core– IV	Laboratory course for CoreIII - Practical	3	2	100	20	80

### Course Outcomes:

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

1. Identify simple, complex tissues and vascular bundle orientation in plants.
2. Distinguish and compare the anatomical features of dicot and monocot plants.
3. Recognize primary, secondary and anomalous thickening of plants.
4. Compare the young and mature stages of reproductive organs of a plant.
5. Justify the identification of anatomical and embryological specimens.

### List of Practical's

1. Anatomical observation of monocot and dicot leaf, stem and root (monocot – Grass/*Canna* and dicot – *Tridax*)
2. Normal secondary thickening in dicot stem (*Azadiractaindica*).
3. Anomalous secondary thickening (*Boerhavia*, *Nyctanthes* and *Dracaena*).
4. T.S of young and mature anther (*Datura metal*)
5. Dissection of dicot embryo and endosperm (*Cucumis* and *Tridax*).
6. Observation of simple and complex tissues (Charts/permanent slides).
7. Observation of vascular bundle orientation (Charts/permanent slides).
8. L.S. of ovule and types of ovule (Charts/permanent slides).

### Practical Books:

1. Sundara Rajan S, Practical manual of plant anatomy and embryology, 1st Edition, Anmol Publications Pvt Ltd, Bangalore, Karnataka, India, 2003.
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. Pandey BP, Modern Practical Botany, 1<sup>st</sup> 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			
II	20UBO2CC4P	Laboratory course for coreIII – Practical					3	2			
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. R. Ravikumar

**Checked by:**

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	20UBOVAC1	VAC – I	Bioinoculants for Commercialization	25	-	100	-	100

**Course outcomes:**

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

1. Recognize the concept and significance of bio-fertilizers.
2. Practice the skills for mass production of different bio-fertilizers.
3. Explain the concept and significance of bio-pesticides.
4. Demonstrate the skills on mass production of different bio-pesticides.
5. Get exposure on quality maintenance and marketing strategies of bio-fertilizers.

**Unit I:** Concept and significance of bioinoculants. Types of bioinoculants. General account on asymbiotic, symbiotic nitrogen fixing bacteria, phosphate solubilizing bacteria and mycorrhizae.

**Unit II:** Mass cultivation and application of cyanobacteria, *Azospirillum*, *Azotobacter*, *Rhizobium*, *Azolla* and *Mycorrhizal* bioinoculants.

**Unit III:** Concept and significance of biopesticides. Types and their application. Bioherbicides and bioinsecticides. Integrated pest management.

**Unit IV:** Mass production and application of herbal, bacterial, fungal and viral biopesticides. Methods of making bio-compost, vermicompost and its application.

**Unit V:** National and International scenario of bioinoculants. Quality control, storage and marketing, small and large-scale strategies of bioinoculants.

**Text Books:**

1. Kumaresan V, Biotechnology, 6<sup>th</sup> Edition, Saras Publications Pvt Ltd, Nagercoil, Tamil Nadu, India, 2013.
2. Dubey RC, A Text book of Biotechnology, 5<sup>th</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2014.
3. SubbaRao NS, Biofertilizers in Agriculture and Forestry, 3<sup>rd</sup> Edition. CBS Publishers and Distributors Pvt Ltd, New Delhi, India, 2019.

**Book for Reference:**

1. Sadasivam K, Kumar K and Govindarajan K, Biofertilizers Technology, 1<sup>st</sup> Edition, Scientific Publishers Pvt Ltd, Chennai, India, 2004.
2. Bhattacharya DP and Purohit P, Organic Farming: Biocontrol and Biopesticide Technology, 1<sup>st</sup> Edition, Agrobios, Jodhpur, Rajasthan, India, 2012.

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

Semester	Code	Title of the Paper					Hours	Credits				
I	20UBOVAC1	Bioinoculants for Commercialization					3	2				
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. K. Mohamed Rafi

**Checked by:**

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
V	20UBOVAC2	VAC – II	Forensic Botany	25	-	100	-	100

### Course outcomes:

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

1. Narrate the concept and applications of forensic botany.
2. Determine the value of plants from forensic point of view.
3. Recognize forensic importance of botanical specimens.
4. Categorize various botanical specimens for forensic evidences.
5. Justify cases based on classic and modern botanical evidences.

**Unit I:** Introduction to forensic botany and its importance. General plant classification based on morphology, anatomy, systematics and palynology.

**Unit II:** Various types of planktons and diatoms and their forensic importance. Isolation and identification of pollen grains. Identification and matching of various types of wood, timber varieties, seeds and leaves.

**Unit III:** Various types of poisonous plants and their toxins – *Abrus precatorius*, *Aconitum* spp., *Cinchona* spp., *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Nerium indicum*, *Nicotiana glauca*, *Ricinus communis* and *Thevetia peruviana*. Abused drug yielding plants – *Opium*, *Cannabis*, *Cocaine*, *Tobacco*, *Datura* and *Psilocybin* mushroom.

**Unit IV:** Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration. Analysis of samples, DNA analysis, typing and barcoding.

**Unit V:** Classic forensic botany cases: Case histories by using plant anatomy and systematics, palynology, plant ecology, limnology, plant molecular biology and Drug enforcement. Introduction to quarantine and narcotic bureau.

### 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. Hall DW and Byrd J, Forensic Botany: a practical guide. 1<sup>st</sup> Edition, Wiley-Blackwell publishers Pvt Ltd, United States, 2012.
3. James SH, Nordby JJ, Bell S, Forensic Science: An Introduction to Scientific and Investigative Techniques, 4<sup>th</sup> Edition, CRC Press Pvt Ltd, Taylor and Francis Group, United Kingdom, 2015.

### Books for Reference:

1. Ganesslen RE, Essentials of Forensic Science: Blood, Bugs and Plants, 1<sup>st</sup> Edition, Facts on File Publishers Pvt Ltd, New York, United States, 2008.
2. Wessels T, Forensics – A Field Guide to Reading the Forested Landscape, 1<sup>st</sup> Edition, Norton and Company Pvt Ltd, New York, United states, 2013.

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

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBOVAC2	Forensic Botany					25	-			
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. A. Aslam

**Checked by:**

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	20UBO3CC5	Core – V	Cytology and Genetics	4	4	100	25	75

### Course Outcomes:

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

1. Inculcate the structure and function of cells and organelles.
2. Impart knowledge on chromosomes and their aberrations.
3. Enlighten Mendelian inheritance and their deviations.
4. Effect of mutation due to environmental changes.
5. Molecular understanding of mutations and diseases.

### Unit I: Unit of life

**12 Hours**

Organization of prokaryotic and eukaryotic cells. Structure, composition and properties of cell wall, cell membranes and cytoplasm. Structure and functions of cellular organelles (nucleus, mitochondria, chloroplasts, endoplasmic reticulum, golgi complex, cytoskeleton, ribosomes) and ergastic substances. #Lysosomes#.

### Unit II: Cell Cycle and Cell Division

**12 Hours**

Cell Cycle, mechanisms and significance of mitotic and meiotic cell divisions #amitosis#. Structure and chemical composition of chromosomes. Euchromatin and heterochromatin. Special types of chromosomes - giant chromosome, supernumerary chromosomes, chimaera and SAT-chromosome.

### Unit III: Principles of Genetics

**12 Hours**

History, branches and applications of genetics, principles of genetics, Mendel's laws, deviation from Mendelian ratio, lethality, multiple factor hypothesis, incomplete dominance, Epistasis, non-epistasis, inheritance of quantitative traits, multiple alleles complementary factor, chromosomal theory of inheritance. #pleiotropism#.

### Unit IV: Chromosomal genetics

**12 Hours**

Linkage and crossing over, sex linkage in plants, cytoplasmic inheritance, sex determination in plants. Chromosomal aberrations -deletions, duplications, inversions and translocations, Aneuploidy - (monosomy, nullisomy and trisomy). Euploidy, Polyploidy – (autopolyploids – allopolyploids). #Sex linked inheritance in plants#.

### Unit V: Molecular genetics

**12 Hours**

DNA, RNA as genetic material, one gene one enzyme hypothesis, Operon concept, one cistron one polypeptide hypothesis. Modern concept of genes - cistron, muton and recon. Genetic code, Mutation – spontaneous and induced, causes and consequences. Molecular mechanism of mutation. #Mutagens – types and their effects#.

### #-----# Self-study portion

**Text Books:**

1. Kumar N, Plant Cell Biology, 1<sup>st</sup> Edition, ALP Books Pvt Ltd, New Delhi, India, 2010.
2. Verma PS and Agarwal VK, Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, S. Chand & Company Pvt Ltd, New Delhi, India, 2010.
3. Vyas SP, Mehta A, Cell and Molecular Biology, CBS Publishers & Distributors Pvt Ltd, New Delhi, India, 2014.

**Books for Reference:**

1. Lodish H, Berk A, Kaiser CA, Kriger M, Scott MP, Bretscher A, Ploegh H, Matsudaira P, Molecular Cell Biology, 6<sup>th</sup> Edition, W.H. Freeman & Company, New York, USA, 2008.
2. Hartwell LH, Hood L, Goldberg ML, Reynolds AE, Silver LM, Veres RC, Genetics from Genes to Genomes, 3<sup>rd</sup> Edition, Tata 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			
III	20UBO3CC5	Cytology and Genetics					4	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. R. Radhakrishnan

**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	20UBO3CC6P	Core – VI	Laboratory course for core V - Practical	3	2	100	20	80

### Course Outcomes:

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

1. Understanding of plant cell structure through temporary mounts.
2. Imparting the knowledge of genetics through problem solving and fossil records.
3. Understanding of cellular organelles.
4. Understanding of cell inclusions.
5. Understanding of chromosomal variations.

### List of Practical's

#### A. Cytology

1. Observation of the structure of cell organelles through electron micrographic photos from standard books
2. Observation of structure of plant cell through temporary mounts
3. Observation of cell inclusions (non-living)
4. Phytochemical tests for starch, sugars and proteins in plant cells
5. Observation of cell division by onion root tip squash method
6. Observation of polyploidy in onion root tips after treatment with Colchicine

#### B. Genetics

1. Problems relevant to monohybrid ratio
2. Problems relevant to dihybrid ratio
3. Problems relevant to non-Mendelian ratio
4. Construction of chromosomal map

### Practical Books:

1. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.
2. Arumugam N, Meyyan R, Kumaresan V and Sundaralingam R, Genetics Biometrics and Bioinformatics, 1<sup>st</sup> Edition, Saras Publication Pvt Ltd, Nagercoil, Tamil Nadu, India, 2014.
3. Chitra KY, A Practical manual of Encology Cytology, Genetics, Biochemistry, Physiology and Biostatistics, 1<sup>st</sup> Edition, Agrobios Pvt Ltd, Jodhpur, India, 2018.

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

Semester	Code	Title of the Paper					Hours	Credits			
III	20UBO3CC6P	Laboratory course for core V – Practical					3	2			
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. R. Radhakrishnan

**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	20UBO3AC5	Allied – V	Applied Botany – I	4	3	100	25	75

### Course Outcomes:

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

1. Outline the diversity of cryptogams and seed plants.
2. Identify the economic uses of natural wealth from cryptogams and seed plants.
3. Perceive the alternative uses of and applications of cryptogams and seed plants.
4. Appraise the values of natural wealth from cryptogams and seed plants.
5. Recommend alternative bio resources for human welfare.

### Unit I: Algae

12 Hours

General characteristics and outline classification of algae (F. E. Fritsch, 1985). Thallus organization, food reserve and habitats of algae. A detailed study of structure, reproduction, life cycle and economic uses of the following genera – <sup>#</sup>*Oscillatoria*<sup>#</sup>, *Nostoc* and *Chlorella*. Cultivation methods and of fresh water (*Spirulina*), and marine (*Kappaphycus*) algae.

