

**VIVEKANANDHA**  
**COLLEGE OF ARTS AND SCIENCES FOR WOMEN**  
**(AUTONOMOUS)**

**ELAYAMPALAYAM, THIRUCHENGODE (Tk), NAMAKKAL (Dt) - 637 205**  
**(Affiliated to Periyar University, Approved by AICTE and Re-Accredited with “A<sup>+</sup>” by NAAC)**



**PG AND RESEARCH DEPARTMENT OF BOTANY**  
**M. Sc., BOTANY**  
**SYLLABUS**

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

**(TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005)**

**VIVEKANANDHA EDUCATIONAL INSTITUTIONS**

**ANGAMMAL EDUCATIONAL TRUST**

**ELAYAMPALAYAM, THIRUCHENGODE (Tk), NAMAKKAL (Dt) - 637 205**

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(AUTONOMOUS)  
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**B.Sc., Botany**

**For Candidates Admitted from the academic year - 2023 – 2024 Onwards Under Tamil Nadu State Council for Higher Education Syllabus Pattern:**

**1. Vision:**

- To imparting skills and values for the women graduates through innovative teaching, learning and research in plant science to meet the needs of youth and national demand.

**2. Mission:**

- To create demand for Botany.
- Strengthen the Department by research.
- To provide quality education through field study and projects, laboratory courses and entrepreneurial skills in Botany to achieve their diligence.
- To raise the students high academic caliber to meet the requirements of industries through productive research in various fields of Botany.
- To enhance opportunities to the rural women students for their successful career.

**3. Scope of the programme:**

Botany is a classical science dealing with not merely the morphology of plants but also their functional aspects and economic importance. Further, the study helps us to understand the role of plants in maintaining the environment besides, saving as a renewable energy sources. Plants are most valuable in treating the ailments of mankind. It has several branches such as Plant Diversity, Plant Morphology, Taxonomy, Anatomy, Embryology, Plant Pathology, Plant Ecology, Ethnobotany, Genetics, Plant Biotechnology, Plant Physiology, Biochemistry, Horticulture, Medicinal Plants, Biofertilizers, etc., besides serving as the basis for several other biosciences. It is a basic science with several research disciplines like modern transgenic biology.

#### 4. Programme Outcomes (POs):

The M.Sc. Botany program is designed to achieve the following objectives	
PO1	To impart knowledge on the fundamental, advanced and emerging concepts in Botany.
PO2	To provide up to date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO3	To comprehend and interpret various facets of Botany including the importance and judicious utilization of plant sources.
PO4	To address various critical issues in conserving the biodiversity with special reference to economically important plants and the plants listed in RED data.
PO5	To understand the principles and applications of various traditional and modern techniques used in Botany.
PO6	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO7	To impart knowledge on the economic importance of plant/microbial resources and their products and to promote entrepreneurship skill.
PO8	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO9	To motivate the students to take up innovative and cutting-edge research in frontier areas of Botany and related biology subjects.
PO10	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.

#### 5. Programme Specific Outcomes (PSOs):

On successful completion of the M. Sc., Botany program, the students are expected to	
PSO1	Familiarize with the fundamental, advanced and emerging concepts in Botany.
PSO2	Understand the role of plants and their interactions with other organisms in various ecosystems.
PSO3	Identify the potency of plant resources in contemporary research and visualize future thrust areas in Botany.
PSO4	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO5	Acquire basic knowledge on principles and applications of laboratory instruments and adequate skills to handle them.
PSO6	Choose and apply appropriate tools, techniques, resources, etc. to perform various experiments in Botany.
PSO7	Carry out scientific experiments independently or in collaboration with inter-disciplinary or multidisciplinary approaches.
PSO8	Disseminate knowledge on conservation of biodiversity and protection of environment.
PSO9	Awareness on the sustainable utilization of plant/microbial resources following the bioethical norms.
PSO10	Demonstrate proficiency in communicating with various stakeholders like students, teachers, scientists and society.

