

# **DEPARTMENT OF BOTANY**

## **COURSE STRUCTURE & SYLLABI**

**(For the students admitted from year 2023-2024 onwards)**

**Programme : B.Sc. Botany**



**JAMAL MOHAMED COLLEGE (AUTONOMOUS)**

Accredited with A++ Grade by NAAC (4<sup>th</sup> Cycle) with CGPA 3.69 out of 4.0  
(Affiliated to Bharathidasan University)

**TIRUCHIRAPPALLI – 620 020**

# B.SC. BOTANY

Sem	Course Code	Part	Course Category	Course Title	Ins. Hrs/ Week	Credit	Marks		Total
							CIA	ESE	
I	23U1LT1/LA1/ LF1/LH1/LU1	I	Language - I		6	3	25	75	100
	23UCN1LE1	II	English - I	English for Communication - I	6	3	25	75	100
	23UBO1CC1	III	Core - I	Plant Diversity (Algae, Fungi and Archegoniate)	5	5	25	75	100
	23UBO1CC2P		Core - II	Laboratory course for core - I - Practical	3	3	20	80	100
	23UCH1AC1:2		Allied - I	Inorganic, Organic and Physical Chemistry - I	5	4	25	75	100
	23UCH1AC2P		Allied - II	Volumetric Estimations - Practical	3	2	20	80	100
	23UCN1AE1	IV	AECC - I	Value Education	2	2	-	100	100
	Total				30	22			700
II	23U2LT2/LA2/ LF2/LH2/LU2	I	Language - II		6	3	25	75	100
	23UCN2LE2	II	English - II	English for Communication - II	6	3	25	75	100
	23UBO2CC3	III	Core - III	Plant Anatomy and Embryology	6	6	25	75	100
	23UBO2CC4P		Core - IV	Laboratory course for core - III - Practical	3	3	20	80	100
	23UCH2AC3:2		Allied - III	Inorganic, Organic and Physical Chemistry - II	4	4	25	75	100
	23UCH2AC4P		Allied - IV	Organic Analysis - Practical	3	2	20	80	100
	23UCN2SS	IV	Soft Skills Development	Soft Skills Development	2	2	-	100	100
	23UCN2CO	V	Community Outreach	JAMCROP	-	@	-	-	@
	23U2BT1/ 23U2AT1		Basic Tamil - I/ Advanced Tamil – I	எழுத்தும் இலக்கியமும் அறிமுகம் - I / தமிழ் இலக்கியமும் வரலாறும் - I	-	-	-	100 <sup>#</sup>	-
	Total				30	23			700
III	23U3LT3/LA3/ LF3/LH3/LU3	I	Language - III		6	3	25	75	100
	23UCN3LE3	II	English - III	English for Communication - III	6	3	25	75	100
	23UBO3CC5	III	Core - V	Cytology, Genetics and Evolution	4	4	25	75	100
	23UBO3CC6P		Core - VI	Laboratory course for core - V - Practical	3	3	20	80	100
	23UZO3AC5		Allied - V	General Zoology	4	4	25	75	100
	23UZO3AC6P		Allied - VI	General Zoology - Practical - I	3	2	20	80	100
	23UBO3GE1	IV	Generic Elective - I		2	2	-	100	100
	23UCN3AE2		AECC - II	Environmental Studies	2	2	-	100	100
	Total				30	23			800
IV	23U4LT4/LA4/ LF4/LH4/LU4	I	Language - IV		6	3	25	75	100
	23UCN4LE4	II	English - IV	English for Communication - IV	6	3	25	75	100
	23UBO4CC7	III	Core - VII	Microbiology and Plant Pathology	5	5	25	75	100
	23UBO4CC8P		Core - VIII	Laboratory course for core - VII - Practical	3	3	20	80	100
	23UZO4AC7		Allied - VII	Economic Zoology	5	4	25	75	100
	23UZO4AC8P		Allied - VIII	Economic Zoology - Practical - II	3	2	20	80	100
	23UBO4GE2	IV	Generic Elective - II		2	2	-	100	100
	23UCN4EL		Experiential Learning	Internship	-	2	-	100	100
	23UCN4EA	V	Extension Activities	NSS, NCC, etc.	-	1	-	-	-
	23U4BT2/ 23U4AT2		Basic Tamil - II/ Advanced Tamil – II	எழுத்தும் இலக்கியமும் அறிமுகம் - II/ தமிழ் இலக்கியமும் வரலாறும் - II	-	-	-	100 <sup>#</sup>	-
	Total				30	25			800
V	23UBO5CC9	III	Core - IX	Plant Systematics and Economic Botany	6	6	25	75	100
	23UBO5CC10		Core - X	Plant Physiology	6	6	25	75	100
	23UBO5CC11		Core - XI	Biochemistry, Biophysics and Biological Techniques	6	6	25	75	100
	23UBO5CC12P		Core - XII	Laboratory course for core - IX, X and XI - Practical	3	3	20	80	100
	23UBO5DE1A/B		Discipline Specific Elective - I		5	5	25	75	100
	23UBO5SE1	IV	Skill Enhancement Course - I	Algal Cultivation Techniques for Entrepreneurship	2	1	-	100	100
	23UBO5SE2		Skill Enhancement Course - II	Greenhouse Technology	2	1	-	100	100
	23UBO5EC1		Extra Credit Course - I*	Online Course	-	*	-	-	-
	Total				30	28			700
VI	23UBO6CC13	III	Core - XIII	Plant Ecology and Phytogeography	6	6	25	75	100
	23UBO6CC14		Core - XIV	Plant Molecular Biology and Biotechnology	6	6	25	75	100
	23UBO6CC15P		Core - XV	Laboratory course for core - XIII and XIV – Practical	5	5	20	80	100
	23UBO6PW		Project Work	Project Work	3	2	-	100	100
	23UBO6DE2A/B		Discipline Specific Elective - II		5	4	25	75	100
	23UBO6DE3A/B		Discipline Specific Elective - III		4	3	25	75	100
	23UCN6AE3	IV	AECC - III	Gender Studies	1	1	-	100	100
	23UBO6EC2		Extra Credit Course - II*	Online Course	-	*	-	-	-
	23UBOECA		Extra Credit Course for all**	Online Course	-	**	-	-	-
	23UCN6ECA1		Extra Credit Course for all†	Entrepreneurship Development	-	†	-	-	-
	* Programme Specific Online Course for Advanced Learners ** Any Online Course for Enhancing Additional Skills † Course for Enhancing Entrepreneurial Skills				Total	30	27		
Grand Total						148			4400

### GENERIC ELECTIVE COURSES

Semester	Course Code	Course Title
III	23UBO3GE1	Edible Mushroom Cultivation and Commercialization
IV	23UBO4GE2	Nursery, Gardening for Entrepreneurship

### # Self-Study Course – Basic and Advanced Tamil

(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Semester	Course Code	Course Title
II	23U2BT1	Basic Tamil – I (எழுத்தும் இலக்கியமும் அறிமுகம் - I)
	23U2AT1	Advanced Tamil – I (தமிழ் இலக்கியமும் வரலாறும் - I)
IV	23U4BT2	Basic Tamil – II (எழுத்தும் இலக்கியமும் அறிமுகம் - II)
	23U4AT2	Advanced Tamil – II (தமிழ் இலக்கியமும் வரலாறும் - II)

### **Mandatory**

Basic Tamil Course - I and II are offered for the students who have not studied Tamil Language in their schools and college.

Advanced Tamil Course - I and II are offered for those who have studied Tamil Language in their schools but have opted for other languages under Part - I.

### DISCIPLINE SPECIFIC ELECTIVES

Semester	Course Code	Course Title
V	23UBO5DE1A	Biostatistics and Bioinformatics
	23UBO5DE1B	Enzyme Technology
VI	23UBO6DE2A	Industrial Botany
	23UBO6DE2B	Seed Technology
	23UBO6DE3A	Horticulture and Plant Breeding
	23UBO6DE3B	Silviculture

### ALLIED COURSES FOR B.Sc. CHEMISTRY & B.Sc. ZOOLOGY

Semester	Course Code	Part	Course Category	Course Title
III	23UBO3AC5	III	Allied - V	Applied Botany – I
	23UBO3AC6P		Allied - VI	Laboratory Course for Applied Botany I – Practical
IV	23UBO4AC7		Allied - VII	Applied Botany – II
	23UBO4AC8P		Allied - VIII	Laboratory Course for Applied Botany II – Practical

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBO1CC1	Core – I	5	5	25	75	100
Course Title		PLANT DIVERSITY (ALGAE, FUNGI AND ARCHEGONIATE)					
SYLLABUS							
Unit	Contents						Hours
I	<b>Algae:</b> 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 – <i>Oscillatoria</i> , <i>Volvox</i> , <i>Oedogonium</i> , <i>Caulerpa</i> , <i>Dictyota</i> and <i>Polysiphonia</i> . Economic importance of algae with reference to industry, *agriculture and medicine*.						15
II	<b>Fungi:</b> General characteristics and outline classification of fungi (Alexopoulos and Mims, 1979). Detailed study of occurrence, morphology, reproduction and life cycle of the following genera – <i>Albugo</i> , <i>Aspergillus</i> , <i>Puccinia</i> and <i>Polyporus</i> . Economic importance of fungi with reference to medicine, agriculture and industry. Lichens – General characters, types and *economic importance of fungi*.						15
III	<b>Bryophytes:</b> General characteristics and classification of bryophytes (Rothmaler, 1951). A detailed study of the structure, anatomy, reproduction and life cycle of the following genera – <i>Marchantia</i> , <i>Porella</i> , <i>Anthoceros</i> and <i>Polytrichum</i> . Economic importance of bryophytes.						15
IV	<b>Pteridophytes:</b> General characteristics and classification of Pteridophytes (Sporne, 1975). Morphology, anatomy, reproduction and life cycle of the following genera – <i>Lycopodium</i> , <i>Equisetum</i> and <i>Adiantum</i> (Excluding developmental stages). Stelar evolution and economic importance of Pteridophytes. Paleobotany: Fossil types, methods of fossilization, Geological time scale, brief study of <i>Rhynia</i> , <i>Lepidodendron</i> and * <i>Calamities</i> *.						15
V	<b>Gymnosperms:</b> General characters and classification of gymnosperms (Sporne, 1967). Morphology, anatomy, reproduction and life cycle of the following genera – <i>Cycas</i> and <i>Pinus</i> . Economic importance of gymnosperms with reference to wood, essential oils, resins and drugs. Abrief study of the fossil gymnosperms – * <i>William sonia</i> *.						15
VI	<b>Current Trends (For CIA only)</b> – Contemporary developments related to the course during the semester concerned.						

\*.....\* Self Study

<b>Text Book(s):</b>
1. Sharma OP. A Text Book of Algae, 1 <sup>st</sup> Edition, Tata McGraw Hill Education Pvt Ltd, New Delhi, India, 2011. 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. Mehrotra, RS & Aneja, KR. An introduction to Mycology, 2nd Ed., New Age International Publishers, New Delhi, 1999. 4. Sporne, KR. The Morphology of Pteridophytes Hutchinson & Co., London, 2015. 5. Arnold. C. A. An Introduction to Paleobotany McGraw Hill Book Company, London, 2013.

<b>Reference Book(s):</b>	
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. Alexopoulos CJ, Mims CW and Blackwell M, Introductory Mycology, 4 <sup>th</sup> Edition, Wiley Publishers, New Delhi, India, 2007. 3. Pandey BP, Botany for Degree Students, 2 <sup>nd</sup> Edition, Chand & Company Pvt Ltd, New Delhi, India, 2010. 4. Sporne, K. R. The Morphology of Gymnosperm. Scientific Publishers, Jodhpur, (2015). 5. Steward. N. Wilson & Rothwell, W. Gar. Paleobotany and evolution of Plants, Cambridge University Press, 2005.	
<b>Web Resource(s):</b>	
1. <a href="https://www.biologydiscussion.com/algae/thallus-organisation-in-algae-botany/53555">https://www.biologydiscussion.com/algae/thallus-organisation-in-algae-botany/53555</a> 2. <a href="https://www.plantscience4u.com/2018/11/what-is-mode-of-nutrition-in-fungi.html">https://www.plantscience4u.com/2018/11/what-is-mode-of-nutrition-in-fungi.html</a> 3. <a href="https://www.biologydiscussion.com/lichens-2/lichens-symbiotic-association-and-reproduction/49914">https://www.biologydiscussion.com/lichens-2/lichens-symbiotic-association-and-reproduction/49914</a> 4. <a href="https://www.biologydiscussion.com/lichens-2/economic-importance-of-lichens-botany/53600">https://www.biologydiscussion.com/lichens-2/economic-importance-of-lichens-botany/53600</a>	

Course Outcomes		
CO Number	CO Statement	Cognitive Level (K-Level)
CO1	Summarize the salient features and general characters of Algae, Fungi, Lichens Bryophytes, Pteridophytes and Gymnosperms.	K1
CO2	Understand the various trends of classification and internal structures and life cycle patterns of lower group of plant and Pteridophytes and Gymnosperms.	K2
CO3	Application of economic importance of algae, fungi, lichens, Bryophytes, Pteridophytes and gymnosperms for the production of various industrial based products.	K3
CO4	Analyse the fossil, fossilization methods and geological time scale of evolutionary features in Pteridophytes and Gymnosperms.	K4
CO5	Evaluate the various modes of structure, reproduction and life history of Pteridophytes and Gymnosperms.	K5

#### Relationship Matrix:

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

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

**Course Coordinator: Dr. M. Kamaraj**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UBO1CC2P	Core – II	3	3	20	80	100
Course Title		LABORATORY COURSE FOR CORE - I – PRACTICAL					

SYLLABUS		
Unit	Contents	Hours
	<ol style="list-style-type: none"> <li>1. Micropreparation and observation of vegetative and reproductive parts of the following algal specimens – <i>Oscillatoria</i>, <i>Volvox</i>, <i>Oedogonium</i>, <i>Caulerpa</i>, <i>Dictyota</i> and <i>Polysiphonia</i>.</li> <li>2. Micropreparation and observation of the following fungal specimens – <i>Albugo</i>, <i>Aspergillus</i>, <i>Puccinia</i> and <i>Polyporus</i>.</li> <li>3. Micropreparation and observation of the following bryophyte specimens – <i>Marchantia</i>, <i>Porella</i>, <i>Anthoceros</i> and <i>Polytrichum</i>.</li> <li>4. Micropreparation and observation of the following pteridophyte specimens – <i>Lycopodium</i>, <i>Equisetum</i> and <i>Adiantum</i>.</li> <li>5. Micropreparation and observation of the following gymnosperm specimens – <i>Cycas</i> and <i>Pinus</i>.</li> <li>6. Observation of following permanent fossil slides – <i>Rhynia</i>, <i>Lepidodendron</i>, <i>Calamities</i> and <i>Williamsonia</i>.</li> <li>7. Botanical tour to witness the specimens in their natural habitats (not exceeding three days).</li> </ol>	45

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>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.</li> <li>2. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand &amp; Company Pvt Ltd, New Delhi, India, 2011.</li> <li>3. Sharma OP, Practical Botany, 7<sup>th</sup> Edition, PragatiPrakashan Educational Publishers Pvt Ltd, Meerut, India, 2014.</li> </ol>
<b>Reference Book(s):</b>
<b>Web Resource(s):</b>

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Explain the internal structures of algae and fungi through microscopic observation.	K1
CO2	Examine the morphology, anatomy and reproductive parts of bryophytes.	K2
CO3	Observe the morphology, anatomy and reproductive parts of pteridophytes and gymnosperms.	K3
CO4	Categorize fossil plants based on geological time period.	K4
CO5	Realize the natural plant diversity through field visit.	K5

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	03	01	02	02	02	03	02	01	02	02	2.0
CO2	01	03	02	02	01	01	03	02	01	02	1.8
CO3	02	01	03	02	02	02	01	03	02	02	2.0
CO4	02	02	02	03	01	02	03	02	01	02	2.0
CO5	03	02	02	01	01	02	02	02	02	03	2.0
Mean Overall Score											1.9
Correlation											Medium

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

**Prepared by:****1. Dr. M. Kamaraj**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UCH1AC1:2	Allied – I	5	4	25	75	100
Course Title		Inorganic, Organic and Physical Chemistry – I					

SYLLABUS		
Unit	Contents	Hours
I	<b>PERIODIC PROPERTIES, INDUSTRIAL GASES AND INSECTICIDES</b> <b>1.1 Periodic properties:</b> Ionization potential, *electron affinity* and electro negativity - Definition, factors affecting and variation in the periodic table. <b>1.2 Industrial Gases:</b> Fuel gases composition and Preparation of Water gas, Producer gas, LPG, Gobar gas and Natural gas. <b>1.3 Insecticides:</b> Introduction – Lists of various pesticides, methods of pest control, methods of using pest control chemicals. Insecticides – Arsenic compounds, Bordeaux mixture DDT and BHC.	15
II	<b>BIOMOLECULES</b> <b>2.1. Carbohydrates:</b> Classification. Glucose and fructose – Preparation, properties and uses. Sucrose – Manufacture and properties. Starch and cellulose – uses. <b>2.2. Amino Acids and Proteins:</b> Amino acids – Definition, classification – Essential and non essential, preparation and properties of glycine – Peptide bond – Proteins – Classification based on physical properties and biological functions. <b>2.3. Nucleic acids:</b> DNA and RNA – Differences between DNA and RNA, functions - *Structure of DNA*.	15
III	<b>BLOOD AND POLYMERS</b> <b>3.1. Blood and Haematological agents:</b> Blood – Composition of blood, Blood grouping and matching, Clotting of blood. Haematological agents – Coagulants – Vitamin K and Protamine sulphate. Anticoagulants – Coumarine and Heparin. <b>3.2. Polymers:</b> Definition, classifications of polymers – Natural and synthetic polymers, Thermoplastic and thermosetting polymer. Addition and condensation polymerization. Preparation, properties and uses of polyethylene, *PVC, Teflon*, polystyrene, nylon 6, 6, and Bakelite.	15
IV	<b>SEPARATION AND PURIFICATION TECHNIQUES</b> <b>4.1 Separation Techniques:</b> Distillation-steam, *fractional* and azeotropic distillation, crystallization – principles, working techniques and applications. <b>4.2 Chromatography</b> – Paper, thin layer chromatography, HPLC and GC-MS - principle, experimental techniques and applications.	15
V	<b>ACIDS - BASES AND CATALYSIS</b> <b>5.1. Acids-Bases:</b> Arrhenius, Lowry-Bronsted and Lewis concepts of acids and bases, pH, buffer solution, Henderson-Hasselbalch equation and its importance (no derivation) - Biological importance of pH and buffer solutions in living system. <b>5.2 Catalysis:</b> Catalysis – Importance of catalysis. Types of catalysis - Homogeneous and heterogeneous catalysis, factors affecting catalysis. Definitions of catalytic promoter, *catalytic inhibitor, catalytic poison*. Theory of enzyme catalysis.	15

\*.....\* Self Study

<b>Text Book(s):</b>
1. P. L. Soni, Text book of Inorganic Chemistry, S. Chand & Co., New Delhi, Revised Edition, 2017 2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co., New Delhi, First Edition, 2006 3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Vishal Publications, Jalandhar, 48 <sup>th</sup> Edition, 2019