### Unit II: Fungi and Lichens

12 Hours

General characteristics and outline classification of fungi (Alexopoulos and Mims, 1979). Detailed study of occurrence, morphology, reproduction and life cycle of the following genera – *Albugo*, *Saccharomyces* and *Puccinia*. Brief account on cultivation of edible mushroom (*Pleurotus*), medicinal mushroom (*Ganoderma*) antibiotic producing fungi (*Penicillium*), brief account on mass production of bio-enzymes. <sup>#</sup>Lichens – General characters, types and economic importance of Lichens<sup>#</sup>.

### Unit III: Bryophytes

12 Hours

General characteristics and classification of bryophytes (Rothmaler, 1951). Structural description of the following genera – *Marchantia*, *Anthoceros* and *Polytrichum*. A brief mention of use of bryophytes for antibiotics, anti-cancer, food, ornamental and pesticides. Environmental importance of mosses in pedogenesis and <sup>#</sup>peat bog<sup>#</sup>.

### Unit IV: Pteridophytes

12 Hours

General characteristics and outline classification of pteridophytes (Sporne, 1975). structural description of the following genera – *Lycopodium*, *Equisetum* and *Adiantum*. Importance of pteridophytes as vegetable (*Diplazium esculentum*), indoor plant (*Nephrolepis*) and <sup>#</sup>medicinal value<sup>#</sup>.

### Unit V: Gymnosperms

12 Hours

General characters and outline classification of gymnosperms (Sporne, 1967). Morphology, anatomy, reproduction, life cycle and economic uses of the following genus – *Cycas*. Importance of gymnosperms as wood (*Pinus*), anti-cancer drug (*Taxus* and *Ephedra*), resins (*Pinus*). A brief study of types and application of fossil plants in paleoclimatology and <sup>#</sup>climate models<sup>#</sup>.

<sup>#</sup>.....<sup>#</sup> Self-Study portion

**Text Books:**

1. Vasishta PC, Sinha AK and Kumar A, Botany for Degree Students (Volumes), 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.
2. Hait G, Bhattacharya K and Ghosh AK, A Text Book of Botany, 5<sup>th</sup> Edition, New Central Book Agency Pvt Ltd, Kolkata, India, 2011.
3. Sharma OP, Plants and Human Welfare, Prakathi Prakashan Publications Pvt Ltd, Meerut, India, 2015.

**Reference Books:**

1. Alexopoulos CJ, Mims CW and Blackwell M, Introductory Mycology, 4<sup>th</sup> Edition, Wiley Publishers, New Delhi, India, 2007.
2. Sharma OP, A Text Book of Algae, 1<sup>st</sup> Edition, Tata McGraw Hill Education 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			
III	20UBO3AC5	Applied Botany – I					4	3			
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. Aslam

**Checked by:**

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
III	20UBO3AC6P	ALLIED – VI	Laboratory course for Applied Botany I – Practical	3	2	100	20	80

### Course Outcomes:

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

1. Experience laboratory skills of handling botanical specimens.
2. Describe diversity of plants.
3. Demonstrate preparation and curation of botanical specimens.
4. Identify commercial potential of cryptogams.
5. Appraise the traits and key characters of cryptogams.

### List of Practical's

1. Generic level identification of algal specimens in a mixture.
  - a. *Oscillatoria*
  - b. *Nostoc*
  - c. *Chlorella*
  - d. *Spirulina*
2. Identification of following fungi in both host as well as permanent slides
  - a. *Albugo*
  - b. *Saccharomyces*
  - c. *Puccinia*
3. Observation of external and internal structure of
  - a. *Marchantia*
  - b. *Anthoceros*
  - c. *Polytrichum*
  - d. *Lycopodium*
  - e. *Equisetum*
  - f. *Adiantum*
  - g. *Diplazium*
  - h. *Nephrolepis*
  - i. *Cycas*
  - j. *Pinus*
4. Identification of spotters related to economic uses of species mentioned in theory

### Practical Books:

4. Santra SC, Chatterjee TP and Das AP, College Botany Practical (Volume II), 1<sup>st</sup> Edition (Reprinted), New Central Book Agency Pvt Ltd, Kolkata, India, 2001.
5. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.
6. Sharma OP, Practical Botany, 7<sup>th</sup> Edition, PragatiPrakashan Educational Publishers Pvt Ltd, Meerut, India, 2014.

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

Semester	Code	Title of the Paper					Hours	Credits		
III	20UBO3AC6P	Laboratory course for Applied Botany I - Practical					3	2		
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. A. Aslam

**Checked by:**

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
III	20UBO3GE1	Generic Elective – I#	Edible Mushroom Cultivation and Commercialization	2	2	100	-	100

### Course Outcomes:

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

1. To provide an adequate knowledge about importance and habitation of mushroom.
2. To get knowledge nutritional value, cultivation unit and storage methods.
3. To acquire knowledge about spawn and spawning techniques.
4. To understand the factors influencing the mushroom cultivation and post harvesting methods.
5. Students get detailed knowledge about cost economics, importance and preparation of value-added products.

### Unit I: Introduction

**6 Hours**

History, Importance and scope of edible mushrooms, morphology of mushroom, identification of edible and poisonous mushrooms. Entrepreneurial competencies for mushroom cultivation #Mushroom cultivation in India#.

### Unit II: Biological importance, composting and storage:

**6 Hours**

Nutritional and medicinal values of edible mushrooms, Composting: importance in waste recycling. Compost used for edible mushroom. Farm and the layout of culture room, harvesting room. #Storage - methods of short term and long-term storage#.

### Unit III: Spawning and cultivation methods:

**6 Hours**

Strains, containers, quantity of spawn to be used, spawning types and techniques, compost preparation, casing. Cultivation of button, milky and #oyster mushrooms#.

### Unit IV: Crop management:

**6 Hours**

Air temperature, humidity, ventilation, watering and watering methods, disposal of used compost and recycling, cropping period, insects and pests, #insecticides and their use#.

### Unit V: Economics of cultivation and Post-harvest technologies:

**6 Hours**

Cost economics – Permanent medium scale mushroom farm. Post harvesting: Picking, grading, packing, Sanitation, supply and demand ratio, Marketing and e. marketing. Value added products of mushrooms and #Mushroom recipes# (Soup, pulao, pickles, omelette).

### #-----# Self-study portion

### Text Books:

1. Pandey RK, Ghosh SK and Chauhan KS, A hand book on mushroom cultivation, 1<sup>st</sup> Edition, Emkay Publications Pvt Ltd, New Delhi, India, 1996.
2. Parveen Garg, Mushroom cultivation, 1<sup>st</sup> Edition, B R Publishing Corporation Pvt Ltd, New Delhi India, 2015.
3. Rajan S. Mushroom technology, 2<sup>nd</sup> Edition, CBS Publishers and Distributors, Pvt Ltd, New Delhi India, 2020.

### Books for Reference:

1. Nita Bahl, Hand book of Mushroom, Oxford and IBH Book House Pvt Ltd, New Delhi, India, 2005.
2. Eiri B, Hand Book of Mushroom Cultivation, Processing and Packaging, Engineers India Research Institute, New Delhi, India, 2007.

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

Semester	Code	Title of the Paper					Hours	Credits			
III	20UBO3GE1	Edible Mushroom Cultivation and Commercialization					2	2			
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:**

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	20UBO4CC7	Core– VII	Microbiology and Plant Pathology	5	5	100	25	75

### Course Outcomes:

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

1. Describe the characters and classification of bacteria and study the principle and application of various types of microscopes.
2. Analyse the internal & external structures, growth and air borne disease caused by bacteria.
3. Study the characters and classification of plant and animal viruses and emphasis the most virulence human viral infections.
4. Correlate the epidemiology and forecasting of plant disease.
5. Acquire the knowledge of plant disease, integrated pest management and innovative methods for plant disease control.

### Unit I: Fundamentals of microbiology

**15 Hours**

History and scope of microbiology. Classification of microorganisms – Haeckel’s three kingdom concept, Whittaker’s five kingdom concept and outline of Bergey’s manual of systematic bacteriology (9th Edition). General features of archaebacteria, eubacteria, cyanobacteria, mycoplasmas, rickettsia, chlamydia’s, <sup>#</sup>actinomycetes<sup>#</sup>. Microscopy – principles and applications of bright field, dark field, phase contrast and electron microscopy (TEM & SEM).

### Unit II: Bacteria

**15 Hours**

Morphology – cell size, shape and arrangement. Brief outline of capsule, flagella, axial filaments and pilli. Cell wall – composition and characteristics. Structures internal to the cell wall – cytoplasm, ribosomes, mesosomes and nucleus. <sup>#</sup>Bacterial growth curve<sup>#</sup>. Human disease caused by bacteria – Air borne bacterial disease – Mycobacterium tuberculosis, Mycoplasma, Pneumonia and Streptococcal pharyngitis.

### Unit III: Viruses

**15 Hours**

History, classification of viruses, morphology – shape, size, structure – helical viruses (naked and enveloped viruses), icosahedral (naked and enveloped) viruses and complex viruses. General characteristics of plant and animal viruses. Viral multiplications (Lytic cycle, Lysogenic cycle). Human disease caused by virus – <sup>#</sup>Chicken pox<sup>#</sup>, Influenza, MERS and SARS.

### Unit I: Plant pathology

**15 Hours**

Definition, history, importance of plant diseases. Epidemiology and forecasting of plant diseases, common terminologies relevant to plant pathology and Koch’s postulates. Classification of plant diseases, symptoms of fungal, bacterial and <sup>#</sup>viral diseases<sup>#</sup>.

### Unit V: Plant Diseases

**15 Hours**

Study of the following plant disease: Tikka disease of ground nut, Early blight of potato, Wilt disease of cotton, Loose smut of wheat, Bacterial blight of paddy, Citrus canker, <sup>#</sup>Bunchy top of banana<sup>#</sup>. Management of plant disease – cultural and chemical methods, integrated pest management (IPM), disease control by immunizing the host, breeding for disease resistant and innovative methods of plant disease control.

#.....# Self-Study portion

**Text Books:**

1. Dubey RC and Maheshwari DK, A Text Book of Microbiology, 4<sup>th</sup> Edition, Chand and Company Pvt Ltd, New Delhi, India, 2013.
2. Pandey BP, Plant pathology, 11<sup>th</sup> Edition, Chand and Company Pvt Ltd, New Delhi, India, 2014.
3. Willey JM, Sherwood LM and Woolverton CJ, Prescott’s Microbiology, 10<sup>th</sup> Edition, McGraw Hill Education Pvt Ltd, New York, 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. Mehrotra RS and Aggarwal A, Plant Pathology, 3<sup>rd</sup> Edition, McGraw Hill Education (India) Company Pvt Ltd, New Delhi, India, 2017.

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

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBO4CC7	Microbiology and Plant Pathology					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= 32, Relationship: Moderate											

**Prepared by:**

Dr. H. Syed Jahangir

**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	20UBO4CC8P	Core – VIII	Laboratory course for core - VII – Practical	3	2	100	20	80

### Course Outcomes:

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

1. Calibrate microscope.
2. Study the basic rules, sterilization methods and preparation of culture media for the enumeration of bacteria.
3. Differentiate cell wall characters of bacteria through Gram's staining technique.
4. Pure culture methodology is adopted for the characterization of bacteria.
5. Correlate the morphological and internal tissue of the infected plants.