## 6. Methods of Evaluation:

<b>Theory</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
<b>Total</b>		<b>100 Marks</b>
<b>Practicals</b>		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	60 Marks
	Record and Viva-Voce	
<b>Total</b>		<b>100 Marks</b>
<b>Methods of Assessment</b>		
<b>Recall (K1)</b>	Simple definitions, MCQ, Recall steps, Concept definitions.	
<b>Understand/ Comprehend (K2)</b>	MCQ, True/False, Short essays, Concept explanations, Short summary or overview.	
<b>Application (K3)</b>	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain.	
<b>Analyze (K4)</b>	Problem-solving questions Finish a procedure in many steps, Differentiate between various ideas, Map knowledge.	
<b>Evaluate (K5)</b>	Longer essay/ Evaluation essay, Critique or justify with pros and cons.	
<b>Create (K6)</b>	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations.	

**In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.**

**The S, M, L is based on the Course outcomes. The mapping is based on the revised Bloom's Taxonomy Verbs used to describe your Course outcomes.**

- **Remember and Understanding – Lower level**
- **Apply and Analyze – Medium Level**
- **Evaluate and Create – Strong Leve**

## 7. Scheme of Examination:

The scheme of Examinations for different semesters shall be as follows:

**M. Sc., Botany**  
**(For the candidates admitted from the academic year 2023 - 2024 onwards)**  
**(Tamil Nadu State Council for Higher Education)**

Sem	Course	Subject Title	Subject Code	Ins. Hours/Week	Credits	Exam Hours	Marks		Total
							Int	ESE	
I	Core Course – I	Plant Diversity - I (Algae, Fungi, Lichens and Bryophytes)	23P1BOC01	5	4	3	25	75	100
	Core Course – II	Plant Diversity - II (Pteridophytes, Gymnosperms and Paleobotany)	23P1BOC02	5	4	3	25	75	100
	Core Course – III	Laboratory Course - I (Covering Core Papers - I & II)	23P1BOCP01	5	4	4	40	60	100
	Elective Course - I	Microbiology, Immunology and Plant Pathology	23P1BODE01	5	2	3	25	75	100
	Elective Course - II	Horticulture	23P1BODE02	5	2	3	25	75	100
	Ability Enhancement Course – AEC - I	Mushroom Cultivation	23P1BOAC01	2	2	3	25	75	100
	Skill Enhancement Course – SEC - 1	Nursery and Gardening	23P1BOS01	3	2	3	25	75	100
	<b>Total</b>				<b>30</b>	<b>20</b>	<b>-</b>	<b>190</b>	<b>510</b>
II	Core Course – IV	Taxonomy of Angiosperms and Economic Botany	23P2BOC03	5	4	3	25	75	100
	Core Course – V	Anatomy and Embryology of Angiosperms	23P2BOC04	4	4	3	25	75	100
	Core Course – VI	Ecology, Phytogeography, Conservation Biology and Intellectual Property Rights	23P2BOC05	4	4	3	25	75	100
	Core Course – VII	Laboratory Course- II (Covering Core Papers IV, V and VI)	23P2BOCP02	4	4	4	40	60	100
	Elective Course - III	Research Methodology, Computer Applications and Bioinformatics	23P2BODE03	4	3	3	25	75	100
	Elective Course - IV	Nanobiotechnology	23P2BODE04	4	3	3	25	75	100
	Ability Enhancement Course – AEC – 2	Entrepreneurial Opportunities in Botany	23P2BOAC02	2	2	3	25	75	100
	Skill Enhancement Course – SEC - 2	Internship/Industrial Activity	23P2BOS03	3	2	-	100	-	100
<b>Total</b>				<b>30</b>	<b>26</b>	<b>-</b>	<b>290</b>	<b>510</b>	<b>800</b>