<b>Reference Book(s):</b>	
1. Puri B.R., Sharma L.R., Kalia K.K., Principles of Inorganic Chemistry, Shoban Lal, Nagin Chand & Co. New Delhi, 23 <sup>rd</sup> , 1993 2. Bahl and Arun Bahl, Advanced Organic Chemistry, S.Chand & Co., New Delhi, 19 <sup>th</sup> Edition, 2005 3. R. L. Madan, G.D. Tuli, Simplified Course in Physical Chemistry, S. Chand & Co., New Delhi, 5 <sup>th</sup> Revised and Enlarged, 2009	
<b>Web Resource(s):</b>	
1. <a href="https://onlinecourses.nptel.ac.in/noc22_cy03/preview">https://onlinecourses.nptel.ac.in/noc22_cy03/preview</a> 2. <a href="https://www.toppr.com/">https://www.toppr.com/</a> 3. <a href="https://byjus.com/chemistry/">https://byjus.com/chemistry/</a>	

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Describe the periodic properties, polymers and catalysis	<b>K1</b>
CO2	Classify the carbohydrates, amino acids, proteins and appraise their applications.	<b>K2</b>
CO3	Apply chromatographic techniques	<b>K3</b>
CO4	Analyse the blood groups	<b>K4</b>
CO5	Evaluate the value of pH of a solution	<b>K5</b>

#### Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	<b>3</b>
<b>CO2</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO3</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO4</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO5</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>Mean Overall Score</b>											<b>2.2</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinators: Mr. M. Varusai Mohamed**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
I	23UCH1AC2P	Allied – II	3	2	20	80	100
Course Title		VOLUMETRIC ESTIMATIONS - PRACTICAL					

List of Practicals	Hours
<b>Volumetric Estimation Practicals</b> 1. Estimation of Sodium Hydroxide ( $\text{Na}_2\text{CO}_3$ Vs HCl Vs NaOH) 2. Estimation of Hydrochloric Acid ( $\text{H}_2\text{C}_2\text{O}_4$ Vs NaOH Vs HCl) 3. Estimation of Oxalic Acid ( $\text{FeSO}_4$ Vs $\text{KMnO}_4$ Vs $\text{H}_2\text{C}_2\text{O}_4$ ) 4. Estimation of Ferrous Sulphate ( $\text{H}_2\text{C}_2\text{O}_4$ Vs $\text{KMnO}_4$ Vs $\text{FeSO}_4$ ) 5. Estimation of Ferrous Ammonium Sulphate ( $\text{H}_2\text{C}_2\text{O}_4$ Vs $\text{KMnO}_4$ Vs $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$ ) 6. Estimation of $\text{KMnO}_4$ ( $\text{K}_2\text{Cr}_2\text{O}_7$ Vs FAS Vs $\text{KMnO}_4$ ) 7. Estimation of Zinc by EDTA ( $\text{MgSO}_4$ Vs EDTA Vs $\text{ZnSO}_4$ ) 8. Estimation of Magnesium by EDTA ( $\text{MgSO}_4$ Vs EDTA Vs $\text{MgSO}_4$ )  <div style="text-align: right;"> <b><u>Scheme of valuation</u></b>  <b>Record</b> – 10 Marks  <b>Procedure writing</b> – 10 Marks  <b>For Estimation</b> – 60 Marks  <b><u>For Estimation Results:</u></b>                1-2% - 60 marks                2-3% - 50 marks                3-4% - 40 marks                &gt;4% - 30 marks           </div>	<b>45</b>

#### Text Books:

1. Peter McPherson, Volumetric Analysis, Royal Society of Chemistry, 1<sup>st</sup> Edition 2014.
2. K.B. Baliga et al., College Analytical Chemistry, Himalaya Publishing House, 19<sup>th</sup> Edition, 2011
3. Venkateswaran V. Veerasamy R. Kulandaivelu A.R, Basic Principles of Practical Chemistry, S. Chand & Co Pvt. Ltd, New Delhi, 2<sup>nd</sup> Edition 1997.

#### Reference Books:

1. Handbook Of Inorganic Qualitative Analysis by Maharudra Chakraborty, Scifinity Publication; 1<sup>st</sup> Edition 2019.
2. Vogel, Text Book of Quantitative Chemical Analysis,, Pearson Education, 6<sup>th</sup> edition ,2009.
3. Day R A., Underwood A I., Quantitative Analysis, New York: Pearson Emory University. Print. 6<sup>th</sup> edition, 1991

#### Web Resources:

1. <https://www.studiestoday.com/useful-resources-chemistry-class-12-chemistry-practicals-volumetric-analysis-estimation-oxalic-0>
2. <https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXI/chemistry/kelm206.pdf>

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
CO1	Recall the principle of volumetric techniques and to classify the methods of preparation of solutions with different concentration.	<b>K1</b>
CO2	Estimate the concentration of a various solution	<b>K2</b>
CO3	Apply the principle of volumetric concept in the estimation	<b>K3</b>
CO4	Analyze the quality of portability of water	<b>K4</b>
CO5	Assess the quantity of chemical substance in a solution	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3	3	3	3	2	3	3	1	2	2	2.5
<b>CO2</b>	3	3	3	3	1	3	3	2	2	2	2.5
<b>CO3</b>	3	3	3	2	2	3	3	2	3	1	2.5
<b>CO4</b>	2	1	2	3	3	3	3	3	3	3	2.6
<b>CO5</b>	3	3	2	2	3	3	3	3	3	2	2.7
<b>Mean Overall Score</b>											<b>2.56</b>
<b>Correlation</b>											<b>High</b>

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

**Course Coordinator: Dr. S. K. Periyasamy**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
<b>II</b>	<b>22UBO2CC3</b>	<b>Core – III</b>	<b>6</b>	<b>6</b>	<b>25</b>	<b>75</b>	<b>100</b>
<b>Course Title</b>		<b>PLANT ANATOMY AND EMBRYOLOGY</b>					

SYLLABUS		
Unit	Contents	Hours
<b>I</b>	<b>Meristematic and permanent tissues:</b> Introduction to tissues, General classification of tissues. Meristematic tissues: Definition, classification Based on origin, function and position). Theory of shoot organization – Tunica-cortex, Theory of root organization – Histogen theory. Permanent tissues: Simple permanent tissues – Structure, types and functions of Parenchyma, Collenchyma and Sclerenchyma. Complex permanent tissues - Structure, types and functions of Xylem and Phloem.	<b>18</b>
<b>II</b>	<b>Tissue system:</b> Origin, structure and function of epidermal tissue system, special epidermal structures and hydathodes. Secretory tissue – glandular, resin ducts and laticiferous tissue. Ground tissue – extrastelar (cortex), intrastelar (pericycle, pith and medullary rays) and mesophyll. *Types of vascular bundles*.	<b>18</b>
<b>III</b>	<b>Anatomical features of plant organs</b> 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. Brief account on dendrochronology. Anomalous secondary thickening in <i>Boerhavia</i> , <i>Nyctanthes</i> and <i>*Dracaena*</i> .	<b>18</b>
<b>IV</b>	<b>Structural organization and fertilization</b> Anther structure, microsporogenesis and development of malaegametophyte. Ovule structure, and types, megasporogenesis, development of Monosporic, Bisporic and Tetrasporic types of embryo sacs. Pollination – Factors favour for pollination, types, advantages and disadvantages. Fertilization – *Double fertilization and triple fusion*.	<b>18</b>
<b>V</b>	<b>Endosperm, embryo, apomixis and polyembryony</b> Endosperm development and its types. Functions of endosperm. Development of dicot and monocot embryos. Brief note on apomixis, parthenocarpy, polyembryony and its types. Seed structure, development, function and *dispersal of seeds*.	<b>18</b>
<b>VI</b>	<b>Current Trends (For CIA only) – Brief account on dendrochronology.</b>	

\*.....\* Self Study

<b>Text Book(s):</b>	
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.	
<b>Reference Book(s):</b>	
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.	

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understanding the basic concepts in Plant Anatomy and Embryology.	K1
CO2	Identify different type of tissue system and their organization.	K2
CO3	Analyze the secondary thickening and anomalous secondary thickening in dicot and monocot leaf, stem and root.	K3
CO4	Evaluate the structural organization of flower and the process of pollination and fertilization.	K4
CO5	Categorize the plant relationships based on internal anatomy and reproductive system.	K5

#### Relationship Matrix:

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

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

Course Coordinator: Dr. R. Ravi kumar

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UBO2CC4P	Core – IV	3	3	20	80	100
Course Title		LABORATORY COURSE FOR CORE - III – PRACTICAL					

SYLLABUS	
Contents	Hours
<b><u>List of Practicls:</u></b> <ol style="list-style-type: none"> <li>1. Study of primary anatomy of monocot and dicot leaf, stem and root with help of hand cut stained sections (monocot – Grass/<i>Canna</i> and dicot – <i>Tridax</i>).</li> <li>2. Study of normal secondary thickening in dicot stem (<i>Azadiractaindica</i>).</li> <li>3. Study of anomalous secondary thickening (<i>Boerhavia</i>, <i>Nyctanthes</i> and <i>Dracaena</i>).</li> <li>4. T.S of young and mature anther (<i>Datura metal</i>)</li> <li>5. Isolation and mounting of embryo (<i>Cucumis</i> and <i>Tridax</i>).</li> <li>6. Observation of simple and complex tissues (Charts / permanent slides / photographs).</li> <li>7. Observation of vascular bundle orientation (Charts / permanent slides / photographs).</li> <li>8. Study of L.S. of ovule and types of ovule (Charts / permanent slides / photographs).</li> </ol>	45

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. SundaraRajan S, Practical manual of plant anatomy and embryology, 1st Edition, Anmol Publications Pvt Ltd, Bengalore, Karnataka, India, 2003.</li> <li>2. Pandey SN and Chandha A, Plant anatomy and Embryology. 1<sup>st</sup> Edition, Vikas Publishing House Pvt Ltd, New Delhi, India, 2009.</li> <li>3. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand &amp; Company Pvt Ltd, New Delhi, India, 2011.</li> </ol>
<b>Reference Book(s):</b>
<b>Web Resource(s):</b>

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
CO1	Categorize the structure and functions of primary and complex tissues.	<b>K4</b>
CO2	Distinguish and compare the anatomical features of dicot and monocot plants.	<b>K5</b>
CO3	Illustrate the primary, secondary and anomalous thickening of plants.	<b>K3</b>
CO4	Discuss the development of the endosperm and embryo.	<b>K2</b>
CO5	Justify the identification of anatomical and embryological specimens.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	03	02	02	01	02	03	02	01	01	02	<b>1.9</b>
<b>CO2</b>	02	03	01	02	02	02	03	02	02	01	<b>2.0</b>
<b>CO3</b>	01	01	03	02	01	02	01	03	02	02	<b>1.8</b>
<b>CO4</b>	03	02	01	01	02	01	03	02	01	02	<b>1.8</b>
<b>CO5</b>	01	02	02	02	03	03	01	02	02	01	<b>1.9</b>
<b>Mean Overall Score</b>											<b>2.0</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinator: Dr. R. Ravi kumar**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UCH2AC3:2	Allied – III	4	4	25	75	100
Course Title		Inorganic, Organic and Physical Chemistry – II					

SYLLABUS		
Unit	Contents	Hours
I	<b>INDIAN MEDICINAL PLANTS AND BIOLOGICALLY IMPORTANT COMPOUNDS</b> 1.1 <b>Indian Medicinal Plants:</b> Hibisous Rosa Sinesis - Adathoda Vasica - Azadirachta Indica – Solanum Trolobatum – Active Constituents and Medicinal uses. 1.2 <b>Biologically important compounds:</b> Haemoglobin and Chlorophyll- structure and biological role.	12
II	<b>NUCLEAR CHEMISTRY</b> 2.1 <b>Structure of nucleus</b> - Composition of nucleus, nuclear forces, nuclear stability-mass defect, binding energy, n/p ratio and magic numbers, *Definition of isotopes, isobars, isotones and isomers* 2.2 <b>Radioactivity-</b> Definition, types of radioactivity, Properties of $\alpha$ , $\beta$ and $\gamma$ rays: Detection and measurement – Wilson cloud chamber and G.M. Counter, nuclear fusion and fission reactions, applications of radio isotopes – in analytical chemistry, in medicine, rock dating and carbon dating	12
III	<b>VITAMINS AND DRUGS</b> 3.1 <b>Vitamins</b> – Definition, classification. Sources and deficiency diseases of vitamins A, D, E, K, B <sub>6</sub> , B <sub>12</sub> and C. 3.2 <b>Drugs:</b> Sulpha drugs - Definition, structure and uses of sulphapyridine and sulphathiazole. Antibiotics – Definition, structure and uses of penicillin and Chloromycetin. Antipyretics - Definition, structure and uses of paracetamol and aspirin. Anti inflammatory - Definition, structure and uses of ibuprofen and Naproxen.	12
IV	<b>ENZYMES AND HORMONES</b> 4.1 <b>Enzymes-</b> Classification of enzymes, chemical nature, factors affecting rate of enzyme action, specificity of enzyme action, mechanisms of enzyme action – lock and key, biological functions of enzymes, applications of enzymes- therapeutic, analytical, industrial uses. 4.2. <b>Hormones-</b> introduction, structure and physiological functions - Adrenaline, thyroxine, oxytocin and insulin.	12
V	<b>COLLOIDS</b> 5.1. <b>Colloids:</b> Definition, colloidal solution and suspension, phases of colloidal solution-Electrical properties – *Electrophoresis and Electro osmosis (definition and uses only)* - protection of colloids – Gold number- medicinal applications of colloids. 5.2 <b>Emulsion:</b> definition, types, preparation, properties and applications. 5.3. <b>Gels:</b> definition, types, preparation, properties and applications.	12

\*.....\* Self Study

<b>Text Book(s):</b>
1. Puri B.R., Sharma L.R., Kalia K.K., Principles of Inorganic Chemistry, Shoban Lal, Nagin Chand & Co. New Delhi, 23 <sup>rd</sup> , 1993
2. P. L. Soni and H.M. Chawla, Text Book of Organic Chemistry, S. Chand & Co., New Delhi, 28 <sup>th</sup> Edition, 1999
3. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co., New Delhi, First Edition, 2006



<b>Reference Book(s):</b>
1. R. D Madan, Modern Inorganic Chemistry, S. Chand & Co., New Delhi, 2 <sup>nd</sup> reprint, 1987
2. A .K. Srivastava, Organic Chemistry, New Age International Publishers, New Delhi, 1 <sup>st</sup> Edition, 2002
3. R. L. Madan, G.D. Tuli, Simplified Course in Physical Chemistry, S. Chand & Co., New Delhi 5 <sup>th</sup> revised and enlarged Edition, 2009
<b>Web Resource(s):</b>
1. <a href="https://onlinecourses.nptel.ac.in/noc22_cy20/preview">https://onlinecourses.nptel.ac.in/noc22_cy20/preview</a>
2. <a href="https://www.toppr.com/">https://www.toppr.com/</a>
3. <a href="https://byjus.com/chemistry/">https://byjus.com/chemistry/</a>

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Describe the Indian medicinal plants, types of radioactivity and physiological functions of hormones	<b>K1</b>
<b>CO2</b>	Discuss the properties of alpha, beta and gamma rays	<b>K2</b>
<b>CO3</b>	predict the sources and deficiency diseases of vitamins and illustrate the various drugs	<b>K3</b>
<b>CO4</b>	Classify the enzymes and explain the mechanism of enzyme action	<b>K4</b>
<b>CO5</b>	Compare the phases of colloidal solutions and predict the applications	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3	<b>3</b>
<b>CO2</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO3</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO4</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>CO5</b>	2	2	2	2	2	2	2	2	2	2	<b>2</b>
<b>Mean Overall Score</b>											<b>2.2</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinators: Dr. R. Abdul Vahith**

Semester	Course Code	Course Category	Hours/Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
II	23UCH2AC4P	Allied - IV	3	2	20	80	100
<b>Course Title</b> <b>Organic Analysis - Practical</b>							

List of Practicals	Hours
<b>Qualitative analysis of the following organic compounds:</b> <ol style="list-style-type: none"> <li>Carbohydrate</li> <li>Amide</li> <li>Aldehyde</li> <li>Ketone</li> <li>Monocarboxylic acid</li> <li>Dicarboxylic acid</li> <li>Amine</li> </ol> <p style="text-align: center;"><b><u>Scheme of valuation</u></b></p> <p><b>Record</b> – 10 Marks  <b>Procedure writing</b> – 10 Marks  <b>For Organic Analysis</b> – 60 Marks</p> <p><b><u>For Organic Analysis Results Marks Distribution:</u></b></p> <p>(i) Special Elements Present/ Absent – 20 marks  (ii) Aromatic/ Aliphatic – 10 marks  (iii) Saturated/ Unsaturated – 10 marks  (iv) Functional Group Present – 20 marks</p>	<b>45</b>

<b>Text Books:</b>
1. Ganapragasm N S and Ramamurthy G, Organic Chemistry Lab Manual, S. Vishwanathan Printers and Publishers (P) Ltd., Chennai, 2 <sup>nd</sup> Edition, 2007. 2. Venkateswaran V. Veerasamy R. Kulandaivelu A.R, Basic Principles of Practical Chemistry, S. Chand & Co Pvt. Ltd, New Delhi, 2 <sup>nd</sup> Edition, 1997. 3. Furniss B S, et al., Vogel's Textbook of Practical Organic Chemistry, ELBS Longman, London, 7 <sup>th</sup> Edition, 1984.
<b>Reference Books:</b>
1. A. I. Vogel's, Text Book of Practical Organic Chemistry, Prentice Hall, 5 <sup>th</sup> Edition, 1989.
<b>Web Resources:</b>
1. <a href="https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20%20Pharmaceutical%20Organic%20Chemistry.pdf">https://jru.edu.in/studentcorner/lab-manual/bpharm/Lab%20Manual%20-%20%20Pharmaceutical%20Organic%20Chemistry.pdf</a> 2. <a href="https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm108.pdf">https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm108.pdf</a> 3. <a href="https://faculty.chas.uni.edu/~manfredi/860-121/ORG%20LAB%20MAN%20S08.pdf">https://faculty.chas.uni.edu/~manfredi/860-121/ORG%20LAB%20MAN%20S08.pdf</a>

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Recall the preliminary tests of organic qualitative analysis.	K1
CO2	Differentiate the aliphatic and aromatic nature of the organic compounds	K2
CO3	Examine the nature of the organic compound	K3
CO4	Separate the functional groups through appropriate chemical reactions	K4
CO5	Summarize their results of the organic analysis in a scientific way.	K5

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	2	3	3	3	2	2	2.7
CO2	3	2	3	3	3	3	3	2	3	1	2.6
CO3	3	2	3	3	2	3	3	3	2	2	2.4
CO4	3	2	1	3	3	3	3	3	3	2	2.6
CO5	3	2	3	1	2	3	3	2	3	1	2.3
Mean Overall Score											2.52
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
$\geq 1.5$ and < 2.5	Medium
$\geq 2.5$	High

**Course Coordinator: Dr. S. Syed Abuthahir**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBO3CC5	Core – V	4	4	25	75	100
Course Title		Cytology, Genetics and Evolution					