### List of Practical's

#### A. Microbiology

1. Microbiology Laboratory: Basic rules and requirements
2. Principle and methods of sterilization (Physical and Chemical Methods).
3. Preparation of culture media
  - a) Preparation of solid and liquid medium
    - i) Nutrient agar medium
    - ii) Potato Dextrose Agar medium
4. Calibration and standardization of microscope by using ocular micrometre and stage micrometre
5. Isolation of bacteria and fungi from soil and water by serial dilution techniques
6. Demonstration of techniques for pure culture of bacteria and fungi
  - a) Streak plate method
  - b) Pour plate method
  - c) Spread plate method
7. Gram staining techniques
8. Methylene Blue dye reduction test

#### B. Plant Pathology

Study of morphological and internal part of the following infected plants

1. Tikka disease of ground nut
2. Early blight of potato
3. Wilt disease of cotton
4. Loose smut of wheat
5. Bacterial blight of paddy
6. Citrus canker
7. Bunchy top of banana

### Practical Books:

1. Dubey RC and Maheshwari DK, Practical microbiology, 1<sup>st</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010.
2. Santra SC, Practical Botany, 1<sup>st</sup> Edition, New Central Book Agency Pvt Ltd, Kolkata, India, 2015.

3. Huma N and Hussain Khan H, Practical lab manual for microbiology and plant pathology, 1<sup>st</sup> Edition, AkiNik Publications Pvt Ltd, New Delhi, India, 2018.

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

Semester	Code	Title of the Paper					Hours	Credits			
III	20UBO4CC8P	Laboratory course for coreVII - Practical					3	2			
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:**

Dr. H. Syed Jahangir

**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	20UBO4AC7	ALLIED – VII	Applied Botany – II	5	3	100	25	75

### Course Outcomes:

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

1. Illustrate the external characters of flowering plants.
2. Classify the flowering plants based on their external characters.
3. Appraise the plants as useful resources for human use and welfare.
4. Recommend unique food supplements and herbal value-added products.
5. Solve the problems related with human environment applying physiology principles.

### Unit I: Plant morphology

**15 Hours**

Morphology - Parts of a plant – Stem, Leaf and root modification with examples – outline classification of Simple and compound leaves - Phyllotaxy - Inflorescence - Racemose, Cymose, Mixed and Special types - Terminology of floral parts, diagram and formula. Primary internal (vegetative and reproductive) structure of dicot and monocot plants.

### Unit II: Taxonomy

**15 Hours**

Systems of Classification: Artificial (Linnaeus system) - Natural (Bentham and Hooker's system). Plant Nomenclature - Brief accounts of ICBN, Herbarium technique. Study of the general characteristics and economic importance of Rutaceae, Fabaceae, Caesalpinaceae, Rubiaceae, Apocyanaceae, Euphorbiaceae and Arecaceae.

### Unit III: Food supplements

**15 Hours**

Economic Importance of plants – Plant diet for cardio, renal, anti-hypertention, anti-aging, bone, detox and mental health. Non-alcoholic beverage plants – Coffee, Tea therapy (green tea) Tea extract capsules, Cocoa, Chocolate, Gano-coffee, herbal 'teas' (*Psidium*, *Mangifera*). Prebiotic fibre plants (*Murayya*, *Cyomopsis*), Cereals, pseudocereals and small grain cereal as food supplements and snacks.

### Unit IV: Oil yielding plants

**15 Hours**

Essential oils – applications – perfumes (rose, ylang-ylang, jasmine, lemon grass oil, rosemary and sandalwood oil). Food supplement oils – linseed, flax seed oils as source of omega-3-fatty acid. Vegetable oils – coconut, palm oil. Soapbark, soapwort, soap berries, soap pods. Preparation of organic herbal soap. Importance of herbal cosmetics.

### Unit V: Plant eco-physiology – relevance to human welfare

**15 Hours**

Water relations in plants – osmosis, transpiration and hydrological cycle. Types and factors affecting transpiration. Water footprint of products and processes. Photosynthesis: apparatus, pigments – light (z-scheme) and dark reaction – outline of Calvin cycle, difference between C3, C4 and CAM pathway and their relevance to indoor gardening plants. Carbon sequestration and carbon banking. Respiration – aerobic and anaerobic respiration, fermentation pathway and its importance. Plant growth regulators – types and commercial hormones and their applications in gardening and horticulture.

#.....# Self-Study portion

**Text Books:**

1. Rao KN, Krishnamurthy KV and Rao GS, Ancillary Botany, 1<sup>st</sup> Edition, ViswanathanPvt Ltd, New Delh, India, 1983.
2. Shukla RS and Chandel PS, Ecology and utility of plants, 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2008
3. Sharma OP, Plants and Human Welfare, 2<sup>nd</sup> Edition, PrakathiPrakashanPublicationsPvt Ltd, Meerut, India, 2015.

**Books for Reference:**

1. Jeffrey C. An Introduction to Plant Taxonomy, 1<sup>st</sup> Edition, Cambridge University Press, United Kingdom, 1982.
2. Pandey BP. Taxonomy of Angiosperms, 2<sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 1999.

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

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBO4AC7	Applied Botany – II					5	3			
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. A. Aslam

**Checked by:**

Dr. M. GhouseBasha

**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	20UBO4AC8P	ALLIED – VIII	Laboratory course for Applied Botany II – Practical	3	2	100	20	80

### Course Outcomes:

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

1. Illustrate the external characters of flowering plants.
2. Classify the flowering plants based on their external characters.
3. Appraise the plants as useful resources for human use and welfare.
4. Recommend unique food supplements and herbal value-added products.
5. Solve the problems related with human environment applying physiology principles.

### List of Practical's

#### A. Angiosperm morphology and taxonomy (drawing and description of specimens only):

1. Phyllotaxy (*Annona, Psidium, Quisqualis, Nerium, Allamanda, Acalypha* and *Mollugo*)
2. Compound leaves (*Azadirachta, Butea, Albizzia, Moringa, Cleome*)
3. Parts of a flower (*Tribulus*)
4. Racemose inflorescence (*Crotalaria, Mangifera, Caesalpinia, Achyranthes, Cocos, Allium, Tridax*)
5. Cymose inflorescence (*Jasmine, Clerodendron, Hamelia, Heliotropium, Mollugo*)
6. Mixed and special (*Ficus, Leucas, Euphorbia cyathophora, Ocimum, Zizyphus*)
7. Description and identification features for the families (Rutaceae, Fabaceae, Caesalpinaceae, Rubiaceae, Apocyanaceae, Euphorbiaceae, and Areaceae).

#### B. Nutritional quality analysis of plants (Minor experiments):

1. Estimation of ascorbic acid (vitamin-C)
2. Determination of moisture content in plant samples.
3. Observation of oxidative darkening of vegetables and fruits.
4. Estimation of gluten formation in natural foods.
5. Nutritional quality analysis of plants.

#### C. Physiology experimental set up

1. Ganong's photometer
2. Light screen experiment
3. Bell jar experiment for oxygen evolution
4. Observation of Kranz anatomy of leaves
5. Observation of transpiration in leaves.

### Practical Books:

1. Mehta AS and Verma AP, Experiments in Plant Physiology, 1<sup>st</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 1987.
2. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand & Company Pvt Ltd, New Delhi, India, 2011.
3. Sharma OP, Plants and Human Welfare, 2<sup>nd</sup> Edition, PrakathiPrakashan Publications Pvt Ltd, Meerut, India, 2015.

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

Semester	Code	Title of the Paper	Hours	Credits						
IV	20UBO4AC7P	Laboratory course for Applied BotanyII - Practical	3	2						
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. A. Aslam

**Checked by:**

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	20UBO4GE2	Generic Elective – II#	Nursery and gardening for entrepreneurship	2	2	100	-	100

### Course Outcomes:

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

1. Distinguish the concept of nursery and Gardening.
2. Expand the skills for growing fresh and safe vegetables.
3. Create awareness about home gardening.
4. Develop different skills regarding the gardening operations.
5. Apply nursery and gardening for entrepreneurship.

### Unit 1: Nursery

**6 Hours**

Definition, objectives, scope and building up of infrastructure for nursery and planning. Planting - direct seeding and transplants. Hardening of plants, green house, mist chamber, shed roof, shade house and glass house.

### Unit 2: Gardening

**6 Hours**

Definition, objectives and scope, formal and informal gardening, garden components, landscape and home gardening. Plant materials and design, computer applications in landscaping. Gardening operations - soil laying, manuring, watering. Kitchen garden, terrestrial garden, soil less culture, vertical garden and bonsai. Management of pests and diseases

### Unit 3: Seeds

**6 Hours**

Structure and types - Seed dormancy, causes and methods of breaking dormancy, seed storage: Seed banks, factors affecting seed viability, genetic erosion, seed production technology, seed testing and certification.

### Unit 4: Vegetative propagation

**6 Hours**

Methods- natural vegetative propagation, artificial vegetative propagation- cutting, layering, grafting and budding, stock and scion relationship. Cultivation of chrysanthemum, roses and jasmine.

### Unit 5: Entrepreneurship

**6 Hours**

Marketing of ornamental and nursery plants– methods, publicity and marketing mix. Schemes and supporting agencies for entrepreneurship– 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**

**Text Books:**

1. Bose TK and Mukherjee D, Gardening in India, 1<sup>st</sup> Edition, Oxford and IBH Publishing Pvt Ltd, New Delhi, India, 1972.
2. Sadhu MK, Plant Propagation, 1<sup>st</sup> Edition, New Age International Pvt Ltd, New Delhi, India, 2007.
3. Kumar N, Introduction to Horticulture, 8<sup>th</sup> Edition, Medtech, Scientific International Pvt Ltd, New Delhi, India, 2017.

**Books for Reference:**

1. Pearson CE, Complete Gardening, 1<sup>st</sup> Edition, Treasure Press, London, England, 1982.
2. Whiteaker S, English Garden Embroidery, 1<sup>st</sup> Edition, Century Hutchinson Ltd, London, England, 1989.

**Web Reference:**

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

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

Semester	Code	Title of the Paper					Hours	Credits			
IV	20UBO4GE2	Nursery and Gardening for Entrepreneurship					2	2			
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. R. Radhakrishnan

**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
V	20UBO5CC9	Core – IX	Plant Systematics and Economic Botany	6	5	100	25	75

### Course outcomes:

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

1. Impart knowledge on taxonomy and its significance.
2. Realize the morphological characters of plant.
3. Understand the different type of taxonomic classification.
4. Describe the vegetative and reproductive characteristic of plants.
5. Familiarize the students with plants having immense economic importance.

### Unit I: Morphology of Angiosperms

**18 Hours**

Parts of a plant body, habit, habitats, modification of leaf, stem and root, reproductive parts (inflorescences, flower and fruits), floral diagram and floral formula. Herbarium techniques, digital herbarium and plant data bases.

### Unit II: Systems of classification

**18 Hours**

History of plant taxonomy. Types of classification – artificial (Linnaeus) natural (Bentham & Hooker), phylogenetic (Engler & Prantle) and outline of APG III & IV classification. Plant nomenclature, binomial, ICBN and its rules. Brief account of cytotaxonomy, chemotaxonomy, numerical taxonomy and molecular taxonomy. BSI and NBRI.

### Unit III: Plant families

**18 Hours**

Study of the following families based on Bentham and Hooker's system of classification – Annonaceae, Rutaceae, Capparidaceae, Anacardiaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Myrtaceae, Cucurbitaceae, #Apiaceae#.

### Unit IV: Plant families

**18 Hours**

Study of the following families based on Bentham and Hooker's system of classification – Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, #Solanaceae#, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae and Poaceae.

### Unit V: Economic botany

**18 Hours**

Cultivation process, economic products and uses of rice, pigeon pea, sunflower, sugar cane, coconut, ground nut, cotton and teak. Process and uses of tea and coffee. Trade potential of *Moringa* (leaf and unripe fruit), curry leaves, periwinkle, *Senna* and glory lilly.