Sem	Course	Subject Title	Subject Code	Ins. Hours/ Week	Credits	Exam Hours	Marks		Total
							Int	ESE	
III	Core Course – VIII	Cell and Molecular Biology	23P3BOC06	5	4	3	25	75	100
	Core Course – IX	Genetics, Plant Breeding and Biostatistics	23P3BOC07	5	4	3	25	75	100
	Core Course – X	Recombinant DNA Technology and Industrial Applications	23P3BOC08	5	4	3	25	75	100
	Core Course - XI	Laboratory Course - III	23P3BOCP03	5	3	4	40	60	100
	Elective Course - V	Phytochemistry	23P3BODE05	4	3	3	25	75	100
	Elective – VI	Biopesticide Technology	23P3BODE06	4	3	3	25	75	100
	Ability Enhancement Course – AEC - 3	Organic Farming	23P3BOAC03	2	2	3	25	75	100
<b>Total</b>				<b>30</b>	<b>23</b>	<b>-</b>	<b>190</b>	<b>510</b>	<b>700</b>
IV	Core Course – XII	Plant Physiology and Plant Metabolism	23P4BOC09	5	4	3	25	75	100
	Core Course – XIII	Biochemistry and Applied Biotechnology	23P4BOC10	5	4	3	25	75	100
	Core Course – XIV	Laboratory Course -IV	23P4BOCP04	4	3	4	40	60	100
	Elective Course – VII	Forestry and Wood Technology	23P4BODE07	4	3	3	25	75	100
	Elective Course - VIII	Gene Cloning and Gene Therapy	23P4BODE08	4	3	3	25	75	100
	Ability Enhancement Course – AEC - 4	Algal Technology	23P4BOAC04	2	2	3	25	75	100
	Project Work	Project with viva-voce	23P4BOPR01	6	3	-	40	60	100
	<b>Total</b>				<b>30</b>	<b>22</b>	<b>-</b>	<b>205</b>	<b>495</b>
<b>Total No. of Hours, Credits and Marks</b>				<b>120</b>	<b>91</b>	<b>-</b>	<b>875</b>	<b>2025</b>	<b>2900</b>

### 8. Conditions for Admission:

A candidate who has passed B. Sc., Examination with Botany as main subject of any university or an examination accepted as equivalent thereto or as per norms said by the Government of Tamil Nadu is permitted to appear and qualify for M. Sc., Degree examination of this university after a course of study of two academic years.

## 9. Duration of the Programme:

The programme for the degree of Master of Science in Botany shall consist of two academic years divided into four semesters.

## 10. Examination:

The theory and practical examination shall be of three and four hours respectively duration to each paper at the end of the semester. The candidates failed in any subject will be permitted to appear for each failed subject or subjects in the subsequent examination. However in the final semester examination if the failure one or two subjects they can appear for a supplementary exam within a month.

The examination consists of Continuous Internal Assessment (CIA) and External Assessment (EA).

### Internal Assessment Marks for Theory papers are as follows

Attendance	- 5 Marks
Assignment	- 5 Marks
Seminar	- 5 Marks
CIA – I and II Test	- 5 Marks
Model Examinations	- <u>5 Marks</u>
<b>Total</b>	- <u>25 Marks</u>

### Internal Assessment Marks for Practical papers are as follows

Attendance	- 10 Marks
Observation Note	- 10 Marks
Model Examinations	- <u>20 Marks</u>
<b>Total</b>	- <u>40 Marks</u>

## 11. Distribution of Marks for Attendance:

Percentage	Marks	
	Theory	Practical
75 - 80	1	2
81 - 85	2	4
86 - 90	3	6
91 - 95	4	8
96 - 100	5	10

### Note:

Minimum 75 % of attendance is compulsory to sit for the exam. A condonation can be permitted between 65 % and 74.9 %.

## Question Paper Pattern for M. Sc., Botany Programme

**Time: 3 Hrs**

**Max. Marks: 75**

**PART – A** (10 x 1 = 10 Marks)

*(Answer all questions)*

(Multiple Choice Questions - Two questions from each unit)

**PART – B** (5 x 7 = 35 Marks)

*(Answer all questions)*

(One question from each unit with internal choice)

**PART – C** (3 x 10 = 30 Marks)

*(Answer any three questions)*

(One question from each unit)

### 12. Format to be followed in dissertation

The formats/certificate for dissertation to be submitted by the students are given below:

#### 1) Format for the preparation of project work

- (a) Title page
- (b) Bonafide certificate
- (c) Acknowledgement
- (d) Table of contents

### Contents

Chapter No.	Title	Page No.
1.	Introduction	
2.	Review of literature	
3.	Materials and Methods	
4.	Results	
5.	Discussion	
6.	Summary	
7.	References	



Format of the title Page

**TITLE OF THE DISSERTATION**

Dissertation Submitted in partial fulfillment of the  
requirement for the award of the Degree of

**Bachelor of Science in Botany**

to the Periyar University, Salem 636 011

By

Student Name

Register Number

Under the Guidance of

Guide Name

College / University Department

Year

**Format of the Certificate**

**CERTIFICATE**

This is to certify that the dissertation entitled .....(title of the dissertation).....submitted by ..... (name of the candidate).... in partial fulfillment of the requirement of the degree of Master of Science in Botany to the Periyar University, Salem is a bonafide record of independent research work done by her during the period .... (Year)... of her study in the Department of Botany at Vivekanandha College of Arts and Sciences for Women, Elayampalayam, under my supervision and guidance. This dissertation has not formed the basis for the award of any Degree, Diploma, similar titles or associate ship to any candidates of this University.