SYLLABUS		
Unit	Contents	Hours
I	Organization of prokaryotic and eukaryotic cells. Structure, composition and properties of middle lamella, cell wall (primary and secondary), pits (simple and bordered), plasmodesmata, plasma membranes (fluid mosaic model) and cytoplasm. Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis. Structure and functions of cellular organelles (nucleus, mitochondria, chloroplasts, endoplasmic reticulum, golgi complex, ribosomes), cytoskeleton and ergastic substances. *Lysosomes*.	12
II	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, SAT - chromosome, Polytene and Lampbrush chromosomes.	12
III	History, branches and applications of genetics, principles of genetics, Mendel's laws, monohybrid, dihybrid crosses. Reciprocal cross - Back cross and Test cross, deviation from Mendelian ratio, lethality, multiple factor hypothesis, incomplete dominance - <i>Mirabilis jalapa</i> , Epistasis, non-epistasis, inheritance of quantitative traits, multiple alleles - ABO Blood grouping in Human. complementary factor, chromosomal theory of inheritance. *pleiotropism*.	12
IV	Linkage and crossing over, Sex linked inheritance – Haemophilia and colour blindness, 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*. Extra nuclear inheritance and its significance- Male sterility in corn, Maternal inheritance – Plastid Inheritance in <i>Mirabilis jalapa</i> . Genetics of <i>Neurospora</i> . Population genetics: Hardy - Weinberg principle.	12
V	Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamarck and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of speciation - *Allopatric and sympatric*.	12

\* ..... \* Self Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Sinnott, E.W., Dunn, L.L and Dobzhansky, T. Principles of Genetics, Tata McGraw Hill Publishing Co. New Delhi, 1997.</li> <li>2. Singh, R. J. 2016. Plant Cytogenetics, 3<sup>rd</sup> Edition. CRC Press, Boca Raton, Florida, USA.</li> <li>3. Verma, P.S and V.K. Agarwal. Cytology. S. Chand &amp; Co. Ltd., New Delhi. 2002.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Klug, W.S., Cummings, M.R., Spencer, C.A. Concepts of Genetics. 9<sup>th</sup> edition. Benjamin Cummings, U.S.A. 2009.</li> <li>2. Cooper, G.M and Hausman, R.E. The Cell: A Molecular Approach. 5<sup>th</sup> edition. ASM Press &amp; Sunderland, Washington, D.C. Sinauer Associates, MA. 2009.</li> <li>3. Gardner, E.J., Simmons, M.J and Snustad, D. Principles of Genetics, John Wiley Sons Inc., 8<sup>th</sup> Edn., New York. 1991.</li> </ol>

Web Resource(s)	
1.	<a href="http://www.freebookcentre.net/Biology/Cell-Biology-Books.html">http://www.freebookcentre.net/Biology/Cell-Biology-Books.html</a>
2.	<a href="https://www.us.elsevierhealth.com/medicine/cell-biology">https://www.us.elsevierhealth.com/medicine/cell-biology</a>
3.	<a href="https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A">https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A</a>
4.	<a href="http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html">http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html</a>
5.	<a href="https://www.us.elsevierhealth.com/medicine/genetics">https://www.us.elsevierhealth.com/medicine/genetics</a>
6.	<a href="https://libguides.uthsc.edu/genetics/ebooks">https://libguides.uthsc.edu/genetics/ebooks</a>

Course Outcomes		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
<b>CO1</b>	Enumerate the structure and functions of cells, cellular structures and organelles.	<b>K1</b>
<b>CO2</b>	Explain about cell cycle, cell division and laws of inheritance with suitable examples.	<b>K2</b>
<b>CO3</b>	Elucidate concepts of sex determination and sex linked inheritance.	<b>K3</b>
<b>CO4</b>	Analyze the importance of genes interactions at population and evolutionary levels.	<b>K4</b>
<b>CO5</b>	Determine the various fossilization methods and their significance in evolution.	<b>K5</b>

#### Relationship Matrix

Course Outcomes (Cos)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
<b>CO1</b>	03	03	01	03	02	01	02	02	03	01	2.1
<b>CO 2</b>	03	03	02	02	03	03	02	03	03	02	2.6
<b>CO 3</b>	03	03	02	03	01	02	01	03	03	02	2.3
<b>CO 4</b>	03	03	03	03	03	02	03	03	03	03	2.9
<b>CO 5</b>	03	03	02	03	02	02	01	03	01	03	2.3
<b>Mean Overall Score</b>											2.4
<b>Correlation</b>											Medium

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

**Course Coordinator: Dr. R. Radhakrishnan**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBO3CC6P	Core – VI	3	3	20	80	100
Course Title		Laboratory Course for Core - V – Practical					

SYLLABUS	
Contents	Hours
<p><b>Cytology:</b></p> <ol style="list-style-type: none"> <li>1. Observation of the structure of cell organelles through photomicrographs.</li> <li>2. Observation of structure of plant cell through temporary mounts.</li> <li>3. Observation of cell inclusions (non-living)</li> <li>4. Histochemical identification of starch, <b>sugars, proteins and alkaloids</b> in plant cells</li> <li>5. Observation of polyploidy in onion root tips after treatment with Colchicine (<i>DBT Star College Scheme</i>)</li> <li>6. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.</li> <li>7. Observation of meiosis in Rheo flower buds - Demo.</li> </ol> <p><b>Genetics:</b></p> <ol style="list-style-type: none"> <li>1. Problems relevant to monohybrid ratio</li> <li>2. Problems relevant to dihybrid ratio</li> <li>3. Problems relevant to non-Mendelian ratio</li> <li>4. Construction of chromosomal map</li> </ol>	45

<p><b>Text Book(s):</b></p> <ol style="list-style-type: none"> <li>1. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics Springer, New York, 2012.</li> <li>2. Gupta P.K. Cell and Molecular Biology (5<sup>th</sup> ed.), Rastogi Publications, Meerut, 2017.</li> <li>3. Krebs J.E., Goldstein E.S and Kilpatrick S.T. Lewin's GENES XII (12<sup>th</sup> ed.). Jones &amp; Bartlett Learning. 2017.</li> </ol>
<p><b>Reference Book(s):</b></p> <ol style="list-style-type: none"> <li>1. Gardener, J, Simmons, H.J and Snustad, D.P. Principle of Genetics, John Wiley &amp; Sons, New York, 2006.</li> <li>2. De Robertis E.D.P. and De Robertis E.M.P. Cell and Molecular Biology (8<sup>th</sup> ed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA, 2017.</li> </ol>
<p><b>Web Resource(s)</b></p> <ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&amp;redir_esc=y</a></li> <li>2. <a href="https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219">https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219</a></li> <li>3. <a href="https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X">https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X</a></li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Identify the structure of cell organelles and stages of cell division.	<b>K1</b>
<b>CO2</b>	Classify the types of cell divisions	<b>K2</b>
<b>CO3</b>	Compare the functions of various ergastic substances present in plant tissues.	<b>K3</b>
<b>CO4</b>	Perform free hand sectioning of plant materials and decipher the internal tissue organization.	<b>K4</b>
<b>CO5</b>	Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (Cos)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	03	03	01	03	02	01	02	02	01	03	2.1
<b>CO 2</b>	03	02	02	02	03	03	02	03	02	02	2.4
<b>CO 3</b>	02	02	03	02	01	02	01	03	03	03	2.2
<b>CO 4</b>	03	03	02	03	03	02	03	02	03	03	2.7
<b>CO 5</b>	03	02	02	03	02	03	03	03	02	02	2.5
<b>Mean Overall Score</b>											2.3
<b>Correlation</b>											Medium

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

**Course Coordinator: Dr. R. Radhakrishnan**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UZ03AC5	Allied – V	4	4	25	75	100
<b>Course Title</b>		<b>GENERAL ZOOLOGY</b>					

SYLLABUS		
Unit	Contents	Hours
I	<b>Invertebrates</b> Classification of Invertebrates upto phyla with salient features and suitable examples. Cockroach: *External morphology*, mouth parts, Digestive system, respiratory system, circulatory system, nervous system and reproductive system.	12
II	<b>Chordates</b> General classification of Chordates – salient features of chordates with suitable examples. <b>Frog</b> – *External features*, digestive system, respiratory system, circulatory system, Nervous system and urino-genital system.	12
III	<b>Animal Physiology</b> Physiology of digestion, Composition and functions of human blood, Respiration; Transport of oxygen and carbon-dioxide, Structure of neuron, nerve impulse conduction, *Structure of kidney* and nephron in Human – Reproduction in man.	12
IV	<b>Endocrinology</b> Endocrine glands, Structure and functions of Pituitary, Thyroid, Islets of Langerhans, Adrenal and Sex glands – *Menstrual cycle*.	12
V	<b>Embryology &amp; Evolution</b> Gametogenesis – spermatogenesis and oogenesis, Fertilization, cleavage - cleavage patterns. Blastulation, Gastrulation in Frog. Origin of life and evolution of cell - Theories on evolution by Lamarck and Charles Darwin, organic evolution, *Evidences of evolution*.	12

\*.....\* Self-Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Nair,N.C., Leelavathy,S., Soundara Pandian, N., Murugan,T., Thangamani, A., Prasannakumar,S., Narayanan,L.M., and Arumugam,N., Animal Diversity Invertebrata and Chordata. Saras Publication, Nagercoil. Fifth Ed., 2013</li> <li>2. Arumugam, N. and Mariakuttikan,A., Animal Physiology. Saras Publication, Nagercoil. 2011.</li> <li>3. Arumugam, N, A Text Book of Embryology, Saras Publication, Nagercoil. Fourteenth Ed., 2013.</li> <li>4. Arumugam, N, Organic Evolution, Saras publication, Nagercoil. 2010</li> </ol>
<b>Reference Book(s):</b>
1. Ekambaranatha Ayyar, Outlines of Zoology. Vol. I & II S.Viswanathan (Printers & Publishers ) Pvt. Ltd., Chennai,1993
<b>Web Resource(s):</b>
<ol style="list-style-type: none"> <li>1. <a href="http://www.itis.usda.gov/itis/status.html">http://www.itis.usda.gov/itis/status.html</a></li> <li>2. <a href="http://www.bishop.hawaii.org/bishop/HBS/hbs1.html">http://www.bishop.hawaii.org/bishop/HBS/hbs1.html</a></li> <li>3. <a href="http://www.itis.usda.gov/itis/status.html">http://www.itis.usda.gov/itis/status.html</a></li> <li>4. <a href="http://www.bishop.hawaii.org/bishop/HBS/hbs1.html">http://www.bishop.hawaii.org/bishop/HBS/hbs1.html</a></li> <li>5. <a href="https://nptel.ac.in/courses/102/104/102104042/">https://nptel.ac.in/courses/102/104/102104042/</a></li> <li>6. <a href="https://courses.lumenlearning.com&gt;digestive system/Anatomy and Physiology">https://courses.lumenlearning.com&gt;digestive system/Anatomy and Physiology</a></li> <li>7. <a href="https://www.lung.ca&gt;lung .infor&gt;respiratory system">https://www.lung.ca&gt;lung .infor&gt;respiratory system</a></li> </ol>



Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand the emergence and diversity of Invertebrate fauna and to realize the structural features and physiological processes in Invertebrates.	K1 & K2
CO2	Classify the taxonomy among chordates and to study the structure and function of chordate systems.	K2
CO3	Develop knowledge on physiological processes in human beings and role of organ systems.	K3
CO4	Analyze the integrated functions of endocrine glands in reproduction.	K4
CO5	Evaluate the biological processes involved in development and the fundamental complex processes leading to evolutionary changes	K5

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	2	2	3	3	2	2.7
CO2	3	3	3	3	3	2	2	3	3	2	2.7
CO3	3	3	3	3	3	2	2	3	3	2	2.7
CO4	3	3	3	3	3	2	2	3	3	2	2.7
CO5	3	3	3	3	3	2	2	3	3	2	2.7
Mean Overall Score											2.7
Correlation											High

Mean Overall Score	Correlation
< 1.5	Low
$\geq 1.5$ and < 2.5	Medium
$\geq 2.5$	High

**Course Coordinator: Dr. H. E. Syed Mohamed**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UZO3AC6P	Allied – VI	3	2	20	80	100
Course Title		GENERAL ZOOLOGY - PRACTICAL - I					

SYLLABUS		
Unit	Contents	Hours
	<p><b>DISSECTION:</b></p> <p><u>Invertebrates</u> Cockroach: Mouthparts, Digestive and Nervous systems.</p> <p><u>Chordates</u> Frog – Pro-dissector software: Digestive, Arterial and Venous systems.</p> <p><u>Animal Physiology</u> Blood Grouping Preparation of Blood Smear and Observation of RBC and WBC. Qualitative estimation of excretory products: Ammonia, Urea and Uric acid.</p> <p><b>SPOTTERS:</b></p> <p><u>Invertebrates</u> <i>Paramecium, Ascon, Obelia, Aurelia, Fasciola hepatica, Taenia solium, Ascaris male and female, Nereis, Earthworm, Prawn, Butterfly, Freshwater Mussel, Snail, Sea urchin, Starfish.</i></p> <p><u>Chordates</u> Shark, Tilapia, Frog, Salamanders, Viper, Cobra, Duck, Pigeon, Rabbit, Loris.</p> <p><u>Embryology</u>  Examination of prepared slides to study the following: Frog: Egg – cleavage – blastula – yolk plug stage</p> <p><u>Evolution</u> Fossil: Nautiloid, Ammonoid</p> <p><u>Endocrinology</u> Pituitary, Thyroid, Islets of Langerhans - models</p> <p><b>RECORD</b> A record of lab work shall be maintained and submitted at the time of Practical examination for valuation.</p>	45

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>Jayasurya., Arumugam, N., Nair, N.C., Leelavathy,S., Soundara Pandian,N., Murugan,T. Practical Zoology Volume - 1. Invertebrata. Saras publication, Nagercoil. 2013.</li> <li>Jayasurya., Arumugam, N., Thangamani., Prasannakumar., Narayanan.L.M. Practical Zoology Volume -2. Saras publication, Nagercoil. 2013.</li> <li>Jayasurya., Arumugam, N., Dulsy Fatima., Narayanan,L.M., Meyyan, R.P., Nallasingam,K., Kumaresan,V., Mani,A., Selvaraj,A.M., Mariakuttikan,A. Practical Zoology Volume -3. Cell Biology – Embryology – Animal Physiology – Immunology – Ecology – Genetics – Evolution – Microbiology – Biochemistry – Biophysics. Saras Publication. 2013</li> </ol>

**Reference Book(s):**

1. Nair,N.C., Leelavathy,S., Soundara Pandian, N., Murugan,T., Thangamani, A., Prasannakumar,S., Narayanan,L.M., and Arumugam,N., Animal Diversity Invertebrata and Chordata. Saras Publication, Nagercoil. Fifth Ed., 2013
2. Arumugam, N. and Mariakuttikan,A., Animal Physiology. Saras Publication, Nagercoil. 2011.
3. Arumugam, N, A Text Book of Embryology, Saras Publication, Nagercoil. Fourteenth Ed., 2013.
4. Arumugam, N, Organic Evolution, Saras publication, Nagercoil. 2010

**Web Resource(s):**

1. <http://www.itis.usda.gov/itis/status.html>
2. <http://www.bishop.hawaii.org/bishop/HBS/hbs1.html>
3. <http://www.itis.usda.gov/itis/status.html>
4. <http://www.bishop.hawaii.org/bishop/HBS/hbs1.html>

**Course Outcomes**

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

CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand the anatomy and physiology of selected animal systems.	K1 & K2
CO2	Apply the techniques in blood grouping and the components of blood and nitrogenous wastes testing.	K3
CO3	Classify chordates and determine the characteristics of chordates.	K2
CO4	Analyze the biological processes involved in embryonic development and describe the fundamental processes leading to evolutionary changes.	K4
CO5	Evaluate the integrated functions of endocrine glands.	K5

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	2	3	2	2.7
CO2	3	3	3	3	3	3	2	2	3	2	2.7
CO3	3	3	3	3	3	3	2	2	3	2	2.7
CO4	3	3	3	3	3	3	2	2	3	2	2.7
CO5	3	3	3	3	3	3	2	2	3	2	2.7
Mean Overall Score											2.7
Correlation											High

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

**Course Coordinator: Dr. H. E. Syed Mohamed**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBO3GE1	Generic Elective – I	2	2	-	100	100
Course Title	Edible Mushroom Cultivation and Commercialization						
Syllabus							
Unit	Contents						Hours
I	Introduction: History, importance and scope of edible mushrooms, morphology of mushroom, identification of edible and poisonous mushrooms. Skill development for mushroom cultivation *Mushroom cultivation in India*.						6
II	Biological importance, composting and storage: 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*.						6
III	Spawning and Cultivation Methods: Strains, containers, quantity of spawn to be used, spawning types and techniques, compost preparation, casing. Cultivation of button, milky and *oyster mushrooms*.						6
IV	Crop management: Air temperature, humidity, ventilation, watering and watering methods, disposal of used compost and recycling, cropping period, insects and pests, *insecticides and their use*.						6
V	Economics of Cultivation and Post Harvest Technologies: 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, Export opportunities and *Mushroom recipes* (Soup, pulao, pickles, omelette).						6

\* ..... \* Self Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>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.</li> <li>2. Parveen Garg, Mushroom cultivation, 1<sup>st</sup> Edition, B R Publishing Corporation Pvt Ltd, New Delhi India, 2015.</li> <li>3. Rajan S. Mushroom technology, 2<sup>nd</sup> Edition, CBS Publishers and Distributors, Pvt Ltd, New Delhi India, 2020.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Nita Bahl, Hand book of Mushroom, Oxford and IBH Book House Pvt Ltd, New Delhi, India, 2005.</li> <li>2. Eiri B, Hand Book of Mushroom Cultivation, Processing and Packaging, Engineers India Research Institute, New Delhi, India, 2007.</li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Provide an adequate knowledge about importance and habitation of mushroom.	<b>K1</b>
<b>CO2</b>	Get understating of nutritional value, cultivation unit and practice of storage methods.	<b>K2</b>
<b>CO3</b>	Acquire knowledge and practice about spawning techniques and learn mushroom cultivation techniques.	<b>K3</b>
<b>CO4</b>	Evaluating the factors influencing the mushroom cultivation, practice post harvesting methods and preparation of insecticides.	<b>K4</b>
<b>CO5</b>	Students get training about cost economics and preparation of value-added products.	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. K. Mohamed Rafi**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBO4CC7	Core - VII	5	5	25	75	100
Course Title		Microbiology and Plant Pathology					

SYLLABUS		
Unit	Contents	Hours
I	<b>Fundamentals of Microbiology:</b> History and scope of microbiology. Classification of microorganisms – Haeckel's three kingdom and Whittaker's five kingdom concept. Outline of Bergey's manual of systematic bacteriology (9 <sup>th</sup> Edition). General features of archaeobacteria, eubacteria, cyanobacteria, mycoplasmas, rickettsia, chlamydia's, *actinomycetes*. Microscopy – principles and applications of bright field, dark field, phase contrast and electron microscopy (TEM & SEM).	15
II	<b>Bacteria:</b> 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 nucleoid. *Bacterial growth curve*. Human disease caused by bacteria – Air borne bacterial disease – <i>Mycobacterium tuberculosis</i> , Pneumonia and <i>Streptococcal pharyngitis</i> .	15
III	<b>Viruses:</b> History, classification of viruses, morphology – shape, size, structure – helical (naked and enveloped viruses), icosahedral (naked and enveloped) and complex viruses. General characteristics of plant and animal viruses. Viral multiplications (Lytic cycle, Lysogenic cycle). Human disease caused by virus – *Chicken pox*, Influenza, MERS and SARS (Covid-19).	15
IV	<b>Plant Pathology:</b> Definition, history, importance, epidemiology and forecasting of plant diseases. Common terminologies relevant to the plant pathology and Koch's postulates. Classification of plant diseases, symptoms of fungal, bacterial and *viral diseases*.	15
V	<b>Plant Diseases:</b> 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, *Bunchy top of banana*. 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.	15