### #-----# Self-study portion

### Text Books:

1. Subrahmanyam NS, Modern Plant Taxonomy, 1<sup>st</sup> Edition, South Asia Books Pvt Ltd., New Delhi, India, 1997.
2. Sivaranjan VV, Introduction to the Principles of Plant Taxonomy, 2<sup>nd</sup> Edition, Oxford & IBH Publishing Co Pvt Ltd., New Delhi, India, 1999.
3. Sambamurthy AVSS, Taxonomy of Angiosperms, 1<sup>st</sup> Edition, IK International Publishing House Pvt Ltd., Karnataka, India, 2005.

**Books for Reference:**

1. Lawrence GHM, Taxonomy of Vascular plants, 1<sup>st</sup> Edition, Oxford & IBH Publishing Co Pvt Ltd., New Delhi, India, 1982.
2. Gamble JS, Flora of the presidency of Madras (Vol. I, II & III), 1<sup>st</sup> Edition (Reprinted), Pragn Publications Pvt Ltd., New Delhi, India, 2012.

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

Semester	Code	Title of the Paper					Hours	Credits		
V	20UBO5CC9	Plant Systematics and Economic 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 = 32, 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

**25% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5CC10	Core – X	Plant Physiology	5	5	100	25	75

### Course outcomes:

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

1. Impart knowledge on insight into the functional aspects of plants.
2. Realize the regulation of plant functions by their environment.
3. Recognize the importance of plant physiological events.
4. Acquire the knowledge on mechanism of photosynthesis, respiration, transpiration and mineral absorption.
5. Realize the control of plant growth and development by plant hormones.

### Unit I: Plant-water relations

15 Hours

Importance of water to plant life, structure and properties of water, diffusion, imbibition and osmosis; Absorption of water - active and passive mechanism, Transpiration – types, significance, mechanism of transpiration; Guttation – hydathodes. Ascent of sap – #path of ascent of sap#, mechanism – vital theories, root pressure theory, physical force theories, transpiration pull, cohesion and tension of water theory.

### Unit II: Mineral nutrition

15 Hours

Absorption of mineral salts: Mechanism - ion exchange, passive and active absorption, carrier concept. Translocation of organic solutes – path ways and mechanism, phloem loading and unloading. Mineral nutrition – Major and minor elements, functions and deficiency symptoms. Nitrogen metabolism – role of nitrogen in plants, sources of nitrogen, conversion of nitrate to ammonia, biological nitrogen fixation - mechanism, #formation of root nodules in leguminous plants#. Factors controlling biological nitrogen fixation.

### Unit III: Photosynthesis

15 Hours

Definition, significance, photosynthetic apparatus, photosynthetic pigments and absorption of light energy, Red drop and Emerson's enhancement effects, Two pigment systems, primary photochemical reactions, dark reaction (Calvin cycle), C4 pathway, photorespiration (C<sub>2</sub> cycle), #Crassulacean acid metabolism (CAM)#. Factors affecting photosynthesis.

### Unit IV: Respiration

15 Hours

Types of respiration in plants, Mechanism – glycolysis, anaerobic respiration – Kreb's cycle, electron transport system and oxidative phosphorylation, #Cyanide resistant respiration#, pentose phosphate pathway and its significance. Entner-Doudoroff pathway, Respiratory quotient and Factors affecting respiration.

### Unit V: Growth and Development

15 Hours

Definition, phases and kinetics of growth. Physiological effects of phytohormones – auxins, gibberellins, cytokinins, abscisic acid, brassinosteroids and ethylene. Physiology of flowering – photoperiodism and role of phytochrome in flowering. #Vernalization#. Physiology of senescence and ageing. Circadian rhythms in plants.

### #-----# Self-study portion

**Text Book:**

1. Verma SK and Verma M, A text book of Plant Physiology, Biochemistry and Biotechnology, 10<sup>th</sup> Revised Edition, S. Chand & Company Pvt Ltd., New Delhi, India, 2010.
2. Jain VK, Fundamentals of Plant Physiology, 14<sup>th</sup> Revised Edition, S. Chand & Company Pvt Ltd., New Delhi, India, 2012.
3. Srivastava HS, Plant Physiology and Biochemistry, 7<sup>th</sup> Edition, Rastogi Publications Pvt Ltd., Uttar Pradesh, India, 2018.

**Reference Book:**

1. Salisbury FB and Ross CW, Plant Physiology, 4<sup>th</sup> Edition, Wardsworth Publication, Stansted, United Kingdom, 2006.
2. Taiz L, Zeiger E, Moller IM, Murphy A, Plant physiology and Development, 6<sup>th</sup> Edition, Sinauer Associates Inc., Massachusetts, United States of America, 2015.

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

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBO5CC10	Plant Physiology					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 = 30, Relationship: Moderate												

**Prepared by:**

Dr. R. Radhakrishnan

**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

**15% contents were changed in the revised syllabus.**



Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal Marks	External marks
V	20UBO5CC11	Core – XI	Biochemistry and Biophysics	5	5	100	25	75

### Course outcomes:

At the end of the course the students are able to

1. Realize the structure, properties and formulation of carbohydrates.
2. Analyze 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. Realize the various bioinstrumentation which are used to detect different biomolecules.

### Unit I: Atoms, chemical bonds, pH and buffers

15 Hours

Structure of atoms, chemical bonding - covalent, noncovalent and electrovalent bonding. Van der Waal forces. pH – principles, measurement and uses of pH meter, electrodes and its types. Bronsted-Lowry concept (proton theory of acids and bases), Buffers system – mechanism of buffer action. #Biological buffer systems#.

### Unit II: Carbohydrates, lipids and vitamins

15 Hours

Carbohydrates – Importance and classification. Properties, structure and formulation of mono, oligo and polysaccharides. Lipids – classification, structure and importance. Fatty acids – saturated and unsaturated fatty acid. Biosynthesis of fatty acids. Vitamins – Classification, properties, composition and importance.

### Unit III: Protein, enzyme and nucleic acids

15 Hours

Proteins – classification, structure and function. Protein configuration – primary, secondary, tertiary and quaternary structure. Denaturation and renaturation of protein. Enzymes - nomenclature, classification, mode of action, km value and #isoenzymes#. Biological significance of protein. Nucleic acid – structure and function of DNA, structural variation in DNA (A-form, B-form, C-form, D-form & Z-form). RNA – structure, functions and types.

### Unit IV: Bioenergetics

15 Hours

Bioenergetics – Laws of thermodynamics, concept of entropy and enthalpy, Gibb's free energy and energy transduction in biological systems. Biological oxidation and reduction reactions. Redox potential. Chloroplast and Mitochondrial bioenergetics. High energy compounds - ATP bioenergetics and energy coupled reactions.

### Unit V: Metabolism

15 Hours

Carbohydrate metabolism – metabolism of glycolysis, citric acid cycle and its regulation, Gluconeogenesis pathway and their significance. Lipid Metabolism – oxidation of fatty acids metabolism of triglycerides and cholesterol. #Biosynthesis of saturated and unsaturated fatty acids#. Protein Metabolism – Catabolism of amino acids – transamination, oxidative and non-oxidative deamination.

### #-----# Self-study portion

### Text Books

1. Claycomb J, Tran JQ, Introductory Biophysics, 1<sup>st</sup> Edition, Jones and Bartlett Indian Pvt Ltd., New Delhi, India, 2011.
2. Jain JL, Jain S and Jain N, Fundamentals of Biochemistry, 6<sup>th</sup> Edition, S. Chand & Company Pvt Ltd., New Delhi, India, 2012.
3. Sathyanarayana U and Chakarapani U, Biochemistry, 5<sup>th</sup> Edition (Revised), Books & Allied Pvt Ltd., New Delhi, India, 2017.

### Books for Reference:

1. Stryer L, Berg JM, Tymoczko JL and Gatto GJ, Biochemistry, 8<sup>th</sup> Edition, W. H. Freeman & Company Pvt Ltd., New York, United States, 2015.
2. Nicolls DG and Ferguson SJ, Bioenergetics, 4<sup>th</sup> Edition, Cambridge, United States, 2013.

### Web Reference:

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				
V	20UBO5CC10	Plant Physiology					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 = 32, Relationship: Moderate												

### Prepared by:

Dr. R. Sathish Kumar

### 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

**50% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5CC12P	Core – XII	Laboratory course for core IX, X & XI – Practical	5	5	20	80	100

### Course outcomes:

At the end of the course the students are able to

1. Identify the family, genus, species, and morphology of the useful parts and uses of the tribal medicinal plants.
2. Interpret the Rf values of amino acids/pigments by paper chromatography.
3. Develop practical skills in separation and quantification of plant pigments.
4. Understand the water absorption and their transport in plants
5. Estimate the sugars/protein/lipid in plant tissues.

### Plant systematics and Economic Botany

1. Observation of the following plant parts
  - a) Inflorescence – simple raceme, spike, corymb, head, simple cyme, cyathium and hypanthodium
  - b) Fruits – simple (fleshy) – berry, drupe, pepo and hesperidium; Indehiscent – Nut. Dry – legume, capsule (loculicidal), Aggregate, Compound and Multiple fruits.
2. Identification and description of plants belongs to the following families
 

Annonaceae	Rutaceae	Capparidaceae
Fabaceae	Caesalpinaceae	Mimosaceae
Myrtaceae	Cucurbitaceae	Rubiaceae
Asteraceae	Apocynaceae	Asclepiadaceae
Solanaceae	Acanthaceae	Lamiaceae
Euphorbiaceae	Poaceae	
3. Dissection of floral parts – Dicot and monocot flowers
4. Economic botany with special reference to their morphology, botanical name and family.
  - a) Rice, Pigeon pea, Sunflower, Sugar cane, Coconut, Castor seed, Ground nut, cotton, Teak, Tea, Coffee and Curry leaves.
5. Botanical tour for minimum 3 days and submission of field report.
6. Submission of herbarium specimens of 20 plants with field note book.
7. Submission of any FIVE Economically important plant parts.

### Plant Physiology

1. Determination of osmotic pressure of Onion / Rheo leaf.
2. Effect of light intensity on transpiration using Ganong's Potometer.
3. Determination of stomatal frequency from the given leaf.
4. Measurement of oxygen evolution under different colored lights using Wilmott's bubbler.
5. Quantitative estimation of plant pigments using Spectrophotometer (DBT star college scheme group practical).

## **Biochemistry and Biophysics**

1. Measurement of pH of a solution using pH meter.
2. Preparation of Buffers.
3. Estimation of carbohydrate by Anthrone method.
4. Estimation of proteins by Lowry's method.
5. Gravimetric estimation of lipids.
6. Separation of plant pigments / amino acids by paper chromatography.
7. Isolation and separation of plant protein by SDS PAGE ((DBT star college scheme group practical).

### **Practical Books:**

1. Mehta AS and Verma AP, Experiments in Plant Physiology, 1<sup>st</sup> Edition, S. Chand & Company Pvt Ltd., New Delhi, India 1987.
2. Sundara Rajan S, Practical manual of angiosperm taxonomy, 1<sup>st</sup> Edition, Anmol publications Pvt Ltd., Bengaluru, Karnataka, India, 2003.
3. Sadasivam S and Manickam A, Biochemical Methods, 3<sup>rd</sup> Edition, New Age International Publishers Pvt Ltd., New Delhi, India, 2018.

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

Semester	Code	Title of the Paper	Hours	Credits						
VI	20UBO5CC12P	Laboratory course for core IX, X & XI – Practical	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 = 30, Relationship: Moderate										

### **Prepared by:**

Dr. A. Shajahan

Dr. R. Radhakrishnan

Dr. R. Sathish Kumar

### **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

**15% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5DE1A	Discipline Specific Elective – I	Biostatistics and Bioinformatics	5	4	100	25	75

### Course outcomes:

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

1. Demonstrate the skill of 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 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 numerical and sequence data in biology.