Viva –Voce Examination Date:

**Signature of Head**

**Signature of the Guide**

**Examiners: 1.**

**2.**

### **13. Passing Minimum:**

The Candidate shall be declared to have passed the examination if the candidate secures not less than 38 marks out of 75 marks in each theory paper. There is no passing minimum for internal assessment. For the practical paper, a minimum of 30 marks out of 60 marks in the practical examination and the record notebook taken together. There is no passing minimum for internal assessment and record note book. However submission of a record note book is a must. For the project work and viva – voce the candidate should secure 30 marks out of 60 marks for pass. There is no passing minimum for internal assessment. The candidate should compulsorily attend viva-voce examination to secure pass in that paper. Candidate who does not obtain the required minimum marks for a pass in a paper/project report shall be required to appear and pass the same at a subsequent appearance.

### **14. Classification of successful candidates:**

Candidates who secure not less than **60%** of the aggregate marks in the whole examination shall be declared to have passed the examination in **first class**. All other successful candidates shall be declared to have passed in the **second class**.

Candidates who obtain 75% of the marks in the aggregate shall be deemed to have passed the examination in **first class with distinction** provided they pass all the examinations prescribed for the course at the first appearance.

Candidates who pass all the examinations prescribed for the course in the first instance and within a period of two academic years from the year of admission to the course only are eligible for **Autonomous Ranking**.

### **15. Maximum duration for the completion of the M. Sc., Botany Programme:**

The maximum duration for completion of the PG Programme shall not exceed 4 semesters.

### **16. Commencement of this Regulation:**

These regulations shall take effect from the academic year 2023-24, i e., for students who are to be admitted to the first year of the course during the academic year 2023-24 and thereafter.

### **17. Transitory Provision:**

Candidates who were admitted to the M. Sc., Botany programme of study before 2023-24 shall be permitted to appear for the examinations under those regulations for a period of two years i.e., up to and inclusive of the examination of April/May 2023. Thereafter, they will be permitted to appear for the examination only under the regulations then in force.

<b>Title of the Course</b>		<b>Plant Diversity – I – Algae, Fungi, Lichens and Bryophytes</b>					
<b>Page Number</b>		<b>Core Course - I</b>					
<b>Category</b>	<b>Core</b>	<b>Year</b>	<b>I</b>	<b>Credits</b>	<b>4</b>	<b>Course Code</b>	<b>23P1BOC01</b>
		<b>Semester</b>	<b>I</b>				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		<b>3</b>	<b>2</b>	<b>-</b>	<b>5</b>		
<b>Pre-requisite</b>		Students should be familiar with the basics of algae, fungi, lichens and Bryophytes.					
<b>Learning Objectives</b>		<ol style="list-style-type: none"> <li>1. To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.</li> <li>2. To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes.</li> <li>3. To spark interest in the evolutionary roots of plant development.</li> <li>4. To study the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.</li> <li>5. To expose the beneficial and harmful viewpoint.</li> </ol>					
<b>Unit</b>	<b>Contents</b>						
<b>I</b>	<b>Algae:</b> General account of algology, Contributions of Indian Phycologist (T.V.Desikachary, V.Krishnamurthy and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45) & Silva (1982). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Phylogeny and inter-relationships of algae, origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: <i>Oscillatoria</i> , <i>Scytonema</i> , <i>Ulva</i> , <i>Codium</i> , <i>Diatoms</i> , <i>Dictyota</i> and <i>Gelidium</i> .						
<b>II</b>	<b>Fungi:</b> General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Para sexuality, sex hormones in fungi. Structure, reproduction and life histories of the following genera: <i>Plasmodiophora</i> , <i>Phytophthora</i> , <i>Rhizopus</i> , <i>Taphrina</i> , <i>Polyporus</i> and <i>Colletotrichum</i> .						
<b>III</b>	<b>Lichens:</b> Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basiodiolicheas and Deuterolichens.						
<b>IV</b>	<b>Bryophytes:</b> General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in Bryopsida, Anthoceropsida and Mosses. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Structure, reproduction and life histories of the following genera: <i>Targionia</i> , <i>Lunularia</i> , <i>Porella</i> and <i>Polytrichum</i> .						