\* ..... \* Self Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>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.</li> <li>2. Pandey BP, Plant pathology, 11<sup>th</sup> Edition, Chand and Company Pvt Ltd, New Delhi, India, 2014.</li> <li>3. Willey JM, Sherwood LM and Woolverton CJ, Prescott's Microbiology, 10<sup>th</sup> Edition, McGraw Hill Education Pvt Ltd, New York, 2017.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Ananthanarayan R and Jayaram Paniker CK, Text Book of Microbiology, 10<sup>th</sup> Edition, Universities Press (India) Pvt Ltd, New Delhi, India, 2017.</li> <li>2. Mehrotra RS and Aggarwal A, Plant Pathology, 3<sup>rd</sup> Edition, McGraw Hill Education (India) Company Pvt Ltd, New Delhi, India, 2017.</li> </ol>
<b>Web Resource(s):</b>
<ol style="list-style-type: none"> <li>1. <a href="https://www.biologydiscussion.com/microscope/microscope-types-of-microscope/56714">https://www.biologydiscussion.com/microscope/microscope-types-of-microscope/56714</a></li> <li>2. <a href="https://microbenotes.com/ribosomes-structure-and-functions/">https://microbenotes.com/ribosomes-structure-and-functions/</a></li> <li>3. <a href="https://www.vedantu.com/biology/difference-between-plant-virus-and-animal-virus">https://www.vedantu.com/biology/difference-between-plant-virus-and-animal-virus</a></li> <li>4. <a href="https://ipm.cahnr.uconn.edu/early-blight-and-late-blight-of-potato/">https://ipm.cahnr.uconn.edu/early-blight-and-late-blight-of-potato/</a></li> <li>5. <a href="http://www.nou.ac.in/Online%20Resources/30-8/botany4.pdf">http://www.nou.ac.in/Online%20Resources/30-8/botany4.pdf</a></li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-level)</b>
<b>CO1</b>	Describe the characters and classification of bacteria and study the principle and application of various types of microscopes.	<b>K1</b>
<b>CO2</b>	Analyse the internal & external structures, growth and air borne disease caused by bacteria.	<b>K2</b>
<b>CO3</b>	Study the characters and classification of plant and animal viruses and emphasis the most virulence human viral infections.	<b>K3</b>
<b>CO4</b>	Correlate the epidemiology and forecasting of plant disease.	<b>K4</b>
<b>CO5</b>	Acquire the knowledge of plant disease, integrated pest management and innovative methods for plant disease control.	<b>K5</b>

Relationship Matrix:

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3.0	2.0	1.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.5
<b>CO2</b>	3.0	2.0	3.0	2.0	3.0	2.0	3.0	2.0	3.0	3.0	2.6
<b>CO3</b>	3.0	3.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	2.5
<b>CO4</b>	2.0	3.0	3.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	2.7
<b>CO5</b>	3.0	3.0	2.0	2.0	2.0	2.0	3.0	3.0	3.0	3.0	2.6
<b>Mean Overall Score</b>											2.5
<b>Correlation</b>											High

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

**Course Coordinator: Dr. N. Ahamed Sherif**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBO4CC8P	Core - VIII	3	3	20	80	100
<b>Course Title</b>		<b>Laboratory Course for Core -VII - Practical</b>					

Contents	Hours
<p><b>A. Microbiology</b></p> <ol style="list-style-type: none"> <li>1. Good Laboratory Practices (GLP)</li> <li>2. Principle and methods of sterilization (Physical and Chemical Methods)</li> <li>3. Preparation of culture media               <ol style="list-style-type: none"> <li>a) Preparation of solid and liquid medium                   <ol style="list-style-type: none"> <li>i) Nutrient agar medium</li> <li>ii) Potato Dextrose Agar medium</li> </ol> </li> </ol> </li> <li>4. Calibration and standardization of microscope by using ocular micrometre and stage micrometre</li> <li>5. Isolation of bacteria and fungi from soil by serial dilution techniques</li> <li>6. Demonstration of techniques for pure culture of bacteria and fungi               <ol style="list-style-type: none"> <li>a) Streak plate method</li> <li>b) Pour plate method</li> <li>c) Spread plate method</li> </ol> </li> <li>7. Gram staining techniques</li> <li>8. Methylene Blue dye reduction test</li> </ol> <p><b>B. Plant Pathology</b></p> <p>Study of the morphological and internal part of the following infected plant parts.</p> <ol style="list-style-type: none"> <li>1. Tikka disease of ground nut</li> <li>2. Early blight of potato</li> <li>3. Wilt disease of cotton</li> <li>4. Loose smut of wheat</li> <li>5. Bacterial blight of paddy</li> <li>6. Citrus canker</li> <li>7. Bunchy top of banana</li> </ol>	45

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Dubey RC and Maheshwari DK, Practical microbiology, 1<sup>st</sup> Edition, Chand &amp; Company Pvt Ltd, New Delhi, India, 2010.</li> <li>2. Santra SC, Practical Botany, 1<sup>st</sup> Edition, New Central Book Agency Pvt Ltd, Kolkata, India, 2015.</li> <li>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.</li> </ol>



<b>Web Resource(s):</b>	
1.	<a href="https://youtu.be/_1KP9zOtjXk?si=vN47MSRPSATPYSDr">https://youtu.be/_1KP9zOtjXk?si=vN47MSRPSATPYSDr</a>
2.	<a href="https://youtu.be/alTgt0h5jOE?si=d7RA0QM6MxgNLk_U">https://youtu.be/alTgt0h5jOE?si=d7RA0QM6MxgNLk_U</a>
3.	<a href="https://youtu.be/AZS2wb7pMo4?si=H4F11QsHtoqUQPyw">https://youtu.be/AZS2wb7pMo4?si=H4F11QsHtoqUQPyw</a>
4.	<a href="https://youtu.be/9RuDd1sNVnU?si=J_326iwFI39KL4y">https://youtu.be/9RuDd1sNVnU?si=J_326iwFI39KL4y</a>
5.	<a href="https://www.vedantu.com/biology/rice-bacterial-blight">https://www.vedantu.com/biology/rice-bacterial-blight</a>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-level)</b>
<b>CO1</b>	Calibrate the different type of microscope.	<b>K1</b>
<b>CO2</b>	Study the basic rules, sterilization methods and preparation of culture media for the enumeration of bacteria.	<b>K2</b>
<b>CO3</b>	Differentiate cell wall characters of bacteria through Gram's staining technique.	<b>K3</b>
<b>CO4</b>	Pure culture methodology is adopted for the characterization of bacteria.	<b>K4</b>
<b>CO5</b>	Correlate the morphological and internal tissue of the infected plants.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	2.0	2.0	3.0	2.0	3.0	2.0	2.0	2.0	3.0	3.0	2.4
<b>CO2</b>	3.0	2.0	3.0	2.0	2.0	2.0	3.0	2.0	3.0	3.0	2.5
<b>CO3</b>	3.0	2.0	2.0	2.0	3.0	2.0	3.0	2.0	2.0	3.0	2.4
<b>CO4</b>	3.0	3.0	3.0	2.0	2.0	2.0	2.0	3.0	2.0	3.0	2.5
<b>CO5</b>	3.0	2.0	2.0	2.0	3.0	2.0	3.0	3.0	3.0	3.0	2.4
<b>Mean Overall Score</b>											2.4
<b>Correlation</b>											Medium

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

**Course Coordinator: Dr. N. Ahamed Sherif**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UZO4AC7	Allied - VII	5	4	25	75	100
Course Title							
ECONOMIC ZOOLOGY							

SYLLABUS		
Unit	Contents	Hours
I	<b>Poultry farming and Vermiculture:</b> Poultry farming: Types of fowls – Rearing methods of Broilers and Layers – Poultry nutrition – Poultry diseases (NCD, IBV). Issues and limitations of poultry farming. Vermiculture: Classification, Species of Earthworms – Life cycle of <i>Lampito mauritii</i> – Preparation of vermin bed; vermiwash; Vermicompost – Economic importance; Physicochemical parameters. *Organic farming*.	15
II	<b>Apiculture and Sericulture:</b> Apiculture: Classification- Species - colonial structure– Biology of Honey bee –Bee hives (Newton hive, Langstroth hive) – Honey : Extraction – Nutritive and medicinal values. Sericulture: Classification; Species; Life cycle( <i>Bombyx mori</i> ). Rearing of silk worm: Paraffin paper rearing – Box rearing. Diseases of silk worm: Protozoan (Pebrine) – Bacterial (Septicemia) - Reeling of silk – *Economic importance of silk*.	15
III	<b>Aquaculture:</b> Aquaculture: Freshwater fishes (Indian major carps) – Site selection and construction of pond – Fish feed (Live feed and formulated) – Induced breeding – rearing methods. Fish diseases –: Furunculosis, Epizootic Ulcerative Syndrome (EUS) and *Vibriosis* – Fresh water Prawn culture. *Ornamental fish culture.*	15
IV	<b>Insect Vectors and Pests:</b> Insects pests of crops: Classification, biology nature of damage and control measures of Pests: Paddy ( <i>Scirpophaga incertulas</i> ), Cotton ( <i>Helicoverpa armigera</i> ), sugarcane ( <i>Scirpophaga excerptalis</i> ), Coconut ( <i>Oryctes rhinoceros</i> ). Insects as Vectors of Human Diseases: Classification and Biology, disease spread and control measures of Mosquito *Housefly *	15
V	<b>General Principles of Insect Control:</b> Physical, Mechanical, Chemical and Biological Control and their Advantages limitations. Pesticide uses in India – Precaution in handling pesticides. Integrated Pest Management. Non-conventional Methods of Pest Control. *Organics pesticides and their advantages*	15

\*.....\* Self Study

Text Book(s):
<ol style="list-style-type: none"> <li>1. Shukla.G.S. and Upadhy.V.B. Economic Zoology (Rastogi publications).</li> <li>2. Ganga.G and Sulochana Chetty. J., An introduction to Sericulture(2nd edition)Oxford &amp; IBH Publishing company.</li> </ol>

<b>Reference Book(s):</b>
1. Ahsan, J and Sinha, S.P. A handbook on economic zoology, S.Chand& Co. 2. Sardarsingh – Bee keeping in India. 3. Santhanam – Aquaculture. 4. Ullal.S.R. and Narasimhanna, M.N – Central Silk Board, Govt. of India, Bombay. 5. Singh – Livestock and poultry production. 6. Jhingran – Fish and fisheries. 7. T.V.R. Pillai – Coastal Aquaculture. 8. Maine product export development authority – Freshwater fishes, Ornamental fishes, Shrimph culture – MPEDA Publication series.
<b>Web Resource(s):</b>
<a href="https://www.agropustaka.id/wp-content/uploads/2020/04/agropustaka.id_buku_Modern-Livestock-and-Poultry-Production-8th-Edition-by-James-R.-Gillespie-Frank-B.-Flanders.pdf">https://www.agropustaka.id/wp-content/uploads/2020/04/agropustaka.id_buku_Modern-Livestock-and-Poultry-Production-8th-Edition-by-James-R.-Gillespie-Frank-B.-Flanders.pdf</a> 2. <a href="https://www.pdfdrive.com/poultry-fisheries-apiculture-and-sericulture-d52750733.html">https://www.pdfdrive.com/poultry-fisheries-apiculture-and-sericulture-d52750733.html</a>

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
CO1	Understand the concepts of poultry farming and vermiculture	<b>K2</b>
CO2	Learn the benefits and economic value of animal products from apiculture and sericulture.	<b>K3</b>
CO3	Record the significance of Aquaculture and fish farming	<b>K3</b>
CO4	Classify insects vectors and pests; create awareness of spread of diseases and control methods.	<b>K4</b>
CO5	Apply entrepreneurial skill and illustrate pest management types.	<b>K5</b>

### Relationship Matrix:

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3	3	3	3	3	3	2	2	3	2	2.7
<b>CO2</b>	3	3	3	3	3	3	2	2	3	2	2.7
<b>CO3</b>	3	3	3	3	3	3	2	2	3	2	2.7
<b>CO4</b>	3	3	3	3	3	3	2	2	3	2	2.7
<b>CO5</b>	3	3	3	3	3	3	2	2	3	2	2.7
<b>Mean Overall Score</b>											<b>2.7</b>
<b>Correlation</b>											<b>High</b>

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

**Course Coordinator: Dr. M. Meeramaideen**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UZO4AC8P	Allied - VIII	3	2	20	80	100
Course Title		ECONOMIC ZOOLOGY - PRACTICAL - II					

SYLLABUS		
Unit	Contents	Hours
	<p><b>Dissections:</b></p> <ol style="list-style-type: none"> <li>1. Dissect and display the Earth worm/ Cockroach nervous system</li> <li>2. Dissect and display the Prawn appendages</li> <li>3. Dissect and display the Prawn nervous system</li> <li>4. Dissect and display the silk gland of silk moth larva (Demo)</li> </ol> <p><b>Mountings</b></p> <ol style="list-style-type: none"> <li>1. Mounting of Earth worm: Body setae, Pineal setae.</li> <li>2. Mounting of honey bee sting apparatus</li> <li>3. Mounting of scales: Cycloid, Cteinoid, Placoid</li> <li>4. Mounting the Mouth parts: Mosquito, Honey bee,</li> </ol> <p><b><u>Spotters</u></b></p> <p>Vermiculture- <i>Lampito mauritii</i>, <i>Perionyx excavates</i>.</p> <p>Apiculture – <i>Apis indica</i> ;</p> <p>Sericulture – <i>Bombyx mori</i> ;</p> <p>Aquaculture – Major carps : Catla, Rohu and Mrigal: Prawn – Macrobrachium.</p> <p>Poultry : Layers &amp; Broilers.</p> <p><b>Animal products:</b> Honey, Bee wax, Lac, Silk, and Hen's egg.</p> <p><b>Record Work</b></p> <p>A record of lab work shall be maintained and submitted at the time of Practical Examination for valuation.</p>	45
	<p><b>Current Trends (For CIA only)</b> – Nutrient composition of vermicompost – Advantages of sea food – Health benefits of egg.</p>	

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Jayasurya., Arumugam, N., Nair, N.C., Leelavathy,S., Soundara Pandian,N., Murugan,T. Practical Zoology Volume - 1. Invertebrata. Saras publication, Nagercoil. 2013.</li> <li>2. Jayasurya., Arumugam, N., Thangamani., Prasannakumar., Narayanan.L.M. Practical Zoology Volume -2. Saras publication, Nagercoil. 2013.</li> <li>3. Jayasurya., Arumugam, N., Dulsy Fatima., Narayanan,L.M., Meyyan, R.P., Nallasingam,K.,</li> <li>4. Kumaresan,V., Mani,A., Selvaraj,A.M., Mariakuttikan,A. Practical Zoology Volume -3. Cell</li> <li>5. Biology – Embryology – Animal Physiology – Immunology – Ecology – Genetics – Evolution –</li> <li>6. Microbiology – Biochemistry – Biophysics. Saras Publication. 2013</li> </ol>

<b>Reference Book(s):</b>
1. Nair,N.C., Leelavathy,S., Soundara Pandian, N., Murugan,T., Thangamani, A., Prasannakumar,S., Narayanan,L.M., and Arumugam,N., Animal Diversity Invertebrata and Chordata. Saras Publication, Nagercoil. Fifth Ed., 2013 2. Arumugam, N. and Mariakuttikan,A., Animal Physiology. Saras Publication, Nagercoil. 2011. 3. Arumugam, N, A Text Book of Embryology, Saras Publication, Nagercoil. Fourteenth Ed., 2013. 4. Arumugam, N, Organic Evolution, Saras publication, Nagercoil. 2010
<b>Web Resource(s):</b>
1. <a href="http://www.itis.usda.gov/itis/status.html">http://www.itis.usda.gov/itis/status.html</a> 2. <a href="http://www.bishop.hawaii.org/bishop/HBS/hbs1.html">http://www.bishop.hawaii.org/bishop/HBS/hbs1.html</a> 3. <a href="http://www.itis.usda.gov/itis/status.html">http://www.itis.usda.gov/itis/status.html</a> 4. <a href="http://www.bishop.hawaii.org/bishop/HBS/hbs1.html">http://www.bishop.hawaii.org/bishop/HBS/hbs1.html</a>

Course Outcomes		
Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-Level)
CO1	Understand the different functional systems of earthworm and honey bee through dissection.	K3
CO2	Identify and prepare slides of fish scales and compare the appendages of prawn.	K2
CO3	Classify giving reasons, draw labelled sketch and bring out their biological significance	K3
CO4	Relate the nature of damage and the life cycle of pests	K3
CO5	Report the economic importance of animal products and their significance.	K4

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	3	3	3	3	2	2	3	2	2.7
CO2	3	3	3	3	3	3	2	2	3	2	2.7
CO3	3	3	3	3	3	3	2	2	3	2	2.7
CO4	3	3	3	3	3	3	2	2	3	2	2.7
CO5	3	3	3	3	3	3	2	2	3	2	2.7
Mean Overall Score											2.7
Correlation											High

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

**Course Coordinator: Dr. M. Meeramaideen**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBO4GE2	Generic Elective – II	2	2	-	100	100
<b>Course Title</b>		<b>Nursery, Gardening for Entrepreneurship</b>					

Syllabus		
Unit	Contents	Hours
I	<b>Nursery:</b> 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. *Business analysis of important plants*.	6
II	<b>Gardening:</b> 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*.	6
III	<b>Seeds:</b> 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.	6
IV	<b>Vegetative Propagation:</b> Methods - natural vegetative propagation, artificial vegetative propagation- cutting, layering, grafting and budding, stock and scion relationship. Cultivation of chrysanthemum, roses and jasmine. *Opportunities for floriculture export*.	6
V	<b>Entrepreneurship:</b> Marketing of ornamental and nursery plants– methods, publicity and marketing mix. Application procedure for subsidy of various governments agencies - APEDA, DIC, SIDA, SISI, NSIC, SIDO. Investment procurement – project formation, feasibility, legal formalities, shop act, estimation and costing, investment procedure, loan procurement, *banking*.	6