### Unit I: Descriptive biostatistics

15 Hours

Definition – sampling techniques – types of data, collection, approximation, classification and tabulation – logarithms – Frequency distribution – Diagrammatic and graphical representation of data (Practical learning of construction of Line, Bar, Histogram, Frequency Polygon, Curve and Pie chart using Microsoft Excel).

### Unit II: Measure of data distributions

15 Hours

Central tendency: Mean, median and mode – Measures of dispersion: Range, variance and standard deviation – Introduction to normal, binomial and poisson distributions, Theories of probability – Students t-test, chi square test for goodness of fit and #statistical error#.

### Unit III: Inferential statistics

15 Hours

Introduction to survey of pathogenic diseases of crops and human, Definitions – demonstration rate, ratio and proportion. Calculation of incidence, prevalence, specific mortality, fatality and loss rate (Working out of model problems using WHO tutorials).

### Unit IV: Biological databases

15 Hours

Structure database – PDB; specialized database, literature database; file formats of genebank, Swissprot, PDB, NCBI data model, #data retrieval using entrez#.

### Unit V: Biological sequence analysis

15 Hours

Pair wise sequence comparison - Sequence queries against biological databases – BLAST and FASTA – Multiple sequence alignments – Phylogenetic alignment. Protein structure visualization tools – RasMol and #Swiss PDB Viewer#.

### #-----# Self-study portion

### Text Books:

1. Khan IA and Khanum A, Fundamentals of Biostatistics 2<sup>nd</sup> Edition, Vikas Publications Pvt Ltd., Hyderabad, India, 1994.
2. Gurumani N, An introduction to Biostatistics, 1<sup>st</sup> Edition, MJP Publication Pvt Ltd., Chennai, Tamil Nadu, India, 2005.
3. Prakash S. Lohar. Bioinformatics, 1<sup>st</sup> 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, 1<sup>st</sup> Edition, Cold Spring Harbor Laboratory Press, New York, United States, 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				
VI	20UBO5DE1A	Biostatistics and Bioinformatics					5	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:**

Dr. A. Aslam

**Checked by:**

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

**25% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credit	Max. marks	Internal marks	External marks
V	20UBO5DE1B	Discipline Specific Elective – I	Enzyme Technology	5	4	100	25	75

### Course outcomes:

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

1. Understand the basics of enzymes and its applications.
2. Demonstrate different structure of enzymes.
3. Explain different methods of enzyme assay.
4. Justify the enzyme catalysis and inhibition.
5. Solve different factors involving enzyme kinetics.

### Unit I: Introduction

**15 Hours**

Enzyme properties, sources and applications. Chemical nature and classification of enzymes. Differences between catalyst and biocatalyst. #Functions of enzymes and industrial applications#.

### Unit II: Enzyme structure

**15 Hours**

Primary – peptide bonds. Secondary – alpha helix, beta sheet and super secondary structures. Ramachandran plot. Tertiary and quaternary structure.

### Unit III: Enzyme assay

**15 Hours**

Introduction – Initiating, mixing and stopping reactions. Maintaining enzyme structure during enzyme assay. Quantitative description of enzyme assay. Types of assay, direct and indirect assay. Instrument used for enzyme assay.

### Unit IV: Enzyme catalysis and inhibition

**15 Hours**

Lock and key model. Induced fit and Transition state hypotheses. Mechanism of enzyme catalysis – Acid-base catalysis, covalent catalysis, metal ion catalysis. Proximity and orientation effects. Reversible inhibition – competitive, non-competitive and uncompetitive. Mixed, substrate, allosteric and product inhibition. Irreversible Inhibition – suicide inhibition. #Enzyme immobilization techniques#.

### Unit V: Enzyme kinetics

**15 Hours**

Factors affecting the enzyme activity – concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction. Michealis-Menten Equation, Km, Vmax, L.B Plot, Turnover number and Kcat. Kinetics of Enzyme inhibition. #Kinetics of allosteric enzymes#.

### #-----# Self-study portion

### Text Books:

1. Nicholas CP, Fundamentals of Enzymology, 3<sup>rd</sup> Edition, Oxford University Press Pvt Ltd., New York, United States, 2009.
2. Bhatt SM, Enzymology and enzyme technology, 1<sup>st</sup> Edition, S. Chand and company Pvt Ltd., New Delhi, India, 2014.
3. Sathyanarayana U and Chakarapani U, Biochemistry, 5<sup>th</sup> Edition (Revised), Books & Allied Pvt Ltd., New Delhi, India, 2017.

**Books for Reference:**

1. Voet D and Voet JG, Biochemistry, 4<sup>th</sup> Edition, J. Wiley & Sons Pvt Ltd., New York, United States, 2010.
2. David LN and Michael MC, Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, WH Freeman Company Pvt Ltd., New York, United States, 2013.

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

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBO5DE1B	Enzyme Technology					5	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. 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

**80% contents were changed in the revised syllabus.**



Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5SE2A	Skill Enhancement Course – II	Algal Cultivation Techniques for Entrepreneurship	2	2	100	---	100

### Course outcomes:

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

1. Recall various algae as potential bio resources.
2. Identify the possibilities of large scale cultivation of both fresh water and marine algae.
3. Examine algae as alternative candidate for cultivation.
4. Appraise various cultivation methods for algae.
5. Adapt algal cultivation for entrepreneurial initiatives.

### Unit I: Algae habit and habitats

6 Hours

Aquatic – Freshwater and Marine. Terrestrial – Saphophytes, Cryptophytes. Algae of Unusual habitats – Lithophytes, Halophytes, Epiphytes, Aerophytes, Epizoophytes, Cryophytes, Symbionts or endophytes, endozoophytes, parasites and thermophytes.

### Unit II: Algal culture

6 Hours

Scope and kinds of algal culture. Culture media – ASN III, ASP 2, Bristol, BG11, Fogg's, Beneck's Broth, SP Chu medium. Factors affecting the culture and growth – Physiological, chemical and environmental.

### Unit III: Microalgal culture

6 Hours

Indoor mass cultivation and processing of microalgae. Commercial species and industrial production of microalgae. Outdoor mass culture of microalgae – *Spirulina*, *Chlorella* and *Botryococcus*. Technological aspects of microalgal culture.

### Unit IV: Marine macro algae/seaweed cultivation

6 Hours

Cultivation techniques of following seaweeds – *Sargassum wightii*, *Gracilaria edulis*, *Hypnea musciformis*, *Kappaphycus alvarezii*, *Enteromorpha flexuosa* by line, net, floating bamboo, bottom monoline, mangrove stakes and net methods.

### Unit V: Algae for entrepreneurs

6 Hours

Algae business strategies for the future. Marketing challenges of algae. Training programme offered by NFDB, Pradhan Mantri Matsya Sampada Yojana (PMMSY), SWOT analysis, Awareness on seaweed products, national and international benchmarks. Algal research centers in India. Government (Central and State) assistance (funding) for algal entrepreneurs.

### #-----# Self-study Portion

### Text Books:

1. Amos R, Handbook of Microalgal Culture: Biotechnology and Applied Phycology, 1<sup>st</sup> Edition, Blackwell Science Pvt Ltd., United Kingdom, 2004.
2. Sharma OP, Algae: Diversity of Microbes and Cryptogams, 1<sup>st</sup> Edition, Tata McGraw-Hill Education Pvt Ltd., New York, USA, 2011.
3. Tiwari B, Seaweed Sustainability: Food and non-food applications, 1<sup>st</sup> Edition, Academic Press Pvt Ltd., Cambridge, United States, 2015.

**Books for Reference:**

1. Robert A. Andersen, Algal Culturing Techniques, 1<sup>st</sup> Edition, Elsevier Academic Press, California, United States, 2004
2. Sieg D and Edwards M, Algae for Entrepreneurs: Small Business Application of Algae, 1<sup>st</sup> Edition, Create Space Independent Publishers Pvt Ltd., United States, 2011.

**Web Reference:**

1. <https://plantlet.org/algae-culture-types-culture-media/>
2. <http://www.nrmcf.org/docs/CultureDetails.pdf>
3. <http://www.fao.org/3/y4765e/y4765e04.htm#TopOfPage>
4. <http://www.fao.org/3/w3732e/w3732e02.htm#TopOfPage>
5. <http://www.fao.org/3/ac416e/ac416e00.htm>

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

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBO5SE2A	Algal Cultivation Techniques for Entrepreneurship					2	2				
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. M. Ghouse Basha

**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

**Newly introduced skill enhancement course (100% new content).**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5SE2A	Skill Enhancement Course – II	Food Microbiology	2	2	100	---	100

### Course outcomes:

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

1. Understand the role of microbes in food microbiology.
2. Realize the role of microbes in food spoilage.
3. Inculcate the various applications of food preservation.
4. Recognize the significances of fermentation products.
5. Categorize the microbes on food borne illness.

### Unit I: Food as a substrate for microbes

**6 Hours**

Hydrogen ion concentration (pH), moisture requirement – concept of water activity, oxidation reduction potential, nutrient content, inhibitory substances and biological structure, combined effect of factors affecting the growth. Microbes involved in food microbiology – Importance and #industrial importance of yeast, molds and bacteria#.

### Unit II: Microbial spoilage of foods

**6 Hours**

Contamination of foods – Structure, composition, primary processing and spoilage of vegetables, fruits, meat, sea foods and dairy products.

### Unit III: Principles of food preservation

**6 Hours**

Methods, principles, applications, asepsis, removal, anaerobic condition. Food preservative chemicals (Benzoic and salicylic acid), radiation (gamma, electron beam and radappertization). #Low temperatures and high temperatures#.

### Unit IV: Fermentation products

**6 Hours**

Vitamins – Vitamin B<sub>12</sub>, Riboflavin and Vitamin A. Enzymes – Amylases, Proteolytic enzymes and Pectinases. Organic acids – Citric acid, Fumaric acid, Itaconic acid and #bacterial gluconic acid#.

### Unit V: Food borne illness

**6 Hours**

Bacterial diseases – *Bacillus*, *Clostridium*, *Salmonella* and *Vibrio*. Food borne poisonings, infections and intoxications – mycotoxins, #aflatoxin#, patulin and ochratoxin.

### #-----# Self-study Portion

### Text Books:

1. Frazier WC, Westhoff DC, Food Microbiology, 4<sup>th</sup> Edition, Tata McGraw-Hill publishing Company Pvt Ltd., New York, United States, 1995.
2. Adams, MR, Moss MO, Food Microbiology, 2<sup>nd</sup> Edition, The Royal Society of Chemistry, London, United Kingdom, 1995.
3. Casida LE, Industrial Microbiology, 1<sup>st</sup> Edition (Reprinted), New Age International Pvt Ltd., New Delhi, India, 2006.

**Books for Reference:**

1. James MJ, Modern Food Microbiology, 4<sup>th</sup> Edition, 1<sup>st</sup> Edition (Reprinted), Chapman & Hall, Inc., Pvt Ltd., New York, United States, 2005.
2. Dubey RC, Maheshwari, DK, Microbiology, 1<sup>st</sup> Edition (Revised), S. Chand & Company Pvt Ltd., New Delhi, India, 2010.

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

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBO5SE2B	Food Microbiology					2	2				
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

**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

**20% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5SE3A	Skill Enhancement course – III	Greenhouse Technology	4	4	100	-	100

### Course outcomes:

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

1. Summarize the history of protected cultivation and evolution in control of greenhouse environment.
2. Classify the greenhouses based on shape, utility, construction and covering materials.
3. Manipulate root medium and integrated pest management with reference to greenhouse agriculture.
4. Recognize the rules of watering, irrigation types and application of hydroponics in greenhouse cultivation.
5. Analysis strength, weakness, opportunities and challenges in greenhouse technology.