<b>V</b>	<b>Economic Importance:</b> Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Culturing and cultivation of mushrooms <i>Pleurotus</i> . Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.	
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>	<b>Programme outcomes</b>
CO1	Relate to the structural organizations of algae, fungi, lichens and Bryophytes.	K1
CO2	Demonstrate both the theoretical and practical knowledge in understanding the diversity of basic life forms and their importance.	K2
CO3	Explain life cycle patterns in algae, fungi, lichens and Bryophytes.	K3
CO4	Compare and contrast the mode of reproduction in diverse groups of basic plant forms.	K4
CO5	Discuss and develop skills for effective conservation and utilization of lower plant forms.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended texts:</b>		
<ol style="list-style-type: none"> <li>1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.</li> <li>2. Barsanti, L. and Guadteri, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2<sup>nd</sup>Edition, CRC Press, ISBN: 1439867321.</li> <li>3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, Mc Graw Hill, ISBN:9780070700383, 0070700389</li> <li>4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.</li> <li>5. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.</li> <li>6. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.</li> <li>7. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.</li> <li>2. Edwardlee, R. 2018. Phycology, 5<sup>th</sup>Ed., Cambridge University Press, London.</li> <li>3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.</li> <li>4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers &amp; Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.</li> <li>5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers, ISBN: 9780471522294</li> </ol>		
<b>Web resources:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.britannica.com/science/algae">https://www.britannica.com/science/algae</a></li> <li>2. <a href="https://en.wikipedia.org/wiki/Bryophyte">https://en.wikipedia.org/wiki/Bryophyte</a></li> </ol>		

3. <https://www.britannica.com/plant/bryophyte/Ecology-and-habits>
4. <https://www.livescience.com/53618-fungus.html>.
5. [http://www.uobabylon.edu.iq/eprints/paper\\_11\\_20160\\_754.pdf](http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf)
6. <https://www.youtube.com/watch?v=vcYPI6y-Udo>
7. [https://www.youtube.com/watch?v=XQ\\_ZY57MY64](https://www.youtube.com/watch?v=XQ_ZY57MY64)
8. <http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf>

**Mapping with Programme Outcomes:**

<b>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>	S	3	2	3	2	1	2	2	2	2
<b>CO 2</b>	3	3	2	2	3	3	2	3	2	3
<b>CO 3</b>	2	2	3	3	1	2	1	3	1	3
<b>CO 4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO 5</b>	3	3	2	3	2	3	3	3	3	3

**S - Strong (3)**

**M - Medium (2)**

**L - Low(1)**

Title of the Course		Plant Diversity – II – Pteridophytes, Gymnosperms and Palaeobotany					
Paper Number		Core Course - II					
Category	Core	Year	I	Credits	4	Course Code	23P1BOCO2
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		
Pre-requisite		Students should know about the fundamentals of Pteridophytes, Gymnosperms and fossil records.					
Learning Objectives		<ol style="list-style-type: none"> <li>1. To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.</li> <li>2. To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity.</li> <li>3. To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms.</li> <li>4. To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms.</li> <li>5. To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.</li> </ol>					
Unit	Contents						
I	<b>Pteridophytes:</b> General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stellar evolution. Heterospory and seed habit, Telome theory, morphogenesis, Economic importance of Pteridophytes.						
II	<b>Pteridophytes:</b> Structure, anatomy, reproduction and life histories of the following genera: <i>Isoetes</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Osmunda</i> , <i>Pteris</i> and <i>Azolla</i> .						
III	<b>Gymnosperms:</b> General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K. R. Sporne, 1965). Economic importance of Gymnosperms.						
IV	<b>Gymnosperms:</b> Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: <i>Thuja</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> .						
V	<b>Paleobotany:</b> Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses. Study of organ genera: <i>Rhynia</i> , <i>Lepidocarpon</i> , <i>Lyginopteris</i> , <i>Calamites</i> and <i>Cordaites</i> .						
Course Outcomes:	On completion of this course the student will be able to					Programme Outcomes	
CO1 General	Recall on classification, recent trends in phylogenetic relationship, characters of Pteridophytes and Gymnosperms.					K1 & K3	