\*..... \* Self Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Eiri Staff, Hand Book of Mushroom Cultivation, Processing and Packaging, EiRi Publication, 2007.</li> <li>2. Sadhu MK, Plant Propagation, 1<sup>st</sup> Edition, New Age International Pvt Ltd, New Delhi, India, 2007.</li> <li>3. Kumar N, Introduction to Horticulture, 8<sup>th</sup> Edition, Medtech, Scientific International Pvt Ltd, New Delhi, India, 2017.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Pearson CE, Complete Gardening, 1<sup>st</sup> Edition, Treasure Press, London, England, 1982.</li> <li>2. Whiteaker S, English Garden Embroidery, 1<sup>st</sup> Edition, Century Hutchinson Ltd, London, England, 1989.</li> </ol>
<b>Web Resource(s):</b>
<ol style="list-style-type: none"> <li>1. <a href="https://aggie-horticulture.tamu.edu/ornamental/economic-fact-sheets/plan-for-improved-marketing/">https://aggie-horticulture.tamu.edu/ornamental/economic-fact-sheets/plan-for-improved-marketing/</a></li> <li>2. <a href="https://www.slideshare.net/AnubhaRastogi/role-of-agencies-assisting-entrepreneurship">https://www.slideshare.net/AnubhaRastogi/role-of-agencies-assisting-entrepreneurship</a></li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-level)</b>
<b>CO1</b>	Distinguish the concept of nursery and Gardening.	<b>K1</b>
<b>CO2</b>	Expand the skills for growing fresh and safe vegetables.	<b>K2</b>
<b>CO3</b>	Create awareness and practice cultivation methods about home gardening.	<b>K3</b>
<b>CO4</b>	Develop different skills regarding the gardening operations.	<b>K4</b>
<b>CO5</b>	Apply nursery and gardening for entrepreneurship.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	2	3	2	3	3	2	3	3	2	3	2.6
<b>CO2</b>	2	3	2	2	3	2	2	2	2	3	2.3
<b>CO3</b>	2	2	3	2	2	3	2	2	3	3	2.4
<b>CO4</b>	3	3	2	3	2	3	2	3	3	2	2.6
<b>CO5</b>	3	3	2	3	2	2	3	2	2	3	2.5
<b>Mean Overall Score</b>											2.4
<b>Correlation</b>											Medium

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

**Course Coordinator: Dr. K. Mohamed Rafi**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5CC9	Core – IX	6	6	25	75	100
Course Title		PLANT SYSTEMATICS AND ECONOMIC BOTANY					

SYLLABUS		
Unit	Contents	Hours
I	<b>Morphology of Angiosperms and Herbarium techniques:</b> Parts of a plant body, modifications of stem and root. Types of inflorescences and floral parts, floral diagram, floral formula and fruit types. Herbarium techniques, virtual herbarium and e-flora.	18
II	<b>Systems of classification:</b> History of plant taxonomy. Types of classification – Artificial (Linnaeus), Natural (Bentham & Hooker) and Phylogenetic systems (Engler & Prantle). Outline version of APG-IV. Binomial nomenclature, ICN & ICBN and its rules. Brief account of cytotaxonomy, chemotaxonomy, numerical taxonomy and molecular taxonomy. Role of BSI.	18
III	<b>Plant families:</b> Study of the following families based on Bentham and Hooker's system of classification and economic importance. Annonaceae, Capparidaceae, Rutaceae, Anacardiaceae, Fabaceae (sub families - Papilionaceae, Caesalpiniaceae, Mimosaceae), Myrtaceae, Cucurbitaceae, *Apiaceae*.	18
IV	<b>Plant families:</b> Study of the following families based on Bentham and Hooker's system of classification and economic importance. Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, *Solanaceae*, Acanthaceae, Lamiaceae, Euphorbiaceae, Orchidaceae and Poaceae.	18
V	<b>Economic botany:</b> Cultivation process, economic products and uses of rice, banana, black gram, sunflower, sugar cane, coconut, ground nut & cotton. Process and uses of tea and coffee. Trade potential of <i>Moringa</i> (leaf and unripe fruit), curry leaves, periwinkle, <i>Senna</i> and glory lilly.	18

\*.....\* Self Study Portion

<b>Text Book(s):</b>
1. Subrahmanyam NS, Modern Plant Taxonomy, 1 <sup>st</sup> Edition, South Asia Books Pvt Ltd., New Delhi, 1997.
2. Sivarajan VV, Introduction to the Principles of Plant Taxonomy, 2 <sup>nd</sup> Edition, Oxford & IBH Publishing Co Pvt Ltd., New Delhi, 1999.
3. Sambamurthy AVSS, Taxonomy of Angiosperms, 1 <sup>st</sup> Edition, IK International Publishing House Pvt Ltd., Karnataka, 2005.
4. Sharma OP, Plant taxonomy, 2 <sup>nd</sup> edition. Tata McGraw Hill Education Pvt Ltd., New Delhi, 2017.
<b>Reference Book(s):</b>
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), Pragun Publications Pvt Ltd., New Delhi, India, 2012.
<b>Web Resource(s)</b>
1. <a href="https://www.kew.org/read-and-watch/apg-classification-consensus">https://www.kew.org/read-and-watch/apg-classification-consensus</a>
2. <a href="https://unacademy.com/content/neet-ug/study-material/biology/what-is-the-taxonomic-hierarchy">https://unacademy.com/content/neet-ug/study-material/biology/what-is-the-taxonomic-hierarchy</a>
3. <a href="https://www.iapt-taxon.org/nomen/main.php">https://www.iapt-taxon.org/nomen/main.php</a>
4. <a href="https://biomed.brown.edu/Courses/BIO48/26.Systematics.HTML">https://biomed.brown.edu/Courses/BIO48/26.Systematics.HTML</a>



<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Realize the morphological characters of plant parts and understand the importance of herbarium technique	<b>K1</b>
<b>CO2</b>	Understand the different type of taxonomic classification	<b>K2</b>
<b>CO3</b>	Impart knowledge on plant family Annonaceae to Apiaceae	<b>K3</b>
<b>CO4</b>	Impart knowledge on plant family Rubiaceae to Poaceae	<b>K4</b>
<b>CO5</b>	Familiarize the students with plants having immense economic importance.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (Cos)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>1.9</b>
<b>CO2</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>2.3</b>
<b>CO3</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.0</b>
<b>CO4</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>2.4</b>
<b>CO5</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.1</b>
<b>Mean Overall Score</b>											<b>2.1</b>
<b>Correlation</b>											<b>Medium</b>

<b>Mean Overall Score</b>	<b>Correlation</b>
<b>&lt; 1.5</b>	<b>Low</b>
<b>≥ 1.5 and &lt; 2.5</b>	<b>Medium</b>
<b>≥ 2.5</b>	<b>High</b>

**Course Coordinator: Dr. A. Shajahan**

**Content Revised: 02%**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5CC10	Core – X	6	6	25	75	100
Course Title		PLANT PHYSIOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	<b>Plant-water relations:</b> Importance of water to plant life, structure, properties and potential of water. Diffusion, imbibition, <b>osmosis</b> and <b>its significance</b> and <b>plasmolysis</b> . Mechanism of absorption of water - active and passive, <b>symplast and apoplast pathway</b> . 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. Transpiration - types, <b>opening and closing of stomata</b> , <b>factors affecting transpiration</b> and significance, Guttation – hydathodes.	18
II	<b>Mineral nutrition:</b> <b>Major and minor elements- functions, deficiency symptoms.</b> <b>Mechanism of absorption of minerals and salts</b> - ion exchange, passive and active absorption, carrier concept. Translocation of organic solutes – pathways and mechanism, phloem loading and unloading. 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.	18
III	<b>Photosynthesis:</b> Definition, significance, photosynthetic apparatus, photosynthetic pigments and absorption of light energy, <b>pigment system I (PS I) and Pigment system II (PS II).</b> <b>Light reactions- Non-cyclic and cyclic photophosphorylation.</b> Dark reaction (Calvin cycle), C4 pathway, photorespiration (C <sub>2</sub> cycle), Crassulacean acid metabolism ( <b>CAM pathway</b> ). *Factors affecting photosynthesis*.	18
IV	<b>Respiration:</b> Types of respiration in plants, Mechanism <b>of aerobic and anaerobic respiration</b> – glycolysis, <b>Krebs</b> cycle, Electron transport system and oxidative phosphorylation, <b>Oxidation of extra-mitochondrial NADH</b> , *Cyanide resistant respiration*, pentose phosphate pathway and its significance. Entner-Doudoroff pathway, Respiratory quotient. Factors affecting respiration.	18
V	<b>Growth and Development:</b> Definition, phases and kinetics of growth. <b>Structure</b> and physiological effects of phytohormones - auxins, gibberellins, cytokinins, abscisic acid, brassinosteroids and ethylene. Physiology of flowering - photoperiodism, <b>role of phytochrome in plant development</b> ; *Vernalization*. Physiology of senescence and ageing. <b>Seed dormancy and germination</b> . Circadian rhythms in plants.	18

\*..... \* Self Study

Text Book(s):
4. Jain VK, Fundamentals of Plant Physiology, 19 <sup>th</sup> revised edition, S. Chand & Company Ltd, New Delhi, India, 2018.
5. Bhatla SC and Lal MA. Plant Physiology, Development and Metabolism. Germany, Springer Nature Singapore, 2023.
6. Srivastava HS, Plant Physiology and Biochemistry, 7 <sup>th</sup> Edition, Rastogi publications, Uttar Pradesh, India, 2018.

<b>Reference Book(s):</b>	
4. 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 5. Salisbury FB and Ross CW, Plant Physiology, 4 <sup>th</sup> Edition, Wardsworth Publication, Stansted, United Kingdom, 2006. 6. Verma SK and Verma M, A text book of Plant Physiology, Biochemistry and Biotechnology, 10 <sup>th</sup> revised edition, S. Chand & Company Ltd, New Delhi, India, 2010.	
<b>Web Resource(s)</b>	
1. <a href="https://unacademy.com/content/neet-ug/study-material/biology/plant-water-relation">https://unacademy.com/content/neet-ug/study-material/biology/plant-water-relation</a> . 2. <a href="https://www.toppr.com/guides/biology/mineral-nutrition/metabolism-of-nitrogen">https://www.toppr.com/guides/biology/mineral-nutrition/metabolism-of-nitrogen</a> 3. <a href="https://www.youtube.com/watch?v=XSMjfvDdTY">https://www.youtube.com/watch?v=XSMjfvDdTY</a>	

<b>Course Outcomes</b>		
Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Outlining the physiological relations of water and plants	<b>K1</b>
<b>CO2</b>	Categorize the minerals and their role in plant functions	<b>K2</b>
<b>CO3</b>	Examining the photosynthetic process in different plants	<b>K3</b>
<b>CO4</b>	Organize the molecular respiration events in plants	<b>K4</b>
<b>CO5</b>	Measure the growth and development of plants by hormones studies	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. R. RADHAKRISHNAN**

**Content Revised: 15 % Revised**

Semester	Course Code	Course Category	Hours	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5CC11	CORE – XI	6	6	25	75	100
Course Title	BIOCHEMISTRY, BIOPHYSICS AND BIOLOGICAL TECHNIQUES						
SYLLABUS							
Unit	Content						Hour
I	<b>Atoms, chemical bonds, pH and Buffers:</b> Elementary composition of living matter and structure of an atom. Chemical bonding – Electrovalent bonding, Covalent (Polar and non-polar), Non-covalent (hydrogen bonds,electrostatic bonds and 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). Buffer system -mechanism of buffer action. *Biological buffer systems*.						18
II	<b>Carbohydrates, Lipids and Vitamins:</b> Carbohydrates: Classification of carbohydrates; asymmetry, isomerism, optical isomerism and Stereochemistry of simple sugars, Structure and properties of monosaccharide (glucose and fructose), Disaccharide (maltose, lactose and sucrose). Polysaccharides (starch and cellulose). #Over view of carbohydrates metabolism#. Lipids – classification, Structure, function and importance of lipids. Fatty acids – saturated and unsaturated fatty acid. Biosynthesis of fatty acids. Vitamins – classification, Importance, composition and properties.						18
III	<b>Protein, Enzyme and Nucleic acid:</b> Amino acid – Classification, structure, properties and types. Protein – classification, structure, properties and functions. Levels of protein structure- Primary, secondary, tertiary and quaternary structure. Denaturation and Renaturation of protein. #Over view of protein metabolism#. Enzymes – classification, nomenclature, mode of actions, km value and isozymes. Nucleic acids - Structure and functions of DNA and RNA and its types.						18
IV	<b>Bioenergetics:</b> 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.						18
V	<b>Biological Techniques:</b> Basic of electromagnetic radiation. Principle, applications and types of pH meter, calorimeter, spectrophotometry techniques (UV-visible, Fluorescence and Infrared spectroscopy), centrifugation techniques (Density gradient, Differential and Ultracentrifugation), Chromatography techniques, (Thin layer, HPLC, Gas, Ion exchange and Affinity chromatography) and Electrophoretic techniques (SDS- PAGE and Agarose gel electrophoresis).						18

\*..... \* Self Study Portion

Text Books:
<ol style="list-style-type: none"> <li>1. Jain JL, Jain S and Jain N, Fundamentals of Biochemistry, 8<sup>th</sup> revised and enlarged edition, Chand &amp; Company, New Delhi, India, 2022.</li> <li>2. Sathyanarayana U and Chakarapani U, Biochemistry, 5<sup>th</sup> edition (Revised), Elsevier Health Sciences, Elsevier Relx India Pvt. Ltd. &amp; Books &amp; Allied Pvt. Ltd, New Delhi, 2020</li> <li>3. Claycomb J, Tran JQ, Introductory Biophysics, 1<sup>st</sup> edition, Jones and Bartlett Indian Pvt.Ltd, India, 2017.</li> </ol>

<b>Reference Books:</b>	
<ol style="list-style-type: none"> <li>1. Stryer L., Berg JM., Tymoczko JL, Gatto GJ, Biochemistry, 7<sup>th</sup> Revised edition, W.H. Freeman &amp; Company, New York, 2015.</li> <li>2. Nicolls DG and Ferguson SJ, Bioenergetics, 5<sup>th</sup> edition, Elsevier science Publication, 2018.</li> <li>3. Rajeshwari RM, An introduction to Biophysics, 1<sup>st</sup> edition, Rastogi Publication, Meerut, India, 2021.</li> <li>4. Bajpai, Biological Instrumentation and Methodology, revised edition, S. Chand Company, New Delhi, 2015.</li> </ol>	
<b>Web references:</b>	
<ol style="list-style-type: none"> <li>1. <a href="http://www.unm.edu/~rrobergs/426L4Bioen.pdf">http://www.unm.edu/~rrobergs/426L4Bioen.pdf</a></li> <li>2. <a href="https://books.google.co.in/books?id=STVUzwEACAAJ&amp;printsec=frontcover#v=onepage&amp;q&amp;f=false">https://books.google.co.in/books?id=STVUzwEACAAJ&amp;printsec=frontcover#v=onepage&amp;q&amp;f=false</a></li> <li>3. <a href="https://www.youtube.com/watch?v=FoswKE7tUH8">https://www.youtube.com/watch?v=FoswKE7tUH8</a></li> <li>4. <a href="https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid">https://www.genome.gov/genetics-glossary/Deoxyribonucleic-Acid</a></li> </ol>	

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Understanding the structure, properties and formulation of carbohydrates.	<b>K1</b>
<b>CO2</b>	Identify the different structure, properties and different configuration of proteins.	<b>K2</b>
<b>CO3</b>	Analyse the concept of enthalpy, entropy, free energy and standard free energy.	<b>K3</b>
<b>CO4</b>	Evaluate the metabolism of carbohydrates, lipids and proteins.	<b>K4</b>
<b>CO5</b>	Categorize the various bioanalytical techniques which are used to detect different biomolecules.	<b>K5</b>

### Relationship Matrix:

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

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

**Course Coordinator: Dr. R. SATHISH KUMAR**

**Content Revised: 25 %**

Semester	Course Code	Course Category	Hours	Credits	Marks for Evaluation																				
					CIA	ESE	Total																		
V	23UBO5CC12P	CORE – XII	3	3	20	80	100																		
Course Title	LABORATORY COURSE FOR CORE - IX, X AND XI – PRACTICAL (Plant Systematics and Economic Botany, Plant Physiology, Biochemistry, Biophysics and Biological Techniques)																								
<u>Practical's</u>							<u>Hours</u>																		
<b>Plant Systematics and Economic Botany:</b> 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: <table><tr><td>Annonaceae</td><td>Rutaceae</td><td>Capparidaceae</td></tr><tr><td>Fabaceae</td><td>Caesalpiniaceae</td><td>Mimosaceae</td></tr><tr><td>Myrtaceae</td><td>Cucurbitaceae</td><td>Rubiaceae</td></tr><tr><td>Asteraceae</td><td>Apocynaceae</td><td>Asclepiadaceae</td></tr><tr><td>Solanaceae</td><td>Acanthaceae</td><td>Lamiaceae</td></tr><tr><td>Euphorbiaceae</td><td>Poaceae</td><td></td></tr></table> 3. Dissection of floral parts – Dicot and monocot flowers. 4. Economic botany with special reference to their morphology, botanical name and family. a) Rice, banana, black gram, Sunflower, Sugar cane, Coconut, Castor seed, Ground nut, cotton, 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.							Annonaceae	Rutaceae	Capparidaceae	Fabaceae	Caesalpiniaceae	Mimosaceae	Myrtaceae	Cucurbitaceae	Rubiaceae	Asteraceae	Apocynaceae	Asclepiadaceae	Solanaceae	Acanthaceae	Lamiaceae	Euphorbiaceae	Poaceae		75
Annonaceae	Rutaceae	Capparidaceae																							
Fabaceae	Caesalpiniaceae	Mimosaceae																							
Myrtaceae	Cucurbitaceae	Rubiaceae																							
Asteraceae	Apocynaceae	Asclepiadaceae																							
Solanaceae	Acanthaceae	Lamiaceae																							
Euphorbiaceae	Poaceae																								
<b>Plant Physiology:</b> 1. Determination of osmotic pressure of Onion / Rheo leaf. 2. Effect of light intensity on transpiration using Ganong's Photometer. 3. Determination of stomatal frequency from the given leaf. 4. Measurement of oxygen evolution under different coloured lights using Wilmot's bubbler. 5. Quantitative estimation of plant pigments using Spectrophotometer (DBT star college scheme group practical).																									
<b>Biochemistry, Biophysics and Biological Techniques:</b> 1. Measurement of pH of a solution using pH meter 2. Preparation of Buffers 3. Estimation of carbohydrate by Anthrone method. 4. Estimation of protein by Lowry's method. 5. Gravimetric estimation of lipids 6. Separation of plant pigments / amino acids by paper chromatography																									

<b>Course Outcomes:</b>		
Upon successful completion of this course, the student will be able to		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Develop practical skills in identification of plants, field collection, morphology of useful parts and uses of important plants.	<b>K1</b>
<b>CO2</b>	Interpret the Rf values of amino acids/pigments by paper chromatography.	<b>K2</b>
<b>CO3</b>	Develop practical skills in separation and quantification of plant pigments.	<b>K3</b>
<b>CO4</b>	Understand the water absorption and their transport in plants	<b>K4</b>
<b>CO5</b>	Estimate the sugars/protein/lipid in plant tissues.	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr.A.SHAJAHAN, Dr.R.RADHAKRISHNAN & Dr. R. SATHISH KUMAR**

**Content Revised: 01 %**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5DE1A	Discipline Specific Elective - I	5	5	25	75	100
Course Title	BIostatistics and Bioinformatics						

Syllabus		
Unit	Contents	Hours
I	<b>Descriptive Biostatistics:</b> Definition – sampling techniques – types of data, collection, approximation, classification and tabulation – logarithms – Frequency distribution – Diagrammatic and graphical representation of data (Charting with Excel – Demonstration of Line, Bar, Histogram, Frequency Polygon, Curve and Pie chart – choosing and hanging chart style, adding error bar).	15
II	<b>Measure of data distributions:</b> Central tendency: Mean, median and mode – Measures of dispersion: Range, variance and standard deviation – Introduction to normal, binomial and poisson distributions – Skewness and kurtosis. Theories of probability – Students t-test, chi square test for goodness of fit and *statistical error*.	15
III	<b>Inferential statistics:</b> Spearman's rank and Pearson's correlation coefficient – calculation and interpretation, regression. Brief account on Principal Component Analysis (PCA) – demo of Clust-Vis online tool - 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).	15
IV	<b>Biological databases:</b> Sequence databases – Nucleic acid data bases, NCBI data model, Biological queries. Structural databases – PDB; file formats (FASTA, Swissprot and GenBank) specialized database. Browsing - Searching and data mining – *data retrieval using entrez*. literature database (PubMed).	15
V	Pair wise sequence comparison - multiple sequence alignments, phylogenetic alignment - Sequence queries against biological databases – BLAST. Protein structure visualization tools – RasMol and *Swiss PDB Viewer*.	15

\*..... \* Self Study Portion

Text Book(s):
1. Felix Bast, Biostatistics and Mathematical Biology, 1 <sup>st</sup> Edition, Pearson India Education Services Pvt. Ltd. 2023
2. Khan IA and Khanum A, Fundamentals of Biostatistics 2 <sup>nd</sup> Edition, Vikas Publications Pvt Ltd., Hyderabad, India, 1994.
3. Gurumani N, An introduction to Biostatistics, 1 <sup>st</sup> Edition, MJPP Publication Pvt Ltd., Chennai, Tamil Nadu, India, 2005.
4. Prakash S. Lohar. Bioinformatics, 1 <sup>st</sup> Edition, MJPP Publishers Pvt Ltd., Chennai, Tamil Nadu, India, 2009.