### Unit I: Introduction and classification

**12 Hours**

History, advantages and disadvantages of greenhouse. Classification – Based on shape, utility, construction and covering materials. Plant response to greenhouse environment – light, temperature, relative humidity, ventilation and carbon dioxide. Controlling factors inside the greenhouse – manual controlling, thermostats, active summer and winter cooling system and carbon dioxide enrichment methods. #Greenhouse heating system#.

### Unit II: Planning and facility

**12 Hours**

Site selection, orientation and structural design. Greenhouse ventilation – natural and forced ventilation, microprocessors and computers. Greenhouse construction materials – wood, galvanized iron, aluminium, steel, glass and reinforced cement concrete. Greenhouse covering materials – #Polyethylene#, polyvinyl chloride, polyester and Tefzel T<sup>2</sup> films.

### Unit III: Rooting medium, mulches and plant protection

**12 Hours**

Desirable characters of horticultural soils (physical and chemical). Changes in the management of the root medium. Functions and requirements, types, techniques and disposal of mulches. Chemical, biological and climate control. Integrated Pest Management (IPM). Prophylaxis and #most common greenhouse diseases (Bacterial, fungal and viral diseases) and pests#.

### Unit IV: Irrigation system and fertilization

**12 Hours**

Rules of watering. Quality of the irrigation water. Types and components of hand, perimeter, overhead sprinklers, boom watering and drip irrigation systems. Fertilization – Organic and inorganic nutrients. Hydroponics system – Deep flow and dynamic root floating system. Nutrient film technique and #cultural procedures#.

### Unit V: Economics of greenhouse production and marketing

**12 Hours**

Environmental impact assessment. Economic analysis – capital requirements. Production strategies and tactics. Tropical and mediterranean climates – general aspects, biological aspects and future perspectives. Marketing channels, quality, transport, distribution of greenhouse products and SWOC analysis. #POST-harvest pathology#.

### #-----# Self-study Portion

**Text Books:**

1. Manohar KR, Greenhouse technology and management, 2<sup>nd</sup> Edition, B.S. Publishers Pvt Ltd., New Delhi, India, 2007.
2. Patil NN, Greenhouse Technology – Management, operations and Maintenance, 1<sup>st</sup> Edition, Universal Prakashan Pvt Ltd., Pune, India, 2016.
3. Ghoush A, Greenhouse Technology, 1<sup>st</sup> Edition, New India Publishing Agency Pvt Ltd., New Delhi, India, 2018.

**Books for Reference:**

1. Tiwari GN, Greenhouse for controlled environment, 1<sup>st</sup> Edition, Alpha Science International Pvt Ltd., United Kingdom, 2003.
2. Castilla N and Esteban JB, Greenhouse Technology and Management, 2<sup>nd</sup> Edition, CAB International Pvt Ltd., United Kingdom, 2012.

**Web Reference:**

1. <http://indiaeng.com/Kaveripakkam/04%20-Greenhouse%20technology.htm>
2. <https://www.netafim.com/en/greenhouse/greenhouse-technology/>
3. [https://agritech.tnau.ac.in/agricultural\\_engineering/greenhouse.pdf](https://agritech.tnau.ac.in/agricultural_engineering/greenhouse.pdf)
4. <https://www.azocleantech.com/article.aspx?ArticleID=492>
5. <https://www.irrichvalve.com/wp-content/uploads/2017/07/A-Technical-Introduction-to-Fertigation.pdf>

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

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBO5SE3	Greenhouse Technology					2	2			
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 = 36, Relationship: High											

**Prepared by:**

Dr. N. Ahamed Sherif

**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

**75% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
V	20UBO5SE3B	Skill Enhancement Course – III	Remote Sensing	2	2	100	25	75

### Course outcomes:

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

1. Explain the fundamentals of remote sensing and its types.
2. Describe different type of satellites, sensors and their resolution.
3. Understand Satellite image processing and classification methods.
4. Enlighten the concepts of GIS and GPS.
5. Recognize various application of remote sensing for assessment of bio resources.

### Unit I: Fundamental of remote sensing

**6 Hours**

Introduction to Remote Sensing – definition, principles, electromagnetic radiation (EMR), atmospheric windows. Satellites – polar orbitary, eostationary satellites, platforms and sensors. Remote sensing types – optical, microwave, thermal, multispectral and hyper spectral.

### Unit II: Satellite and sensors

**6 Hours**

Aerial photographs, international and indigenous satellite missions Landsat TM, Landsat OLE, Sentinel 1, 2 Indian Remote Sensing Satellites and their resolution, capabilities. Low and High Resolution – Quick bird, Digital Globe. Satellite merged products- LISS+PAN. Ortho images – Cartosat and Ocean Sat.

### Unit III: Satellite data processing

**6 Hours**

Methods of satellite data download from USGS, Copernicus Open Access Hub, image processing – GPS data collection, georeferencing, mosaicking and sub setting images. Image interpretation and classification – interpretation keys, visual interpretation, unsupervised and supervised classification.

### Unit IV: GIS and GPS

**6 Hours**

Basics of geography, fundamentals of GIS, Map projections, Coordinate system, datum's Spatial and non-spatial data types, digitization, error handling, thematic map generation, visualization. GNSS – GPS, GLONASS/ Galileo - principles of GPS, DGPS, application of GPS. Open Source GIS data and software

### Unit V: Application of remote sensing

**6 Hours**

Biodiversity characterization, Gap analysis, Mapping deforestation, Land use Change Detection, Forest fire risk analysis, Habitat suitability analysis, Setting conservation priority, Species Distribution Models (SDM), Biomass and stack mapping, crop monitoring and forecast.

### #-----# Self-study Portion

### Text Books:

1. Panda BC, Remote Sensing: Principles and Application, 1<sup>st</sup> Edition, Viva Books Pvt Ltd., New Delhi, India, 2008.
2. Lillesand TM, Kiefer RW and Chipman JW, Remote Sensing and Image Interpretation, 6<sup>th</sup> Edition, John Wiley & Sons Inc., New Delhi, India, 2008.

- Bhatta B, Remote Sensing and GIS, 3<sup>rd</sup> Edition, Oxford University Press Pvt Ltd., New Delhi, India, 2021.

### Books for Reference

- Anji Reddy M, A textbook of Remote Sensing and Geographical Information Systems, 3<sup>rd</sup> Edition, BS Publication Pvt Ltd., Hyderabad, India, 2005.
- Chang KT, Introduction to geographic information systems, 6<sup>th</sup> Edition, Tata McGraw Hill Education Pvt Ltd., Noida, India, 2011.

### Web Reference:

- <http://www.sc.chula.ac.th/courseware/2309507/Lecture/remotel8.htm>
- <https://www.princeton.edu/~alaink/Orf467F07/GNSS.pdf>
- [https://webapps.itc.utwente.nl/librarywww/papers\\_2009/general/principlesremotesensing.pdf](https://webapps.itc.utwente.nl/librarywww/papers_2009/general/principlesremotesensing.pdf)

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

Semester	Code	Title of the Paper					Hours	Credits				
V	20UBO5SE3B	Remote Sensing					2	2				
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:

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

**60% contents were changed in the revised syllabus.**



Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6CC13	Core – XIII	Plant Ecology and Phytogeography	5	5	100	25	75

### Course outcomes:

At the end of the course students will be able to

1. Describe the fundamentals of ecology, ecosystem and population ecology.
2. Explain the characteristics of community ecology and various types of species interaction
3. Point out the different pollution and its control measures.
4. Match the energy resources and different types of conservation
5. Understand different phytogeographical regions of India and geospatial methods for assessment of bioresources.

### Unit I: General ecology

**15 Hours**

Definition, fundamentals and scope of ecology, Climatic, edaphic, biotic factors, autecology, synecology speciation, mechanisms and patterns of speciation. Ecosystems – types, dynamics, measurement of productivity – primary, secondary, gross and net. Population Ecology – natality, mortality, age distribution, population fluctuation and dispersal.

### Unit II: Community ecology

**15 Hours**

Characteristics of community, food chain, food web, energy flow and ecological pyramids. Succession and its types, climax and biomes. Species interactions – mutualism, commensalism, parasitism, predation and competition.

### Unit III: Pollution and its control

**15 Hours**

Air pollution, air pollutants, photochemical smog, particulate matter, Bhopal episode, London smog and air pollution control measures. Point and non-point pollution, water pollution and its control measures and acid rain. Water Quality standards – house hold and industrial. Municipal Solid Waste Management (MSW), treatment of sewage water. Overview of environmental acts.

### Unit IV: Biodiversity and conservation

**15 Hours**

Biodiversity – Definition, types, role, functions and loss. IUCN RET (Rare, Endangered, Threatened) categories of species. Conservation types and measures – *In situ* (Protected Areas (PAs), UNESCO Biosphere Reserves, FAOs Globally Important Agriculture Heritage Sites (GIAHS), National Parks, Sacred Groves and Wild life Sanctuaries). *Ex situ* (Botanical Garden, Zoos, Germplasm and Seed Banks). Peoples movements – Appiko, Bishnoi, Chipko and, Silent Valley Movements and Narmada Bachao Andolan.

### Unit V: Phytogeography

**15 Hours**

Phytogeographical regions of India, Vegetation types of Tamil Nadu, island Biogeography, Endemism and its types, Hotspots- definition, Hot spots in Tropical regions. Measurements of Phytogeography, Application of Geospatial technology for Conservation of Natural Resources – Forest and Marine.

### Text Books:

1. Shukla RS and Chandel PS, Plant Ecology and Soil Science, 1<sup>st</sup> Edition, S. Chand & Company Pvt Ltd., New Delhi, India, 1989.
2. Sharma PD, Plant Ecology and Phytogeography, 1<sup>st</sup> Edition, Rastogi Publication Pvt Ltd., Meerut, India, 2019.

- Anil Thakur A, Susheel Bassi K and Sood SK, Plant Ecology and Taxonomy, 1<sup>st</sup> Edition, S. Dinesh and Co Pvt Ltd., Jalandhar, India, 2020.

### Books for Reference:

- Odum E and Barrett G, Fundamentals of Ecology, 5<sup>th</sup> Edition, Brooks/cole publishing company, Pvt Ltd., United States, 2004.
- Miller G and Spoolman S, Essentials of Ecology, 7<sup>th</sup> Edition, Brooks/cole publishing company Pvt Ltd., United States, 2014.

### Web Reference:

- <https://sangu.ge/images/Essentials of Ecology.pdf>
- [https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied\\_Ecology\\_1\\_2647.pdf](https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_1_2647.pdf)
- <https://www.ancpatna.ac.in/departments/botany/lectures/PG%20Sem-II/People's%20Movement%20for%20Conservation-S%20.pdf>

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

Semester	Code	Title of the Paper					Hours	Credits			
VI	20UBO6CC13	Plant Ecology and Phytogeography					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 = 30, Relationship: Moderate											

Prepared by:

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

**70% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6CC14	Core – XIV	Plant Molecular Biology and Biotechnology	5	5	100	25	75

### Course outcomes:

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

1. Describe the salient features of organization and molecular mechanisms of cell
2. Get exposure on prokaryotic and eukaryotic gene regulation
3. Acquire basic knowledge in plant biotechnology.
4. Recognize Agrobacterium transformation and applications of plant biotechnology
5. Acquire basic knowledge in intellectual property rights, biosafety of genetically engineered products and guidelines in India.

### Unit I: Organization of genome

15 Hours

Eukaryote genomic DNA, double helix, different types of DNA structures and packing. DNA genetic material. Extranuclear inheritance. Concept and nature of gene and types of gene. Replication of DNA – Variations in semiconservative mode of replication. <sup>#</sup>RNA – Synthesis and types<sup>#</sup>.