CO2	Learn the morphological/anatomical organization, life history of major types of Pteridophytes and Gymnosperms.	K3 & K4
CO3	Comprehend the economic importance of Pteridophytes, Gymnosperms, and fossils.	K3 & K5
CO4	Understanding the evolutionary relationship of Pteridophytes and Gymnosperms.	K2
CO5	Awareness on fossil types, fossilization and fossil records of Pteridophytes and Gymnosperms.	K1 & K3
<b>K1</b> - Remember; <b>K2</b> - Understand; <b>K3</b> - Apply; <b>K4</b> - Analyze; <b>K5</b> - Evaluate; <b>K6</b> – Create.		
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.</li> <li>2. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.</li> <li>3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.</li> <li>4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.</li> <li>5. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students -Gymnosperms. S. Chand and Company Ltd., New Delhi.</li> <li>6. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.</li> </ol>		
<b>Reference books:</b>		
<ol style="list-style-type: none"> <li>1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.</li> <li>2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12 th edition (Paper back), Vikas Publishing.</li> <li>3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2<sup>nd</sup> edition), Vikas Publications.</li> <li>4. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur.</li> <li>5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paper back), Andesite Press.</li> <li>6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson &amp; Co., London.</li> <li>7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of Fossil Plants, 2<sup>nd</sup> Edition, Academic Press.</li> </ol>		
<b>Web resources:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/">https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/</a></li> <li>2. <a href="http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_23432.aspx">http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_23432.aspx</a></li> <li>3. <a href="https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction">https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction</a></li> </ol>		

+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir\_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false

4. [https://books.google.co.in/books/about/Botany\\_for\\_Degree\\_Gymnosperm\\_Multicolor.html?id=HTdFYFNxnWQC&redir\\_esc=y](https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y)
5. <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>
6. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
7. <https://www.palaeontologyonline.com/>
8. <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>  
<https://trove.nla.gov.au/work/11471742?q&versionId=46695996>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	3	3
CO 4	3	3	2	3	3	3	3	2	3	2
CO 5	3	2	2	2	2	2	2	1	2	1

**S - Strong (3)**

**M - Medium (2)**

**L - Low(1)**



Title of the Course		Core – III – Laboratory Course – I Covering Theory Papers – I and II					
Paper Number		Core Course - III					
Category	Core	Year	I	Credits	4	Course Code	23P1BOCP01
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	-	2	5		
<b>Pre-requisite</b>		Students should be familiar with the fundamentals of algae, fungi, lichens, Bryophytes, Pteridophytes, Gymnosperms, Paleobotany and microbes in addition to essential laboratory techniques.					
<b>Learning Objectives</b>		1. To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups.					
		2. To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.					
		3. To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.					
		4. To develop the technical abilities in staining, sectioning, sterilizing, and characterizing, thallophytes and other varieties of non-flowering plants.					
		5. To compare the structural diversity of fossil and extant plant species.					
<b>Unit</b>		<b>Experiments</b>					
<b>I</b>		<p><b>Algae:</b> Study of algae in the field and laboratory of the genera included in theory. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: <i>Oscillatoria</i>, <i>Scytonema</i>, <i>Ulva</i>, <i>Codium</i>, <i>Diatoms</i>, <i>Dictyota</i> and <i>Gelidium</i> (depending on availability of the specimen). To record the local algal flora–Study of their morphology and structure. Identification of algae to species level (at least One). Preparation of culture media and culture of green algae and blue green algae in the laboratory (Demonstration).</p>					
<b>II</b>		<p><b>Fungi:</b> Study of morphological and reproductive structures of the following living forms: <i>Plasmodiophora</i>, <i>Phytophthora</i>, <i>Rhizopus</i>, <i>Taphrina</i>, <i>Polyporus</i> and <i>Colletotrichum</i> (depending on availability of the specimen). Isolation and identification of fungi from soil, air, and Baiting method. Preparation of culture media. Cultivation of mushroom in the laboratory (Demonstration).</p> <p><b>Lichens:</b> Study of morphological and reproductive structures of the genera <i>Parmelia</i>.</p>					
<b>III</b>		<p><b>Bryophytes:</b> External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Targionia</i>, <i>Lunularia</i>, <i>Porella</i> and <i>Polytrichum</i> (depending on availability of the specimen).</p>					