**Reference Book(s):**

1. MisraBNandMisraMK,IntroductoryPracticalBiostatistics,1stEdition,NayaProkashPvtLtd., Calcutta,India,1983.
2. DavidW, Mount, Bioinformatics–Sequence and genomeanalysis,1<sup>st</sup>Edition, ColdSpring Harbor Laboratory Press, New York, United States, 2001.
3. Lacroix, Z and Critchlow T, Bioinformatics: Managing scientific data, Morgan Kaufmann publishers, Elsevier imprint, San Fransisco, CA. 2003.

**Web Resource(s):**

1. <https://www.who.int/ihr/lyon/surveillance/biostatistics/en/>
2. <https://www.rcsb.org/>
3. [https://youtu.be/Xwh\\_joFo8AX8](https://youtu.be/Xwh_joFo8AX8)
4. <https://statistics.laerd.com/statistical-guides/pearson-correlation-coefficient-statistical-guide.php>
5. <https://biit.cs.ut.ee/clustvis/>
6. <https://www.ncbi.nlm.nih.gov/>

CO No.	Course Outcomes	Cognitive Level (K-level)
CO1	Demonstrates the skill of various numerical and graphic description of statistical data.	K1 & K2
CO2	Identify the patterns and types of data distribution in biological world.	K1 & K2
CO3	Make inference about the data collected in various surveys and experiments to support the decision-making process.	K3 & K4
CO4	Appraise the organization and usage of various biological databases.	K3 & K4
CO5	Develop analytical skills in numerical and sequenced data in biology.	K4 & K5

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. A. ASLAM**

**Content Revised: 12 %**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5DE1B	Discipline Specific Elective – I	5	5	25	75	100
Course Title		ENZYME TECHNOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	<b>Introduction</b> Enzyme properties, sources and applications. Chemical nature and classification of enzymes. Differences between catalyst and biocatalyst.*Functions of enzymes and industrial applications*.	15
II	<b>Enzyme structure:</b> Primary structure– peptide bonds. Secondary structure – alpha helix, beta sheet and super secondary structures. Ramachandran plot. Tertiary and quaternary structure.* <b>Structural classification of protein structure</b> *.	15
III	<b>Enzyme assay:</b> Introduction – Initiating, mixing and stopping reactions. Maintaining enzyme structure during enzyme assay. Quantitative description of enzyme assay. Types of assay, direct, indirect and <b>Ultra-High-throughput (HTA)</b> assay. *Instrument used for enzyme assay*.	15
IV	<b>Enzyme catalysis and inhibition:</b> 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*.	15
V	<b>Enzyme kinetics:</b> Factors affecting the enzyme activity – concentration, pH and temperature. Kinetics of a single-substrate enzyme catalysed reaction. Michealis-Menten Equation, Km, Vmax, <b>LB Plot</b> , Turnover number (Kcat). Kinetics of Enzyme inhibition. *Kinetics of allosteric enzymes*.	15

\* ..... \* Self Study Portion

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>Nicholas CP, Fundamentals of Enzymology, 3<sup>rd</sup> Edition, Oxford University Press Pvt Ltd., New York, United States, 2009.</li> <li>Bhatt SM, Enzymology and enzyme technology, 1<sup>st</sup> Edition, S. Chand and company Pvt Ltd., New Delhi, India, 2014.</li> <li>Sathyanarayana U and Chakarapani U, Biochemistry, 5<sup>th</sup> Edition (Revised), Books &amp; Allied Pvt Ltd., New Delhi, India, 2017.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>Voet D and Voet JG, Biochemistry, 4<sup>th</sup> Edition, J. Wiley &amp; Sons Pvt Ltd., New York, United States, 2010.</li> <li>David LN and Michael MC, Lehninger Principles of Biochemistry, 6<sup>th</sup> Edition, WH Freeman Company Pvt Ltd., New York, United States, 2013.</li> </ol>

<b>Web Resource(s)</b>
1. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4909775/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4909775/</a>
2. <a href="https://www.kth.se/dib/enzyme-technology-1.783173">https://www.kth.se/dib/enzyme-technology-1.783173</a>
3. <a href="https://www.longdom.org/open-access/enzyme-technology-an-emerging-trend-in-biotechnology-25286.html">https://www.longdom.org/open-access/enzyme-technology-an-emerging-trend-in-biotechnology-25286.html</a>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Understand the basics of enzymes and its applications.	<b>K1</b>
<b>CO2</b>	Demonstrate different structure of enzymes.	<b>K2</b>
<b>CO3</b>	Explain different methods of enzyme assay.	<b>K3</b>
<b>CO4</b>	Justify the enzyme catalysis and inhibition.	<b>K4</b>
<b>CO5</b>	Solve different factors involving enzyme kinetics.	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. R. SYED MOIDEEN**

**Content Revised: 02 %**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO5SE1	Skill Enhancement Course – I	2	1	-	100	100
Course Title		ALGAL CULTIVATION TECHNIQUES FOR ENTREPRENEURSHIP					

SYLLABUS		
Unit	Contents	Hours
I	<b>Habit and habitats algae:</b> Aquatic – Freshwater and Marine. Terrestrial – Saphophytes, Cryptophytes. Special habitats – Halophytes, Lithophytes, Epiphytes, Aerophytes, Epizooophytes, Cryophytes, Symbionts, endozoophytes, parasites and thermophytes.	6
II	<b>Culture Media for Algae:</b> Scope and importance of algal culture. Isolation and purification of algae. Culture media for algae – ASN III, ASP 2, Bristol, BG11, Fogg's, Beneck's Broth, SP Chu medium. Factors affecting the culture and growth – Physiological, chemical and environmental.	6
III	<b>Microalgal culture:</b> Indoor mass cultivation and processing of microalgae. Outdoor mass culture of microalgae – <i>Spirulina</i> (blue green algae), Cultivation of <i>Spirulina</i> using Race Way pond, <i>Chlorella</i> , <i>Botryococcus</i> and <i>Haematococcus</i> .	6
IV	<b>Seaweed cultivation :</b> Cultivation techniques of <i>Sargassum wightii</i> , <i>Gracilaria edulis</i> , <i>Gelidium carnea</i> , <i>Laminari adigitata</i> and <i>*Kappaphycu salvarezii*</i> .	6
V	<b>Algae for entrepreneurs:</b> 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*.	6

\* ..... \* Self Study Portion

Text Book(s):
1. Sharma OP, Algae: Diversity of Microbes and Cryptogams, 1 <sup>st</sup> Edition, Tata McGraw-Hill Education Pvt Ltd., New York, USA, 2011. 2. Tiwari B, Seaweed Sustainability: Food and non-food applications, 1 <sup>st</sup> Edition, Academic Press Pvt Ltd., Cambridge, United States, 2015. 3. Vashista B.R, Sinha A.K, Singh V.P. A Text Book of Algae, Revised Edition, Chand Publishing Pvt Ltd., New Delhi. 2023. 4. Srivastava H. N. Algae, 14 <sup>th</sup> Edition, Pradeep Publications, New Delhi. 2007.

<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Robert A. Andersen, Algal Culturing Techniques, 1<sup>st</sup> Edition, Elsevier Academic Press, California, United States, 2004.</li> <li>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.</li> <li>3. Amos R, Handbook of Microalgal Culture: Biotechnology and Applied Phycology, 1<sup>st</sup> Edition, Blackwell Science Pvt Ltd., United Kingdom, 2004.</li> </ol>

<b>Web Resource(s)</b>
<ol style="list-style-type: none"> <li>1. <a href="https://www.plantlet.org/algal-culture-types-culture-media/">https://www.plantlet.org/algal-culture-types-culture-media/</a></li> <li>2. <a href="https://www.nrmcf.org/docs/CultureDetails.pdf">https://www.nrmcf.org/docs/CultureDetails.pdf</a></li> <li>3. <a href="https://www.fao.org/3/y4765e/y4765e04.htm#TopOfPage">https://www.fao.org/3/y4765e/y4765e04.htm#TopOfPage</a></li> <li>4. <a href="https://www.fao.org/3/w3732e/w3732e02.htm#TopOfPage">https://www.fao.org/3/w3732e/w3732e02.htm#TopOfPage</a></li> <li>5. <a href="https://www.fao.org/3/ac416e/ac416e00.htm">https://www.fao.org/3/ac416e/ac416e00.htm</a></li> <li>6. <a href="https://www.algaeplanet.com/on-starting-an-algae-business/">https://www.algaeplanet.com/on-starting-an-algae-business/</a></li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Recall various algae as potential bio resources.	<b>K1</b>
<b>CO2</b>	Identify the possibilities of large scale cultivation of both fresh water and marine algae.	<b>K2</b>
<b>CO3</b>	Examine algae as alternative candidate for cultivation.	<b>K3</b>
<b>CO4</b>	Appraise various cultivation methods for algae.	<b>K4</b>
<b>CO5</b>	Adapt algal cultivation for entrepreneurial initiatives.	<b>K5</b>

**Relationship Matrix:**


<b>Course Outcomes (Cos)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	<b>03</b>	<b>03</b>	<b>01</b>	<b>03</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>2.1</b>
<b>CO2</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>2.6</b>
<b>CO3</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>2.3</b>
<b>CO4</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>2.8</b>
<b>CO5</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>01</b>	<b>03</b>	<b>2.4</b>
<b>Mean Overall Score</b>											<b>2.4</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinator: Dr. R. SYED MOIDEEN**  
**Content Revised: 02 %**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
V	23UBO5SE2	Skill Enhancement Course – II	2	1	CIA	ESE	Total
					-	100	100
Course Title		GREENHOUSE TECHNOLOGY					
SYLLABUS							
Unit	Content						Hours
I	Introduction and classification:  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. *Greenhouse heating system*.						6
II	Planning and facility:  Site selection, orientation and structural design. Greenhouse ventilation – natural and forced ventilation, microprocesors and computers. Greenhouse construction materials – wood, galvanized iron, aluminium, steel, glass and reinforced cement concrete. Greenhouse covering materials – *Polyethylene*, polyvinyl chloride, polyester and Tefzel T2 films.						6
III	Irrigation system and fertilization:  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. *cultural procedures*.						6
IV	Rooting medium, mulches and plant protection:  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)*.						6
V	Economics of greenhouse production and marketing:  Green economics and e-marketing. 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 green house products and SWOC analysis. *POST-harvest pathology*.						6

\* ..... \* Self Study Portion

 Reduce Some Content.

<b>Text Book(s):</b>	
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.
<b>Reference Book(s):</b>	
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.
<b>Web Resources:</b>	
1.	<a href="http://www.agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html">http://www.agritech.tnau.ac.in/horticulture/horti_Greenhouse%20cultivation.html</a>
2.	<a href="https://help.hortitechdirect.com/en/articles/9391870-understanding-greenhouse-marketing-strategies">https://help.hortitechdirect.com/en/articles/9391870-understanding-greenhouse-marketing-strategies</a>

<b>Course Outcomes</b>		
<b>CO Number</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Summarize the history of protected cultivation and evolution in control of greenhouse environment.	K1
<b>CO2</b>	Classify the greenhouses based on shape, utility, construction and covering materials.	K2
<b>CO3</b>	Manipulate root medium and integrated pest management with reference to greenhouse agriculture.	K3
<b>CO4</b>	Recognize the rules of watering, irrigation types and application of hydroponics in greenhouse cultivation.	K4
<b>CO5</b>	Analysis strength, weakness, opportunities and challenges in greenhouse technology.	K5

#### **Relationship Matrix:**

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

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

**Course Coordinator: Dr. N. Ahamed Sherif**

**Content Revised: 02 %**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
VI	23UBO6CC13	Core – XIII	6	6	25	75	100
Course Title		PLANT ECOLOGY AND PHYTOGEOGRAPHY					
SYLLABUS							
Unit	Content						Hours
I	<b>Fundamentals:</b> Scope of Ecology, Definition - autecology, synecology, Environmental variables: biotic, abiotic, edaphic and climatic. Speciation - mechanisms and patterns of speciation (Allopatric& Sympatric). Ecosystems – types, dynamics. *Measurement of productivity – primary, secondary, gross and net*.						18
II	<b>Community and Population ecology:</b> Characteristics of community, food chain, food web, energy flow in ecosystem and ecological pyramids. Succession and its types, climax and biomes. <b>Plant adaptations-hydrophytes, mesophytes, xerophytes and halophytes</b> . Population Ecology – natality, mortality, Immigration and emigration, age distribution, population fluctuation and dispersal. Species interactions – mutualism, commensalism, parasitism, predation and competition.						18
III	<b>Pollution and its control:</b> Point and non-point pollution. Types, Sources, Control measures – Air, Water, Soil, Noise Pollution events and its consequences: London smog(1952), <b>Bhopal Disaster (1982)</b> , Kuwait oil fires (1991) and <b>Great Smog of Delhi (2016)</b> . <b>Biomagnification - Definition, Causes and effects Pollution Management</b> . Municipal Solid Waste (MSW), Sewage water, E-Waste. <b>Overview of environmental acts (Air, Water, Land and Forest)</b> , Solar and <b>*Biomass energy resources*</b> .						18
IV	<b>Biodiversity and conservation:</b> Biodiversity – Definition, types, role, functions. <b>Threats to biodiversity-Fragmentation, Deforestation, Habitat loss, invasive species and Climate change (outline)</b> . IUCN RET (Rare, Endangered, Threatened) categories of species. <i>Conservation types and measures – In situ</i> (Protected Areas (PAs), UNESCO Biosphere Reserves, FAOs Globally Important Agriculture Heritage Sites (GIAHS), National Parks, Sacred Groves and Wild life Sanctuaries). <i>Ex situ</i> (Botanical Garden, Zoos, Germplasm and Seed Banks). Peoples movement – Appiko, Bishnoi, Chipko and, Silent Valley Movements and <b>*Narmada BachaoAndolan*</b> .						18
V	<b>Phytogeography and Computational Ecology:</b> Biogeographical concepts–Island, ecological and Phytogeography. Phytogeography - Phytogeographical regions of India, Vegetation types of Tamil Nadu. Age and area hypothesis, Definition and types of Endemism Criteria of Hotspot - Global and India. <b>Computational Ecology: Applications of Artificial Intelligence (AI), Internet of Things (IoT), Big data, Machine Learning (ML) and Geospatial applications in monitoring and management of Ecology and Environment (Climate, Deforestation, Agriculture)</b> .						18

\* ..... \* Self Study Portion

#### Text Books:

1. Shukla RS and Chandel PS, Plant Ecology and Soil Science, 1st Edition, S. Chand & Company Pvt Ltd., New Delhi, India, 1989.
2. Sharma PD, Plant Ecology and Phytogeography, 1st Edition, Rastogi Publication Pvt Ltd., Meerut, India, 2023.
3. Anil Thakur A, Susheel Bassi K and Sood SK, Plant Ecology and Taxonomy, 1st Edition, S. Dinesh and Co Pvt Ltd., Jalandhar, India, 2020.



<b>Reference Book:</b>	
1. Odum E and Barrett G, Fundamentals of Ecology, 5th Edition, Brooks/cole publishing company, Pvt Ltd., United States, 2004.	
2. Miller G and Spoolman S, Essentials of Ecology, 7th Edition, Brooks/cole publishing company Pvt Ltd., United States, 2014	
<b>Web Reference:</b>	
1. <a href="https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_12647.pdf">https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_12647.pdf</a> (Accessed on 08/09/2024).	
2. Hans Ulrik Riisgård ,2017.General Ecology Outline Of Contemporary Ecology For University Students <a href="https://ia800103.us.archive.org/28/items/GeneralEcology/General%20Ecology.pdf">https://ia800103.us.archive.org/28/items/GeneralEcology/General %20 Ecology.pdf</a> (Accessed on 08/09/2024).	
3. Simon A. Levin,2017 The Princeton Guide to Ecology princeton university press Princeton & Oxford available at <a href="https://vle.upm.edu.ph/pluginfile.php/145570/mod_resource/content/1/02_LEVIN%20Guide%20to%20Ecology.pdf">https://vle.upm.edu.ph/pluginfile.php/145570/mod_resource/content/1/02_LEVIN%20Guide%20to%20Ecology.pdf</a> (Accessed on 08/09/2024).	
4. Christensen, V. and Walters, C.J. (2024). Ecosystem Modelling with EwE. Vancouver, BC: The University of British Columbia. Available from <a href="https://pressbooks.bccampus.ca/ewemodel/">https://pressbooks.bccampus.ca/ewemodel/</a> (Accessed on 08/09/2024).	