### Unit II: Genetic code and gene expression

15 Hours

Introduction, differences between DNA and RNA. Central dogma. Properties of the genetic code. Transcription in eukaryotes, structure of ribosome, process of translation and protein structure. Post transcription modification. Inteins, protein folding and types. <sup>#</sup>Protein targeting in eukaryotes<sup>#</sup>.

### Unit III: Recombination DNA technology

15 Hours

Molecular tools of genetic engineering. Host cells – the factories of cloning. Vectors – the cloning vehicles, methods of gene transfer, gene cloning strategies and genetic engineering of plants. <sup>#</sup>Genetic engineering guidelines<sup>#</sup>.

### Unit IV: Plant tissue culture

15 Hours

History, scope and achievements of plant tissue culture. Types of media and preparation, totipotency and explants. Direct and indirect organogenesis and regeneration. Protoplast isolation, fusion and cell suspension culture. Agrobacterium mediated gene transformation. Improvement of hybrids and production of disease resistant for crop improvements. <sup>#</sup>Applications of plant tissue culture in agriculture<sup>#</sup>.

### Unit V: Intellectual Property Rights and Biotechnology

15 Hours

Definition, types – copyright, trademarks, industrial designs, patents and geographical indicators. Patentable and non-patentable biotechnological products, Patents Act – 1970 and its applications in biotechnology and allied fields. Plant Breeders Rights – PPV and FRA. Department of Biotechnology (DBT). <sup>#</sup>Government of India initiatives for promotion of Biotech Innovation<sup>#</sup>.

### #-----# Self-study portion

### Text Books:

1. Deepa G and Parashar S, IPR, Biosafety and Bioethics, 1<sup>st</sup> Edition, Pearson Education Pvt Ltd., New Delhi, India, 2013.

- Ramawat KG and Goyal S, Molecular Biology and Biotechnology, 2<sup>nd</sup> Edition, S. Chand and company limited Pvt Ltd., New Delhi, India, 2019.
- Satyanarayana U, Biotechnology, 6<sup>th</sup> Edition, Books and Allied Pvt Ltd., Kolkata, India, 2020.

**Books for reference:**

- Freifelder D, Molecular Biology, 2<sup>nd</sup> Edition, Narosa Publishers Pvt Ltd., New Delhi, India 1994.
- Buchanan BB, Grussem W and Jones RL, Biochemistry and Molecular Biology of Plants, IK International Publishers Pvt Ltd., New Delhi, India, 2000.

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

Semester	Code	Title of the Paper					Hours	Credits			
VI	20UBO6CC14	Plant Molecular Biology and Biotechnology					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 = 30, 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

**20% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6CC15	Core – XV	Biological Techniques	5	5	100	25	75

### Course outcomes:

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

1. Explain the uses of various fixatives, microtomes and stains for tissue processing and sectioning.
2. Elucidate the extraction and isolation of plant constituents.
3. Describe the principle and application of colorimeter, spectrophotometer and chromatography in biosciences.
4. Appraise the centrifugation techniques to separate fluids and liquids based on density.
5. Develop theoretical and practical knowledge on biological techniques.

### Unit I: Histological techniques for plant tissues

15 Hours

Techniques of fixing plant tissues. Reagents in killing and fixation – Formalin acetic acid alcohol mixtures and zenker's fluid. Dehydration – Methods and reagents – Ethyl alcohol and xylene. Stains and staining methods – Anilin blue, congo red, fast green, hematoxyline, malachite green, Toluidine Blue O (TBO) and #safranin#, Permanent whole mounts. Cytological methods – Acetocarmine. Maceration method – Harlow's. Microtome – Steps and precautions, types and knives. Methods of embedding and block making.

### Unit II: Extraction and isolation of plant constituents

15 Hours

The nature of cell wall in different plant groups. Methods of disrupting cell walls – physical (#Blending#, grinding with abrasives, disrupter presses and sonication) and enzymatic (EDTA, Zymolase). Extraction of plant constituents by hot and cool methods. Solvent removal from plant constituents

### Unit III: Spectrophotometry techniques

15 Hours

Beer's, Lambert's and Beer-Lambert laws. Principle, components and applications of photoelectric colorimeters. UV-Visible and florescence spectrophotometer, Fourier Transform Infrared Spectroscopy (FTIR), Atomic Absorption Spectroscopy (AAS) and Electrochemical Impedance Spectroscopy (EIS).

### Unit IV: Centrifugation techniques

15 Hours

Definition, Svedberg unit, sedimentation rate and coefficient. Relative centrifugal force (RCF). Centrifugation techniques – density gradient, rate-zonal, isopycnic and differential. Types of rotors and their purposes. Types of centrifuges and its applications – #small bench#, high speed and ultracentrifuge.

### Unit V: Chromatographic techniques

15 Hours

Principles of separation techniques. Mobile phases, Rf value and retention time. Types of chromatography and their applications – Paper, thin layer, column, HPTLC, HPLC, ion exchange and GCMS.

#-----# Self-study portion

**Text Books:**

1. Asokan P, Analytical Biochemistry: Biochemical Techniques, 2<sup>nd</sup> Edition, Chinna publications Pvt Ltd., Vellore, Tamil Nadu, India, 2003.
2. Bajpai PK, Biological Instrumentation and Methodology, 1<sup>st</sup> Revised Edition, Chand & Company Pvt Ltd., New Delhi, India, 2010.
3. Kishore RP and Ashok ED, A Book of Biological Techniques, 1<sup>st</sup> Edition, Nirali Prakashan Pvt Ltd., Pune, India, 2017.

**Books for Reference:**

1. Webster JG, Bioinstrumentation, 1<sup>st</sup> Edition, Wiley publishing company, New Jersey, United States, 2007.
2. Gurumani N, Research Methodology for Biological Sciences, 1<sup>st</sup> Edition, MJP Publication Pvt Ltd., Chennai, Tamil Nadu, India, 2011.

**Web Reference:**

1. <https://nios.ac.in/media/documents/dmlt/HC/Lesson-09.pdf>
2. <https://www.youtube.com/watch?v=SEicK9UT7pY>
3. <https://www.youtube.com/watch?v=HSZJcv8fg5c>
4. <https://microbenotes.com/types-of-spectroscopy/>
5. <https://microbenotes.com/types-of-chromatography/>

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

Semester	Code	Title of the Paper					Hours	Credits				
VI	20UBO6CC15	Core – XV					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 = 35, Relationship: High												

**Prepared by:**

Dr. N. Ahamed Sherif

**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

**Newly introduced core course (100% new content).**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6CC16P	Core – XVI	Laboratory course for core XII, XIV and XV – Practical	5	5	100	20	80

### **Course outcomes:**

At the end of the course the students are able to

1. Demonstrate distribution of various biotic and abiotic factors of environment
2. Experiment with biological techniques related to ecological parameters, plant biotechnology.
3. Analyze the role of nutrients in tissue culture.
4. Assess the quality and quantity of DNA isolated from plant specimens.
5. Test the fixation, staining and visualization methods for plant specimens.

### **Plant Ecology and Phytogeography**

1. Study of morphological and anatomical features of hydrophytes and xerophytes.
2. Study of morphological features of epiphytes, parasites and halophytes.
3. Study of vegetation by quadrat method – frequency, abundance and density.
4. Determination of pH in garden soil.
5. Estimation of Chloride.
6. Estimation of total dissolved solids.
7. Observation of charts, book diagrams and materials from internet pertaining to phytogeographical syllabus.

### **Plant molecular biology and biotechnology**

1. Sterilization techniques.
2. Preparation of stock solutions (medium and plant growth regulators).
3. Plant tissue culture medium preparation (Murashige and Skoog medium – solid and Liquid).
4. Micropropagation of plant by shoot tip and nodal culture (DBT star college scheme group practical).
5. Organogenesis of medicinal plants (DBT star college scheme group practical).
6. Isolation of plant genomic DNA by CTAB method (DBT star college scheme group practical).
7. Quantification of DNA using spectrophotometric method (DBT star college scheme group practical).
8. Patent database and biosafety information resource centre (BIRC) – google search (Demonstration).

### **Biological Techniques**

1. Preparation of fixatives for plant specimens.
2. Preparation of stains for plant specimens. (Acetocarmine, safranin, cotton blue and fast green).
3. Extraction of plant constituents using soxhlet apparatus (Demonstration).
4. Methods of embedding and block making of plant tissues for microtome.

### **Practical Books:**

1. Sundara Rajan S, Plant Ecology and Plant Physiology, 1<sup>st</sup> Edition, Anamol Publication Pvt Ltd., New Delhi, India, 2003.
2. Kishore RP and Ashok ED, A Book of Biological Techniques, 1<sup>st</sup> Edition, Nirali Prakashan Pvt Ltd., Pune, India, 2017.

3. Thatoi H, Dash S and Das SK, Practical Biotechnology: Principles and Protocols, 1<sup>st</sup> Edition, Dreamtech Press Pvt Ltd., New Delhi, India, 2020.

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

Semester	Code	Title of the Paper					Hours	Credits			
VI	20UBO5CC12P	Laboratory course for core IX, X & XI - Practical					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 = 35, Relationship: High											

**Prepared by:**

Dr. K. Mohamed Rafi

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

**45% contents were changed in the revised syllabus.**



Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6DE2A	Discipline Specific Elective – II	Industrial Botany	5	4	100	25	75

### Course outcomes:

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

1. Recall various plants as potential bio resources.
2. Identify the possibilities of large scale production of plant based products.
3. Examine medicinal plants as alternative candidate for industrial applications.
4. Appraise various methods of fermentation.
5. Adapt mushroom cultivation for entrepreneurial initiatives.

### Unit I: SCP and seaweed production

15 Hours

Single cell protein (SCP) – algal single cell protein – *Spirulina and Chlorella* mass cultivation and its applications. *Sargassum* (seaweed) mass cultivation and their applications. #Mass production of *Yeast* #.

### Unit II: Biofuel technology

15 Hours

Introduction to biofuels, bioethanol and industrial production uses and advantages of Bioethanol, biodiesel, Manufacture of biodiesel, biogas production and uses. #Bio-hydrogen production and uses #.

### Unit III: Fermentation technology

15 Hours

Introduction, stages of fermentation, types of bioreactors, formulation and sterilization of medium, isolation and selection of microorganism, production of stock culture and inoculum development, culture of microorganism in bioreactor. Fermentation processes-upstream and downstream process. #Importance of fermentation products #.

### Unit IV: Mushroom cultivation

15 Hours

Morphology of common edible mushrooms, cultivation of paddy straw, oyster and white button mushrooms. Spawn production and storage of mushrooms. Recipes of mushrooms. #Nutritive and medicinal value of edible mushrooms #.

### Unit V: Medicinal plant products

15 Hours

Preparation and processing of cosmaceutical agents (peppermint oil, lavender oil, Lemon grass oil) and natural pesticides (neem, vitex and pyrethrum) – #Cultivation and post-harvest technology of *Vinca rosea, Gloriosa superba* #.

### #-----# Self-study portion

### Text Books:

1. Pandey RK, Ghosh SK and Chauhan KS, A hand book on mushroom cultivation. 1<sup>st</sup> Edition, Emkay Publications Pvt Ltd., Delhi, India, 1996.
2. Kokate CK, Purohit AP and Gokhale SB, Pharmacognosy, 55<sup>th</sup> Edition, Nirali Prakasan Pvt Ltd., Pune, India, 2008.
3. Kumaresan V, Biotechnology, 11<sup>th</sup> Revised Edition, Saras Publication Pvt Ltd., Nagercoil, Tamil Nadu, India, 2013.