<b>IV</b>	<b>Pteridophytes:</b> External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Isoetes</i> , <i>Equisetum</i> , <i>Angiopteris</i> , <i>Osmunda</i> , <i>Pteris</i> and <i>Azolla</i> (depending on availability of the specimen). <i>Fossil slides observation: Rhynia, Lepidocarpon, Calamites.</i>	
<b>V</b>	<b>Gymnosperms:</b> External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: <i>Thuja</i> , <i>Cupressus</i> , <i>Araucaria</i> , <i>Podocarpus</i> , <i>Gnetum</i> and <i>Ephedra</i> (depending on availability of the specimen). <i>Fossil slides observation: Cordaites and Lyginopteris.</i>	
<b>Course outcomes: CO</b>	<b>On completion of this course the student will be able to</b>	<b>Programme outcomes</b>
CO1	Recall and applying the basic keys to distinguish at species level identification of important algae and fungi through its structural organizations.	K1 & K4
CO2	Demonstrate practical skills in thallophytes, Pteridophytes and Gymnosperms.	K2
CO3	Describe the structure of algae, fungi, lichens, Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Determine the importance of structural diversity in the evolution of plant forms.	K5
CO5	Formulate techniques to isolate and culture of alga and fungi as well as to understand the diversity of plant forms.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India. 3. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 4. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan. 5. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominant pub and Distributer, New Delhi.		

**Reference Books:**

1. Chmielewski, J.G and Kraysky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Webster, J and Weber, R. 2007. Introduction to Fungi, 3<sup>rd</sup> Ed. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
4. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
5. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.

**Web resources:**

1. <https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full>
2. <https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>
3. [http://www.cuteri.eu/microbiologia/manuale\\_microbiologia\\_pratica.pdf](http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf)
4. <https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4>
5. <https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883>
6. <https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover>
7. <https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	2	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	3	1	3	1	3
CO3	3	3	3	3	3	3	2	3	2	3
CO4	3	3	2	1	2	2	1	2	1	3
CO5	3	3	3	3	3	3	3	2	3	2

**S - Strong (3)****M - Medium (2)****L - Low(1)**

Title of the Course		Microbiology, Immunology and Plant Pathology					
Paper Number		Discipline Generic Elective – I					
Category	Elective	Year	I	Credits	2	Course Code	23P1BODE01
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		
<b>Pre-requisite</b>		The goal of the course is to provide students with basic understanding of microbiology, immunology, plant pathology and the etiology of specific plant diseases.					
<b>Learning Objectives</b>		1. To provide comprehensive knowledge about microbes and its effect on man and environment.					
		2. To provide comparative analysis of major groups of microbes.					
		3. To study the principles of immune system, immunizing agents like antibodies and vaccines and gene therapy methods.					
		4. To enhance the knowledge and skills needed for self-employment using the microbial derived products.					
		5. To appreciate the role of immune system in conferring disease resistance.					
Unit		Contents					
<b>I</b>		<b>Bacteria:</b> Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types. Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.					
		<b>Viruses:</b> General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.					
		<b>Food Microbiology:</b> Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso and Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin and Mycotoxin. Action of Enterotoxin, Cytotoxin and Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (Rhizosphere and Phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air borne diseases - Swine flu and Measles. Microbial degradation of chemical pesticides and hydrocarbon.					

<b>IV</b>	<p><b>Immunology:</b> Introduction; Immune System; Types of Immunity - Innate and Acquired. Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis – Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophoresis and Immunodiffusion.</p>		
<b>V</b>	<p><b>Plant Pathology:</b> History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection –Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients &amp; minerals and pollution).Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea. Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits; Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection - Immunofluorescence (IF).</p>		
<b>Course outcomes:</b>	<b>On completion of this course the student will be able to</b>		<b>Programme Outcomes</b>
<b>CO</b>			
CO1	Recognize the general characteristics of microbes, plant defense and immune cells.		K1
CO2	Explain about the stages in disease development and various defense mechanisms in plants and humans.		K2
CO3	Elucidate concepts of microbial interactions with plant and humans.		K3
CO4	Analyze the importance of harmful and beneficial microbes and immune system		K4
CO5	Determine and interpret the detection of pathogens and appreciate their adaptive strategies.		K5 & K6
Extended Component (is a part of internal component only, Not to be included in the External Examination question paper)	Professional	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill		

**Recommended Text:**

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.
4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
6. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.