	Course Outcomes	Cognitive Level (K-Level)
CO No.	CO Statement	
CO1	Summarize the Fundamental of Ecology and its measurement.	K1
CO2	Understand the various concepts of community and population ecology	K2
CO3	Appreciate the pollution and its control, applications of pollution treatment	K3 & K5
CO4	Analyse biodiversity and its treats and apply the conservation measures.	K4 & K5
CO5	Evaluate the phytogeographical regions and retrieve biodiversity bigdata and apply the computational tools ecosystem conservation and management	K4 & K5

### Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO 1	PSO2	PSO 3	PSO 4	PSO5	
CO1	01	02	02	02	02	01	02	02	02	03	1.9
CO2	02	01	03	02	02	02	02	03	03	03	2.3
CO3	02	02	03	02	03	01	02	02	03	02	2.2
CO4	02	02	02	03	03	03	03	02	02	02	2.4
CO5	03	02	02	02	03	01	02	02	03	02	2.2
	Mean Overall Score										2.2
	Correlation										Medium

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

Course Co-ordinator: Dr. B. Balaguru

Content Revised: 30 %

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
VI	23UBO6CC14	Core – XIV	6	6	25	75	100
Course Title		PLANT MOLECULAR BIOLOGY AND BIOTECHNOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	<b>Plant genome organization:</b> Introduction, structural features of a representative higher plant gene. Gene families in plants. Regulation of gene expression in prokaryotic and eukaryotic organism ( <i>Arabidopsis thaliana</i> ).	18
II	<b>Organelle genetics:</b> Organization of chloroplast genome, nucleus and chloroplast encoded genes for chloroplast proteins, targeting of proteins to chloroplast. Organisation of mitochondrial and nuclear encoded genes for proteins, targeting protein into mitochondria. *Cytoplasmic male sterility and its role in plant breeding*.	18
III	<b>Plant tissue culture and its applications:</b> History, scope and achievements of plant tissue culture. Media preparation - types of media preparation and sterilization techniques, totipotency and explants. Organogenesis (direct and indirect) and embryogenesis. Protoplast isolation, fusion and cell suspension culture and its applications. *Applications of plant tissue culture in agriculture*.	18
IV	<b>Plant Genetic Engineering:</b> Agrobacterium mediated gene transformation Ti plasmid. Improvement of hybrids and production of disease resistant for crop improvements. Marker genes. Types of vectors and integrated vectors. Development of transgenic plants for virus and bacteria. Resistance to biotic stress - insect, virus and disease resistance. Abiotic stress - Herbicide resistance. *Transgenesis for quality- and as bioreactors*.	18
V	<b>Intellectual Property Rights and bioethics:</b> Definition, types – copyright, trademarks, industrial designs, patents and geographical indicators. Patentable and non-patentable biotechnological products. Farmers rights and farmers acts. Patents Act – 1970. Department of Biotechnology (DBT). Biosafety and Bioethics. Ethical challenges in genetic engineering. *Govt of India – Initiatives for promotion of Biotech – Bio E3 policies*.	18

\*..... \* Self Study Portion

Text Book(s):
<ol style="list-style-type: none"> <li>1. Grierson and Covey S, Plant Molecular Biology by Blackie, 1988.</li> <li>2. Lea P.J and Leegood R.C. Plant Biochemistry and Molecular Biology by John Wiley &amp; Sons, 1993.</li> <li>3. Deepa G and Parashar S, IPR, Biosafety and Bioethics, 1st Edition, Pearson Education Pvt Ltd., New Delhi, India, 2013.</li> <li>4. Ramawat KG and Goyal S, Molecular Biology and Biotechnology, 2nd Edition, S. Chand and company limited Pvt Ltd., New Delhi, India, 2019.</li> <li>5. Satyanarayana U, Biotechnology, 6th Edition, Books and Allied Pvt Ltd., Kolkata, India, 2020.</li> </ol>

<b>Reference Book(s):</b>	
1. Freifelder D, Molecular Biology, 2 <sup>nd</sup> Edition, Narosa Publishers Pvt Ltd., New Delhi, India, 1994. 2. Buchanan BB, Gruissem W and Jones RL, Biochemistry and Molecular Biology of Plants, IK International Publishers Pvt Ltd., New Delhi, India, 2000.	
<b>Web Resource(s)</b>	
1. <a href="https://www.dpmb.ac.in/">https://www.dpmb.ac.in/</a> 2. <a href="https://tnau.ac.in/site/cpmb/">https://tnau.ac.in/site/cpmb/</a> 3. <a href="https://nbri.res.in/r-d-areas/molecular-biology-and-biotechnology/">https://nbri.res.in/r-d-areas/molecular-biology-and-biotechnology/</a> 4. <a href="https://handbook.unimelb.edu.au/2024/subjects/bota30005">https://handbook.unimelb.edu.au/2024/subjects/bota30005</a> 5. <a href="https://ikprress.org/index.php/PCBMB">https://ikprress.org/index.php/PCBMB</a>	

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Describe the salient features of organization and molecular mechanisms of cell.	<b>K1</b>
<b>CO2</b>	Get exposure on prokaryotic and eukaryotic gene regulation.	<b>K2</b>
<b>CO3</b>	Acquire basic knowledge in plant biotechnology.	<b>K3</b>
<b>CO4</b>	Recognize Agrobacterium transformation and applications of plant biotechnology	<b>K4</b>
<b>CO5</b>	Acquire basic knowledge in intellectual property rights, biosafety of genetically engineered products and guidelines in India.	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (Cos)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>2.2</b>
<b>CO2</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>2.2</b>
<b>CO3</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>2.2</b>
<b>CO4</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.2</b>
<b>CO5</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>2.4</b>
<b>Mean Overall Score</b>											<b>2.2</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinator: Dr. K. MOHMAED RAFI**

**Content Revised: 50%**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
VI	23UBO6CC15P	Core – XV	5	5	20	80	100
Course Title		LABORATORY COURSE FOR CORE - XIII and XIV – PRACTICAL					

SYLLABUS	
Contents	Hours
<p><b>Plant Ecology and Phytogeography:</b></p> <ol style="list-style-type: none"> <li>1. Study of morphological and anatomical features of hydrophytes (<i>Hydrilla</i> sp., <i>Nymphaea</i> sp.), xerophytes (<i>Nerium</i> sp.) and Parasite (<i>Cuscuta</i> sp.).</li> <li>2. Study of vegetation by quadrat method – frequency, abundance and density.</li> <li>3. Determination of Girth and Height of the trees</li> <li>4. Determination of pH in garden soil.</li> <li>5. Estimation of Chloride</li> <li>6. Charts- Biogeographical regions of India, Forest types of India.</li> </ol> <p><b>Plant molecular biology and biotechnology:</b></p> <ol style="list-style-type: none"> <li>1. Sterilization techniques - Media, hormones and explants.</li> <li>2. Preparation of stock solutions and plant growth regulators.</li> <li>3. Plant tissue culture medium preparation (Murashige and Skoog medium – solid and Liquid).</li> <li>4. Micropropagation of plant by shoot tip and nodal culture (DBT star college scheme group practical).</li> <li>5. Organogenesis of medicinal plants (DBT star college scheme group practical).</li> <li>6. Isolation of plant genomic DNA by CTAB method (DBT star college scheme group practical).</li> <li>7. Quantification of DNA using spectrophotometric method (DBT star college scheme group practical).</li> <li>8. Patent database and biosafety information resource centre (BIRC) – google search (Demonstration).</li> </ol> <p><b>Field/Industrial Visit:</b> Pertaining to the syllabus content.</p>	75
<p><b>Text Book(s):</b></p> <ol style="list-style-type: none"> <li>1. SundaraRajan S, Plant Ecology and Plant Physiology, 1<sup>st</sup> Edition, Anomol Publication Pvt Ltd., New Delhi, India, 2003.</li> <li>2. 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.</li> <li>3. Kishore RP and Ashok ED, A Book of Biological Techniques, 1<sup>st</sup> Edition, NiraliPrakashan Pvt Ltd., Pune, India, 2017.</li> </ol>	

<b>Reference Book(s):</b>
1. Freifelder D, Molecular Biology, 2 <sup>nd</sup> Edition, Narosa Publishers Pvt Ltd., New Delhi, India, 1994.
2. Buchanan BB, Gruissem W and Jones RL, Biochemistry and Molecular Biology of Plants, IK International Publishers Pvt Ltd., New Delhi, India, 2000.
<b>Web Resource(s)</b>
1. <a href="https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_12647.pdf">https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_12647.pdf</a> (Accessed on 08/09/2024).
2. Hans Ulrik Riisgård ,2017 .General Ecology Outline Of Contemporary Ecology For University Students <a href="https://ia800103.us.archive.org/28/items/GeneralEcology/General%20Ecology.pdf">https://ia800103.us.archive.org/28/items/GeneralEcology/General %20 Ecology.pdf</a> (Accessed on 08/09/2024)
3. <a href="https://www.dpmb.ac.in/">https://www.dpmb.ac.in/</a>
4. <a href="https://tnau.ac.in/site/cpmb/">https://tnau.ac.in/site/cpmb/</a>
5. <a href="https://nbri.res.in/r-d-areas/molecular-biology-and-biotechnology/">https://nbri.res.in/r-d-areas/molecular-biology-and-biotechnology/</a>
6. <a href="https://handbook.unimelb.edu.au/2024/subjects/bota30005">https://handbook.unimelb.edu.au/2024/subjects/bota30005</a> <a href="https://ikprress.org/index.php/PCBMB">https://ikprress.org/index.php/PCBMB</a>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Demonstrate distribution of various biotic and abiotic factors of environment	<b>K1</b>
<b>CO2</b>	Experiment with biological techniques related to ecological parameters, plant biotechnology.	<b>K2</b>
<b>CO3</b>	Analyze the role of nutrients in tissue culture.	<b>K3</b>
<b>CO4</b>	Assess the quality and quantity of DNA isolated from plant specimens.	<b>K4</b>
<b>CO5</b>	Test the fixation, staining and visualization methods for plant specimens.	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. K. Mohamed Rafi & Dr. B. Balaguru**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
V	23UBO6DE2A	DISCIPLINESPECIFIC ELECTIVE – II	5	4	25	75	100
Course Title		INDUSTRIALBOTANY					
SYLLABUS							
Unit	Contents						Hours
I	Agro Industries: Organic Farming: Concept, need of organic farming, types of organic fertilizers, advantages and limitations, Seed Industries: Importance of seed industries, seed production, seed processing and seed marketing with reference to cotton. *Major seed industries and corporations of India*.						15
II	Plant Pharmaceutical Industries: Concepts and advantages. Types of herbal pharmaceutical products: Churna, Asava and Arishta. Active principles and medicinal uses of Adathoda zeylanica, Tinospora cordifolia and Asparagus racemosus. Manufacture of Churna (Triphalachurna), Arishta (Ashoakrishta) and Asava (Kumariasava). Ayurvedic Plants and their role – Turmeric (Curcuma longa), Ashwaganda (Withania somnifera) and Vallarai (Centella asiatica).						15
III	Fruit Processing Industry: Fruit processing - Concepts and need, Cold Storage and Types of Fruit processing - canned fruits, dried fruits and dried fruit chips, fruit pulp, squash, jam, jelly, pickle and ketchups.						15
IV	Bio-pesticide Industry: Introduction, Concepts of Bio-control – Sources of Bio-control Agents and Integrated Management (IPM). Importance of Bio-pesticides, Types of Biopesticides – Indiara and Azadirachtin. *Commercial Significance*.						15
V	Mushroom Industry: History, importance and scope of edible mushrooms (Oyster mushroom - Pleurotus osteratus). Nutritional and medicinal values of edible mushrooms. Cultivation and Harvesting Methods. Storage methods - short term and long-term storage. Value added products of mushrooms. *Entrepreneurial competencies for mushroom cultivation*.						15

\*.....\* Self Study Portion

<b>Text Book(s):</b>
1. Hema S, Savita R, Sanjaykumar R, Fundamentals of Botany (Morphology & Anatomy and Industrial Botany – II), 3 <sup>rd</sup> Edition, Vision Publications Pvt Ltd, Pune, India. 2014.
2. 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.
<b>Reference Book(s):</b>
1. Hema S, Savita R and Rahangdale S, Industrial Botany-I, 2 <sup>nd</sup> Edition, Vision Publication Pvt Ltd., Maharastra, India 2015.
2. Kokate CK, Purohit AP and Gokhale SB, Phamacognosy, 55 <sup>th</sup> Edition, NiraliPrakasan Pvt Ltd., Pune, India, 2008.

<b>Web Resource(s)</b>	
1.	<a href="http://www.nicm.org.in/biopesticides/registered.htm">www.nicm.org.in/biopesticides/registered.htm</a>
2.	<a href="https://coe.mse.ac.in/taxproj.asp">https://coe.mse.ac.in/taxproj.asp</a>
3.	<a href="https://www.eshiksha.mp.gov.in/mpdhe/course/view.php?id=387">https://www.eshiksha.mp.gov.in/mpdhe/course/view.php?id=387</a>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Recall various plants as potential bio resources.	<b>K1</b>
<b>CO2</b>	Identify the possibilities of large scale production of plant based products.	<b>K2</b>
<b>CO3</b>	Examine medicinal plants as alternative candidate for industrial applications.	<b>K3</b>
<b>CO4</b>	Appraise various methods of fermentation.	<b>K4</b>
<b>CO5</b>	Adapt mushroom cultivation for entrepreneurial initiatives.	<b>K5</b>

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. R. SYED MOIDEEN**

**Content Revised: 50%**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
VI	23UBO6DE2B	Discipline Specific Elective – II	5	4	25	75	100
Course Title		SEED TECHNOLOGY					

SYLLABUS		
Unit	Contents	Hours
I	<b>Introduction:</b> Seed technology - history, concepts and scope – types of seed, endospermic and non-endospermic seeds, 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*.	15
II	<b>Seed processing, storage and marketing:</b> 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, labeling, measures for pest and disease control, seed storage and *seed marketing*.	15
III	<b>Seed testing:</b> 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*.	15
IV	<b>Certified seed production:</b> 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*.	15
V	<b>Seed certification and seed legislation:</b> Seed certification – objectives, certification agency, staffing pattern of seed certification agency. Seed development programme - Role of National seed corporation (NSC), Tarai development corporation (TDC), and State farm corporation (SFC) agencies in development of Indian seed industry. 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 and State Government. *Recognition of seed certification agency of foreign countries*.	15

\* .....\* Self Study Portion

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Vanangamudi K, Seed Science and Technology: An illustrated, 1<sup>st</sup> Edition, New India Publishing Agency Pvt Ltd., New Delhi, India, 2014.</li> <li>2. Agarwal RL, Seed Technology, 2<sup>nd</sup> Edition, Oxford &amp; IBH Publishing Co Pvt Ltd., New Delhi, India, 2018.</li> <li>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.</li> </ol>



<b>Reference Book(s):</b>
1. Black M, Bradford KJ and Vazquesz 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.

<b>Web Resource(s)</b>
1. <a href="http://www.fao.org">www.fao.org</a>
2. <a href="http://www.seednet.gov.in">www.seednet.gov.in</a>
3. <a href="http://www.agricoop.nic.in">www.agricoop.nic.in</a>
4. <a href="http://www.online library.willey.com">www.online library.willey.com</a>
5. <a href="http://www.sciencedirect.com">www.sciencedirect.com</a>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-Level)</b>
<b>CO1</b>	Recall various aspects of plant seeds and their production.	<b>K1</b>
<b>CO2</b>	Outline the seed processing, storage and marketing aspects.	<b>K2</b>
<b>CO3</b>	Apply seed testing methods.	<b>K3</b>
<b>CO4</b>	Appraise the importance of seed certification.	<b>K4</b>
<b>CO5</b>	Adapt various legislation procedures for seed certification	<b>K5</b>

**Relationship Matrix:**

<b>Course Outcomes (Cos)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of Cos</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	<b>03</b>	<b>03</b>	<b>01</b>	<b>03</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>2.1</b>
<b>CO2</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>2.6</b>
<b>CO3</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>2.3</b>
<b>CO4</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.2</b>
<b>CO5</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>01</b>	<b>03</b>	<b>2.3</b>
<b>Mean Overall Score</b>											<b>2.3</b>
<b>Correlation</b>											<b>Medium</b>

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

**Course Coordinator: Dr. R. SYED MOIDEEN**

**Content Revised: 10 %**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
VI	23UBO6DE3A	Discipline Specific Elective -III	4	3	CIA	ESE	Total
					25	75	100
Course Title		HORTICULTURE AND PLANT BREEDING					

SYLLABUS		
Unit	Content	Hours
I	<b>Fundamentals of horticulture</b> Scope, value and divisions of horticulture. Soil and climate – limiting factor. Nutrition, irrigation cropping, training and pruning of horticultural crops. <b>Establishment of orchard and cultivation.</b> Overview of plant growth regulators. <b>Harvesting, handling, *storage and preservation of fruits and vegetables*.</b>	12
II	<b>Plant propagation</b> Asexual and sexual methods of plant propagation. Stock and scion relationships. Techniques, advantages and limitations of cuttage (stem and root), layering (simple, mound and air), graftage (inarching, cleft and veneer), budding (“T”, patch and flute). *Propagation of specialized plant parts*.	12
III	<b>Cultivation practices and gardening</b> <b>Cultivation, harvesting, post harvesting practices, disease management and value added products of Mango, Banana, Tomato, Chrysanthemum and Rose.</b> Layout, types and importance of gardening. Lawn establishment and maintenance. Brief account on hydroponics, arboriculture, bonsai and terrarium.	12
IV	<b>Introduction to plant breeding</b> History, scope and objectives plant breeding. <b>Domestication and germplasm conservation: Types of selection, breeding lines, special genetic stocks and wild forms and wild relatives, gene pool concept. Indian plant genetic resources management system.</b> Role of biotechnology in plant breeding. Plant breeder rights and regulations in plant variety protection. <b>*Intellectual Property Rights (IPR)* and Farmers Rights.</b>	12
V	<b>Plant breeding methods</b> Breeding methods: Procedure, merits and demerits of mass, pure line, recurrent and clonal selection. <b>Emasculation and bagging.</b> Techniques and methods of hybridization – Heterosis breeding – Hybrid vigour – Mutation breeding. The segregating population methods: Pedigree, bulk and back cross. Types and role of polyploidy in plant breeding. Brief account on marker assisted selection (MAS).	12

\*.....\* Self Study Portion

Text Book(s):	
1.	Roy D, Plant Breeding a Biometrical Approach, 1 <sup>st</sup> Edition, Narosa Publishing House Pvt Ltd, New Delhi, India, 2012.
2.	Sheela VL, Horticulture, 1 <sup>st</sup> Edition, MJP Pvt Ltd, Chennai, Tamil Nadu, India, 2011.
3.	Kumar N, Introduction to Horticulture, 7 <sup>th</sup> Edition, CBS Publishers & Distributors Pvt Ltd, Delhi, India, 2016.
Reference Book(s):	
1.	Peter KV, Basics of Horticulture, 3 <sup>rd</sup> Revised Edition, New India Publishing Agency, New Delhi, India, 2017.
2.	Singh BD, Plant Breeding Principles and Methods, 12 <sup>th</sup> Edition, MedTech Science Press: A Division of Scientific International Pvt. Ltd, New Delhi, India, 2022.
Web Resources:	
1.	<a href="https://agritech.tnau.ac.in/horticulture/horti_Landscaping_vertical%20gardening.html">https://agritech.tnau.ac.in/horticulture/horti_Landscaping_vertical%20gardening.html</a>
2.	<a href="https://agritech.tnau.ac.in/crop_improvement/crop_imprv_breeding_methods.html">https://agritech.tnau.ac.in/crop_improvement/crop_imprv_breeding_methods.html</a>
3.	<a href="https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf">https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf</a>

Course Outcomes		
CO Number	CO Statement	Cognitive Level (K-Level)
CO1	Realize the scope and importance of horticulture and plant breeding	K1
CO2	Understand the advantages and limitations of various plant propagation techniques.	K1&K2
CO3	Familiarize with cultivation practices of fruits, vegetables and flowers.	K3
CO4	Demonstrate the value added products of horticultural crops.	K4
CO5	Apply the principle involved in conventional and advance plant breeding techniques.	K5