**Books for Reference:**

1. Dubey RC. A textbook of Biotechnology, 5<sup>th</sup> Edition, S. Chand and Company Pvt Ltd., New Delhi, India 2014.
2. Hema S, Savita R and Rahangdale S, Industrial Botany-I, 2<sup>nd</sup> Edition, Vision Publication Pvt Ltd., Maharastra, India 2015.

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

Semester	Code	Title of the Paper					Hours	Credits			
VI	20UBO6DE2A	Industrial Botany					5	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. M. Kamaraj

**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

**5% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UB06DE2B	Discipline Specific Elective – II	Seed Technology	5	4	100	25	75

### Course outcomes:

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

1. Recall various aspects of plant seeds and their production.
2. Outline the seed processing, storage and marketing aspects.
3. Apply seed testing methods.
4. Appraise the importance of seed certification.
5. Adapt various legislation procedures for seed certification

### Unit I: Introduction

**15 Hours**

Introduction – Floral biology. Seed formation. Seed morphology and structural details of Dicot (Castor) and Monocot (Paddy) seeds. Roles and goals of seed technology, importance of quality seeds in agriculture, characteristics of quality seed. #General principles of seed production#.

### Unit II: Seed processing, storage and marketing

**15 Hours**

Seed processing – plan for seed processing, Seed drying, seed cleaning and upgrading, seed collection, seed treatment – seed packaging and handling – Principles of storage – stage of seed storage – Equipment's used for packaging of seeds, labelling, measures for pest and disease control, seed storage and #seed marketing#.

### Unit III: Seed testing

**15 Hours**

Introduction to seed testing, methods of sampling, seed purity and determination of density. Heterogeneity of seed lots. Determination of genuineness of varieties DUS testing. Germination methods – using paper, sand and soil. Standard germination test – Seed dormancy, Seed vigour and Seed viability (Tetrazolium method). #Seed moisture, importance and methods of determination#.

### Unit IV: Certified seed production

**15 Hours**

Certified seed production of the following Cereals – Paddy and Maize. Pulses – Red Gram, Soybean and Black gram. Oil seeds – Groundnut and Sunflower. Fibres – Cotton and Jute. Fruit – Tomato and Chillies. #Vegetables – Cauliflower and Cabbage#.

### Unit V: Seed certification and seed legislation

**15 Hours**

Seed certification – objectives, certification agency, staffing pattern of seed certification agency. Seed Certification Standards – Field and seed inspection. Seed analysis – Tagging of seedlings, field standards. Seed legislation and seed law enforcement, seed certification regulations, power of Central Government and #recognition of seed certification agency of foreign countries#.

### Text Books:

1. Vanangamudi K, Seed Science and Technology: An illustrated, 1<sup>st</sup> Edition, New India Publishing Agency Pvt Ltd., New Delhi, India, 2014.
2. Agarwal RL, Seed Technology, 2<sup>nd</sup> Edition, Oxford & IBH Publishing Co Pvt Ltd., New Delhi, India, 2018.

3. Padmavathi S, Prakash M, Ezhil Kumar S, Sathiyarayanan G and Kamaraj A. A Textbook of Seed science and Technology. New India Publishing Agency Pvt Ltd., New Delhi, India, 2020.

**Reference books:**

1. Black M, Bradford KJ and Vazquez Ramos J, Seed Biology: Advances and Applications, 1<sup>st</sup> Edition, CABI Publishing Pvt Ltd., New York, United States, 2000.
2. Bewley JD and Black M, Seed Physiology of development and germination, 1<sup>st</sup> Edition, Plenum Press, New York, 2011.

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

Semester	Code	Title of the Paper					Hours	Credits			
VI	20UBO6DE2B	Seed Technology					5	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. M. Kamaraj

**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

**100% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UB06DE3A	Discipline Specific Elective – III	Horticulture and Plant Breeding	4	4	100	25	75

### Course outcomes:

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

1. Realize the entrepreneur opportunity and values of horticulture.
2. Conclude the advantages, disadvantages and limitation of various propagation techniques.
3. Familiarize with the cultivation practices of fruits, vegetables and design the various types of gardens.
4. Impart theoretical knowledge on scope and importance of plant breeding.
5. Apply the principle involved in conventional and special plant breeding techniques.

### Unit I: Fundamentals of Horticulture

12 Hours

Scope, value and divisions of Horticulture. Preparation of soil for horticultural crops. <sup>#</sup>Plant growing structures<sup>#</sup>. Nutrition of horticultural crops. Irrigation, training and pruning. Brief account on plant growth regulators and plant protection.

### Unit II: Plant propagation

12 Hours

Asexual and sexual methods of plant propagation – advantages and disadvantages. Techniques of seed propagation. Vegetative propagation – cuttage (stem and root), layering (serpentine and air), graftage (inarching, side, splice and cleft) and budding (shield, ring, patch and flap). Stock and scion relationships. <sup>#</sup>Propagation of specialized plant parts<sup>#</sup>.

### Unit III: Pomology, olericulture and ornamental horticulture

12 Hours

Definition, scope and importance. Cultivation practices of tropical and subtropical (papaya and guava), humid zone (jack), arid zone (pomegranate and fig) and temperate fruit (apple). Classification, types and cultural aspects of vegetables. Layout and importance of gardening – indoor, landscape, kitchen, rockery and water. Lawn – establishment and maintenance. Special group of garden plants. Bonsai and Terrarium. <sup>#</sup>Brief account on Arboriculture<sup>#</sup>.

### Unit IV: Basics of plant breeding

12 Hours

Scope and importance of plant breeding. Self-incompatibility and male sterility in crop plants and their commercial exploitation. Breeding for drought and salt stresses. Preservation and utilization of germplasms. Role of ICAR, IARI and CRRI in crop improvement. Plant breeder rights and regulations for Plant Variety Protection and Farmers Rights. <sup>#</sup>Overview of hybridization<sup>#</sup>.

### Unit V: Plant breeding methods

12 Hours

Breeding methods for self-cross pollinated and asexually propagated plants. Steps in production of single, double and three way cross. Conventional method of plant breeding – Mass and pure line selection. The segregating population methods – pedigree, bulk and backcross. Heterosis and hybrid vigour. Special breeding techniques – Mutation, ideotype, speed and reverse breeding methods. <sup>#</sup>Role of polyploidy in plant breeding<sup>#</sup>. Brief account on marker assisted selection (MAS).

### #-----# Self-study Portion

**Text Books:**

1. Sheela VL, Horticulture, 1<sup>st</sup> Edition, MJP Pvt Ltd., Chennai, Tamil Nadu, India, 2011.
2. Singh BD, Plant Breeding: Principles and Methods, 1<sup>st</sup> Edition, Kalyani Publishers Pvt Ltd., New Delhi, India, 2015.
3. Kumar N, Introduction to Horticulture, 8<sup>th</sup> Edition, Medtech, Scientific International Pvt Ltd., New Delhi, India, 2017.

**Books for Reference:**

1. Allard RW, Principles of Plant Breeding, 2<sup>nd</sup> Edition, Wiley publishing company, New Jersey, United States, 1999.
2. George A, Horticulture: Principles and Practices, 4<sup>th</sup> Edition, Prentice Hall India Learning Pvt Ltd., New Delhi, India, 2009.

**Web Reference:**

1. <https://www.britannica.com/science/horticulture>
2. <https://www.britannica.com/science/plant-breeding>
3. [https://link.springer.com/chapter/10.1007/978-3-319-22521-0\\_5](https://link.springer.com/chapter/10.1007/978-3-319-22521-0_5)

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

Semester	Code	Title of the Paper					Hours	Credits				
VI	20UBO6DE3A	Horticulture and Plant Breeding					4	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. N. AhamedSherif

**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

**50% contents were changed in the revised syllabus.**

Semester	Code	Course	Title of the Course	Hours	Credits	Max. marks	Internal marks	External marks
VI	20UBO6DE3B	Discipline Specific Elective – III	Silviculture	2	2	100	25	75

### Course outcomes:

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

1. Outline the fundamental concepts of Silviculture.
2. Examine the various systems in Silviculture in different bioclimatic conditions.
3. Recognize the importance of tree species in Silviculture.
4. Explain various methods of forest soil conservation.
5. Realize the importance of forest management and seed technology.

### Unit I: Fundamental of Silviculture

12 Hours

Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests, methods of propagation, grafting techniques, site factors and nursery. Planting techniques – nursery beds, polybags and maintenance. Water budgeting, grading and hardening of seedlings special approaches. Establishment and tending.

### Unit II: Systems in Silviculture

12 Hours

Clear felling, uniform shelter wood selection, coppice and conversion systems. Management of silviculture systems of temperate, subtropical, humid tropical, dry tropical and coastal tropical forests with special reference to plantation silviculture, choice of species, establishment and management of standards, enrichment methods, technical constraints, intensive mechanized methods, aerial seeding thinning.

### Unit III: Forest soil conservation

12 Hours

Forests Soils: classification, factors affecting soil formation; physical, chemical and biological properties. Soil conservation: definition, causes for erosion, conservation and management of eroded soils/areas, wind breaks, shelter belts; sand dunes; reclamation of saline and alkaline soils, water logged and other waste lands. Role of forests in conserving soils. Maintenance and buildup of soil organic matter, provision of lopping for green leaf manuring.

### Unit IV: Silviculture of economically important species

12 Hours

Cultivation of following Tropical Species: *Acacia nilotica*, *A. auriculae formis*, *Albizia lebbek*, *Azadirachta indica* *Bombax ceiba*, *Casuarina equisetifolia*, *Ceiba pentandra*, *Dalbergia sissoo*, *D. latifolia*, *Melia azedarach*, *Prosopis juliflora*, *P. cineraria*, *Pinus roxburghii*, *Santalum album*, *Shorea robusta*, *Tectona grandis*, *Tamarindus indica*, *Terminalia arjuna* and *T. chebula*.

### Unit V: Forest Management and seed technology

12 Hours

Principle and techniques, stand structure and dynamics, growing stock estimation management of forest plantations, commercial forests, forest cover monitoring, REDD++ and climate change mitigation. Tree Improvement and seed technology: General concept of tree improvement, methods and techniques, variation and its use, provenance, seed source, exotics, seed production and seed orchards, progeny tests, use of tree improvement in natural forest, genetic testing programming, role of ICFRE and FRI for forest management and monitoring.

**Text Books:**

1. Dwivedi AP, A text book of Silviculture, 1<sup>st</sup> Edition, International Books Distributors Pvt Ltd., Dehradun, India, 2006.
2. Negi SS, Principles and Practices of Silviculture, 1<sup>st</sup> Edition, Bishen Singh Mahendra Pal Singh Pvt Ltd., Dehradun, India, 2016.
3. Yadav AK and Dhanai CS, Principles and Practices of Silviculture, 1<sup>st</sup> Edition, Uttarakhand Open University, Nainital, India, 2020.

**Books for Reference:**

1. Bettinger P, Bostori K, Siry JP and Grebner DL, Forest management and planning 2<sup>nd</sup> Edition, Academic Press Pvt Ltd., New York, United States, 2017.
2. Manikandan K and Prabhu S, Indian Forestry: A breakthrough approach to forest service, 8<sup>th</sup> Edition, Jain Brothers Pvt Ltd., New Delhi, India, 2021.

**Web Reference:**

1. <https://www.uou.ac.in/sites/default/files/slm/FR-01.pdf>
2. <http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forest%20Ind%20year.pdf>
3. <http://ifs.nic.in/Dynamic/book/page3.pdf>

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

Semester	Code	Title of the Paper					Hours	Credits			
V	20UBO6DE3B	Silviculture					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 = 30, Relationship: Moderate											

**Prepared by:**

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

**80% contents were changed in the revised syllabus.**