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. N. Ahamed Sherif**

**Content Revised: 25%**

Semester	Course Code	Course Category	Hours/ Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
VI	23UBO6DE3B	Discipline Specific Elective – III	4	3	25	75	100
Course Title		SILVICULTURE					
SYLLABUS							
Unit	Content						Hours
I	<b>Fundamentals:</b> Key Principles, 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*.						12
II	<b>Systems in Silviculture:</b> Methods in forest regeneration: natural -Seed Dispersal,Root Suckering,Coppicing,Layering,Primary Succession,Secondary Succession. Artificial-Direct Seeding,Nursery-Grown Seedlings,Stump Sprouting,Vegetative Propagation,Afforestation and Reforestation. Method of propagation – Seed propagation, Vegetative, Grafting techniques and Clonal propagation.						12
III	<b>Ecology and Management of Forest Soils:</b> Forest soils – distinguishing features, soils and vegetation development, Forest floor – Organic horizons- -litter dynamics- humus – types- organic matter decomposition- mineralization and immobilization of organic matter- nutrient cycling significance of C:N ratio. Forest soil biology – soil fauna – nitrogen fixation – rhizobium-tree legume symbiosis Frankia non-legume symbiosis- nitrification and denitrification in forest ecosystems. *Micorrhizal associations in forest soils*.						12
IV	<b>Economic importance of Silviculture:</b> Important species Cultivation of following Tropical Species: <i>Acacia nilotica</i> , <i>A. auriculaeformis</i> , <i>Albizialebbek</i> , <i>Azadirachta indica</i> <i>Bombaxceiba</i> , <i>Casuarina equisetifolia</i> , <i>Ceibapentandra</i> , <i>Dalbergiasissoo</i> , <i>D. latifolia</i> , <i>Melia azedarach</i> , <i>Prosopisjuliflora</i> , <i>P. cineraria</i> , <i>Pinusroxburghii</i> , <i>Santalum album</i> , <i>Shorearobusta</i> , <i>Tectonagrandis</i> , <i>Tamarindusindica</i> , <i>Terminalia arjuna</i> and <i>T. chebula</i> .						12
V	<b>Forest Management:</b> Forest type and cover mapping using remote sensing, REDD++ and climate change mitigation. Outline of watershed management, 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, Forest policy andacts, role of ICFRE and *FRI for forest management and monitoring*.						12

\* .....\* Self Study Portion

<b>Text Books:</b>
<ol style="list-style-type: none"> <li>1. Dwivedi AP, A text book of Silviculture, 1st Edition, International Books Distributors Pvt Ltd., Dehradun, India, 2006.</li> <li>2. Negi SS, Principles and Practices of Silviculture, 1st Edition, Bishen Singh Mahendra Pal Singh Pvt Ltd., Dehradun, India, 2016.</li> <li>3. Yadav AK and Dhanai CS, Principles and Practices of Silviculture, 1st Edition, Uttarakhand Open University, Nainital, India, 2020.</li> </ol>

<b>Books for Reference:</b>		
1. Bettinger P, Bostori K, Siry JP and Grebner DL, Forest management and planning 2nd Edition, Academic Press Pvt Ltd., New York, United States, 2017. 2. Manikandan K and Prabhu S, Indian Forestry: A breakthrough approach to forest service, 8th Edition, Jain Brothers Pvt Ltd., New Delhi, India, 2021.		
<b>Web Reference:</b>		
1. <a href="https://www.uou.ac.in/sites/default/files/slm/FR-01.pdf">https://www.uou.ac.in/sites/default/files/slm/FR-01.pdf</a> 2. <a href="http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20Ind%20year.pdf">http://www.jnkvv.org/PDF/12042020171215Forest%20Management%20B.Sc.%20Forestry%20Ind%20year.pdf</a> 3. <a href="http://ifs.nic.in/Dynamic/book/page3.pdf">http://ifs.nic.in/Dynamic/book/page3.pdf</a>		
	<b>Course Outcomes</b>	
<b>CO Number</b>	<b>CO Statement</b>	<b>Cognitive Level(K-Level)</b>
<b>CO1</b>	Summarize the Fundamental of Silviculture	<b>K1</b>
<b>CO2</b>	Understand the various concepts and systems in Silviculture	<b>K2</b>
<b>CO3</b>	Appreciate the forest soil conservation and its management	<b>K3</b>
<b>CO4</b>	Analyse cultivation various economic important tree species	<b>K4 &amp; K5</b>
<b>CO5</b>	Evaluate the forest management and technology	<b>K4 &amp; K5</b>

**Relationship Matrix:**

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO 1</b>	<b>PSO2</b>	<b>PSO 3</b>	<b>PSO 4</b>	<b>PSO5</b>	
<b>CO1</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>1.9</b>
<b>CO2</b>	<b>02</b>	<b>01</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>2.3</b>
<b>CO3</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.2</b>
<b>CO4</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>2.4</b>
<b>CO5</b>	<b>03</b>	<b>02</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>01</b>	<b>02</b>	<b>02</b>	<b>03</b>	<b>02</b>	<b>2.2</b>
<b>Mean Overall Score</b>											<b>2.2</b>
<b>Correlation</b>											<b>Medium</b>

<b>Mean Overall Score</b>	<b>Correlation</b>
<b>&lt; 1.5</b>	<b>Low</b>
<b>≥ 1.5 and &lt; 2.5</b>	<b>Medium</b>
<b>≥ 2.5</b>	<b>High</b>

**Course Coordinator: Dr. B. Balaguru**

**Content Revised: 40 %**

**Allied Botany for B.Sc. Chemistry**

**Allied Botany for B.Sc. Zoology**

## Allied Botany for B.Sc. Chemistry and B.Sc. Zoology

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBO3AC5	Allied – V	4	4	25	75	100
Course Title		Applied Botany – I					
Syllabus							
Unit	Contents						Hours
I	Algae: General characteristics and outline classification of algae (F. E. Fritsch, 1935). Thallus organization, food reserve and habitats of algae. A detailed study of structure, reproduction, life cycle (excluding development stages) and economic uses of the following genera – *Oscillatoria*, Chlorella, Sargassum and Gracilaria. Cultivation methods of fresh water (Spirulina), and marine (Kappaphycus) algae.						12
II	Fungi and Lichens: 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, Brief account on cultivation of edible mushroom (Pleurotus). Introduction to medicinal mushrooms (Ganoderma) and antibiotic producing fungi (Penicillium). Brief account on production of citric acid and acetic acid from fruit peel waste. *Lichens – General characters, types and economic importance of Lichens*.						12
III	Bryophytes: General characteristics and outline classification of Bryophytes (Watson, 1971). Structural description (excluding development stages) of the following genera – Marchantia and Polytrichum. A brief mention of use of bryophytes for antibiotics, anti-cancer, food, ornamental, non-absorbant bandage and pesticides. Environmental importance of mosses in pedogenesis and *peat bog*.						12
IV	Pteridophytes: General characteristics and outline classification of Pteridophytes (Sporne, 1975). Structural description (excluding developmental stages) of the following genera – Lycopodium and Adiantum. and *Economic importance of Pteridophytes*. Cultivation of Azolla.						12
V	Gymnosperms: General characters and outline classification of gymnosperms (Sporne, 1967). Morphology, anatomy, reproduction, life cycle (excluding developmental stages) and economic uses of Cycas. Importance of gymnosperms as wood and resins (Pinus), anti-cancer drug (Taxus and Ephedra). A brief study of types and application of fossil plants in paleoclimatology and *climate models*.						12

\*.....\* Self-Study

### Text Book(s):

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 Book(s):	
1.	Alexopoulos CJ, Mims CW and Blackwell M, Introductory Mycology, 4th 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.

Course Outcomes		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-level)
CO1	Outline the diversity of cryptogams and seed plants.	K1
CO2	Identify the economic uses of natural wealth from cryptogams and seed plants.	K2
CO3	Perceive the alternative uses of and applications of cryptogams and seed plants.	K3
CO4	Appraise the values of natural wealth from cryptogams and seed plants.	K4
CO5	Recommend alternative bio resources for human welfare.	K5

#### Relationship Matrix:

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	3	2	2	1	1	3	1	1	3	2
CO2	2	2	2	2	1	3	1	1	3	2	1.9
CO3	1	1	3	3	2	1	1	2	2	1	1.7
CO4	2	2	2	3	1	1	1	1	1	1	1.5
CO5	2	2	2	3	1	1	1	1	1	1	1.5
Mean Overall Score											1.7
Correlation											Medium

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

**Course Coordinator: Dr. A. Aslam**



Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
III	23UBO3AC6P	Allied - VI	3	2	20	80	100
<b>Course Title</b>		<b>Laboratory Course for Applied Botany - I – Practical</b>					

Syllabus		
	Contents	Hours
	<ol style="list-style-type: none"> <li>Generic level identification of algal specimens in a mixture. <ol style="list-style-type: none"> <li><i>Oscillatoria</i></li> <li><i>Chlorella</i></li> <li><i>Spirulina</i></li> <li><i>Sargassum</i></li> <li><i>Gracilaria</i></li> </ol> </li> <li>Identification of following fungi in both host as well as permanent slides <ol style="list-style-type: none"> <li><i>Albugo</i></li> <li><i>Saccharomyces</i></li> </ol> </li> <li>Observation of external and internal structure of <ol style="list-style-type: none"> <li><i>Marchantia</i></li> <li><i>Polytrichum</i></li> <li><i>Lycopodium</i></li> <li><i>Adiantum</i></li> <li><i>Cycas</i></li> <li><i>Pinus</i></li> </ol> </li> <li>Identification of spotters related to economic uses of species mentioned in theory</li> </ol>	45

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>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.</li> <li>Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand &amp; Company Pvt Ltd, New Delhi, India, 2011.</li> <li>Sharma OP, Practical Botany, 7<sup>th</sup> Edition, Pragati Prakashan Educational Publishers Pvt Ltd, Meerut, India, 2014.</li> </ol>

Course Outcomes		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
CO No.	CO Statement	Cognitive Level (K-level)
CO1	Experience laboratory skills of handling botanical specimens.	K1
CO2	Describe diversity of plants.	K2
CO3	Demonstrate preparation and curation of botanical specimens.	K3
CO4	Identify commercial potential of cryptogams.	K4
CO5	Appraise the traits and key characters of cryptogams.	K5

**Relationship Matrix:**

Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Score of COs
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
<b>CO1</b>	1	3	1	3	1	3	3	2	1	1	1.9
<b>CO2</b>	1	3	1	1	2	3	3	2	1	1	1.8
<b>CO3</b>	2	1	1	3	1	1	3	2	1	1	1.6
<b>CO4</b>	1	3	2	1	1	1	3	2	1	1	1.6
<b>CO5</b>	1	3	1	3	1	1	3	2	1	1	1.7
<b>Mean Overall Score</b>											1.7
<b>Correlation</b>											Medium

Mean Overall Score	Correlation
< 1.5	Low
$\geq 1.5$ and < 2.5	Medium
$\geq 2.5$	High

**Course Coordinator: Dr. A. Aslam**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBO4AC7	Allied – VII	5	4	25	75	100
<b>Course Title</b>		<b>Applied Botany – II</b>					

Syllabus		
Unit	Contents	Hours
I	<p><b>Plant morphology:</b> Parts of a plant – root, Stem and Leaf and their modifications with examples – Simple and compound leaves - Phyllotaxy - Inflorescence - Racemose, Cymose, Mixed and Special types - Terminology of floral parts, diagram and formula.</p> <p><b>Anatomy:</b> Primary internal structure of root and stem in dicots and monocot.</p>	15
II	<p><b>Systems of Classification:</b> Artificial (Linnaeus system) - Natural (Outline of Bentham and Hooker's system; its merits and demerits). Plant Nomenclature - Brief account of ICN, <b>Herbarium technique</b>. Study of the general characteristics and economic importance of <b>Annonaceae</b>, Rutaceae, Caesalpiniaceae, Rubiaceae, <b>Cucurbitaceae</b>, Apocynaceae, Euphorbiaceae and Arecaceae.</p>	15
III	<p><b>Economic Importance of plants:</b> Plant diet for cardio, renal, hypertension, aging, bone, detox and mental health. Non-alcoholic beverage plants – Coffee, Tea therapy (green tea) Tea extract capsules, Cocoa, Chocolate, Gano-coffee, herbal 'teas' (<i>Psidium</i>, <i>Mangifera</i>). Prebiotic fibre plants (<i>Murayya</i>, <i>Cyamopsis</i>), Cereals, pseudo-cereals and *small grain cereal and their value addition as food supplements and snacks*.</p>	15
IV	<p><b>Oil yielding plants:</b> 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*.</p>	15
V	<p><b>Plant physiology</b> 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. <b>A brief mention of difference between C3, C4 and CAM pathway and their relevance to indoor gardening.</b> Introduction to carbon sequestration and *carbon banking*. – Aerobic and anaerobic respiration (fermentation - and its importance). Plant growth regulators – types. *Commercial application of auxin in horticulture*.</p>	15

\*.....\* Self-Study

<b>Text Book(s):</b>
<ol style="list-style-type: none"> <li>1. Rao KN, Krishnamurthy KV and Rao GS, Ancillary Botany, 1<sup>st</sup> Edition, Viswanathan Pvt Ltd, New Delhi, India, 1983.</li> <li>2. Shukla RS and Chandel PS, Ecology and utility of plants, 2<sup>nd</sup> Edition, Chand &amp; Company Pvt Ltd, New Delhi, India, 2008</li> <li>3. Sharma OP, Plants and Human Welfare, 2<sup>nd</sup> Edition, Prakathi Prakashan Publications Pvt Ltd, Meerut, India, 2015.</li> </ol>
<b>Reference Book(s):</b>
<ol style="list-style-type: none"> <li>1. Jeffrey C. An Introduction to Plant Taxonomy, 1<sup>st</sup> Edition, Cambridge University Press, United Kingdom, 1982.</li> <li>2. Pandey BP. Taxonomy of Angiosperms, 2<sup>nd</sup> Edition, Chand &amp; Company Pvt Ltd, New Delhi, India, 1999.</li> </ol>

<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-level)</b>
<b>CO1</b>	Outline the diversity of cryptogams and seed plants.	K1
<b>CO2</b>	Identify the economic uses of natural wealth from cryptogams and seed plants.	K2
<b>CO3</b>	Perceive the alternative uses of and applications of cryptogams and seed plants.	K3
<b>CO4</b>	Appraise the values of natural wealth from cryptogams and seed plants.	K4
<b>CO5</b>	Recommend alternative bio resources for human welfare.	K5

Relationship Matrix:

<b>Course Outcomes (COs)</b>	<b>Programme Outcomes (POs)</b>					<b>Programme Specific Outcomes (PSOs)</b>					<b>Mean Score of COs</b>
	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>	
<b>CO1</b>	3	2	2	1	1	1	2	1	1	2	1.6
<b>CO2</b>	3	2	2	1	1	2	1	1	3	2	1.8
<b>CO3</b>	1	1	2	1	1	1	1	3	3	1	1.5
<b>CO4</b>	3	2	2	1	1	1	1	1	3	2	1.7
<b>CO5</b>	3	2	2	1	1	1	1	1	3	2	1.7
<b>Mean Overall Score</b>											1.6
<b>Correlation</b>											Medium

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

**Course Coordinator: Dr. A. Aslam**

Semester	Course Code	Course Category	Hours / Week	Credits	Marks for Evaluation		
					CIA	ESE	Total
IV	23UBO4AC8P	Allied - VIII	3	2	20	80	100
<b>Course Title</b>		<b>Laboratory Course for Applied Botany - II – Practical</b>					

Syllabus	
Contents	Hours
<p><b>List of Practical</b></p> <p><b>A. Angiosperm morphology and taxonomy (drawing and description of specimens only):</b></p> <ol style="list-style-type: none"> <li>1. Parts of a dicot plant (<i>Amaranthus</i>)</li> <li>2. Phyllotaxy (<i>Annona</i>, <i>Psidium</i>, <i>Quisqualis</i>, <i>Nerium</i>, <i>Allamanda</i>, <i>Acalypha</i> and <i>Mollugo</i>)</li> <li>3. Compound leaves (<i>Azadirachta</i>, <i>Butea</i>, <i>Albizia</i>, <i>Moringa</i>, <i>Cleome</i>)</li> <li>4. Parts of a flower (<i>Tribulus</i>)</li> <li>5. Racemose inflorescence (<i>Crotalaria</i>, <i>Mangifera</i>, <i>Caesalpinia</i>, <i>Achyranthes</i>, <i>Cocos</i>, <i>Allium</i>, <i>Tridax</i>)</li> <li>6. Cymose inflorescence (<i>Jasmine</i>, <i>Clerodendron</i>, <i>Hamelia</i>, <i>Heliotropium</i>, <i>Mollugo</i>)</li> <li>7. Mixed and special (<i>Ficus</i>, <i>Leucas</i>, <i>Euphorbia cyathophora</i>, <i>Ocimum</i>, <i>Zizyphus</i>)</li> <li>8. Description and identification features for the families (Annonaceae, Rutaceae, Caesalpiniaceae, Rubiaceae, Apocynaceae, Cucurbitaceae, Euphorbiaceae, and Arecaceae).</li> </ol> <p><b>B. T.S of stem and root in dicots (<i>Tridax</i>) and monocots (<i>Zea mays</i>)</b></p> <p><b>C. Nutritional quality analysis of plants (Minor experiments):</b></p> <ol style="list-style-type: none"> <li>1. Analysis of nutritional quality of plants using chart</li> <li>2. Estimation of ascorbic acid (vitamin-C)</li> <li>3. Determination of moisture content in plant samples.</li> <li>4. Observation of oxidative darkening of vegetables and fruits.</li> <li>5. Observation of gluten formation in natural foods.</li> </ol> <p><b>D. Physiology experimental set up</b></p> <ol style="list-style-type: none"> <li>1. Ganong's photometer</li> <li>2. Light screen experiment</li> <li>3. Demo of paper chromatography</li> <li>4. Bell jar experiment for oxygen evolution</li> <li>5. Observation of Kranz anatomy of leaves</li> <li>6. Observation of transpiration in leaves.</li> </ol>	45

<p><b>Text Book(s)</b></p> <ol style="list-style-type: none"> <li>1. Mehta AS and Verma AP, Experiments in Plant Physiology, 1<sup>st</sup> Edition, Chand &amp; Company Pvt Ltd, New Delhi, India, 1987.</li> <li>2. Pandey BP, Modern Practical Botany, 1<sup>st</sup> Edition (Reprinted), Chand &amp; Company PvtLtd, New Delhi, India, 2011.</li> <li>3. Sharma OP, Plants and Human Welfare, 2<sup>nd</sup> Edition, Prakathi Prakashan Publications PvtLtd, Meerut, India, 2015.</li> </ol>
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<b>Course Outcomes</b>		
<b>Course Outcomes:</b> Upon successful completion of this course, the student will be able to:		
<b>CO No.</b>	<b>CO Statement</b>	<b>Cognitive Level (K-level)</b>
<b>CO1</b>	Illustrate the external characters of flowering plants.	K1
<b>CO2</b>	Classify the flowering plants based on their external characters.	K2
<b>CO3</b>	Appraise the plants as useful resources for human use and welfare.	K3
<b>CO4</b>	Recommend unique food supplements and herbal value-added products.	K4
<b>CO5</b>	Solve the problems related with human environment applying physiology principles.	K5

**Relationship Matrix:**

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

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

**Course Coordinator: Dr. A. Aslam**