**Reference Books:**

1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653.
2. Jeffery, C., Pommerville. 2014. Alcamos Fundalmedals of Microbiology. 10th Edition. Johns and Bartlett Learning.
3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York, ISBN: 0074623260.
4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN: 812034703X.
5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10th Edition, ISBN: 978-1259281594
6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur.

**Web resources:**

1. <https://www.wileyindia.com/a-textbook-of-plant-pathology.html>
2. <https://www.britannica.com/science/plant-disease>.
3. <https://www.planetatural.com/pest-problem-solver/plant-disease/>
4. <https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9>
5. <https://www.elsevier.com/life-sciences/immunology-and-microbiology/books>
6. <https://www.amazon.in/introduction-immunology-rafia-imran-ebook/dp/B09B66SD3J>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	3	2
CO2	3	3	2	2	3	3	2	1	2	1
CO3	3	3	3	3	3	3	1	3	1	3
CO4	3	3	2	2	3	3	2	1	2	1
CO5	3	3	3	3	3	3	3	2	3	2

**S - Strong (3)****M - Medium (2)****L – Low (1)**

Title of the Course		Horticulture					
Paper Number		Discipline Generic Elective -II					
Category	Elective	Year	I	Credits	2	Course Code	23P1BODE02
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		
Pre-requisite		Students should know fundamental knowledge on horticulture applications.					
Learning Objectives		1. Know about the brief history, divisions, classification and structure of horticultural plants.					
		2. Acquire knowledge on plant growth processes and stages of plant growth.					
		3. Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.					
		4. Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.					
		5. Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.					
Unit	Contents						
I	<b>Introduction to Horticulture:</b> Definition; Brief History, Divisions of Horticulture, Classification of horticultural plants, Structure of Horticultural Plants –Cell and Tissue systems, Anatomy of stem root and leaf, Morphological structures, Plant growth processes-A brief account of Photosynthesis, Respiration, Transpiration and Translocation, Stages of plant growth.						
II	<b>Factors affecting plant growth:</b> Plant Growth Environment: Abiotic factors, Soil –Profile structure, Primary and Secondary nutrients and their functions, Organic matter, Fertilizers –organic, Inorganic and Potting Media, Bio inoculants, Methods of fertilizer application, Directing Plant growth-Training -Pruning and thinning.						
III	<b>Plant propagation:</b> Plant propagation: Seeds –Advantages, Viability, Mechanism of Dormancy and Dormancy Breaking; Methods of Direct and Indirect Seedling Production in Nurseries and Transplantation; Propagation through specialized underground structures –Corm, Tuber, Sucker, Bulb, Bulbil, Rhizome; Vegetative Propagation –Cutting, Layering, Grafting and Budding.						
IV	<b>Micropropagation techniques:</b> Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds –Preparation and Potential uses of artificial seeds, Embryo Rescue, Soil-less Production of Horticultural crops – Hydroponics, sand culture, gravel culture.						
V	<b>Aesthetics of Horticulture:</b> Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai, Growing Plants Indoors, Turf Production, Landscaping-Principles, Types of Parks, Xeriscaping. Postharvest handling of Horticultural Products –Harvesting, Storage, Processing, Elements of Marketing, Robotics in Horticulture.						

Course outcomes:  CO	On completion of this course, the students will be able to:	Programme outcomes
CO1	Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1
CO2	Explain the various structures and growth processes of horticultural plants.	K2
CO3	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3
CO4	Correlate the soil characteristics and fertility to good plant growth.	K4
CO5	Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K5
CO6	Apply horticultural skills and knowledge to explore career opportunities in horticulture industry.	K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>1. Acquaah, G. 2011. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.</li> <li>2. Janik, J. 1972. Horticultural Science. W.H. Freeman &amp; Company, San Francisco.</li> <li>3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.</li> <li>4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.</li> <li>5. Schilleter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.</li> <li>6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.</li> <li>7. Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.</li> <li>2. Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.</li> <li>3. Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.</li> <li>4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.</li> <li>5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.</li> <li>6. Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India.</li> </ol>		



**Web resources:**

1. <https://www.kobo.com/in/en/ebooks/horticulture>
2. <https://www.gale.com/gardening-and-horticulture>
3. <https://www.iaritoppers.com/p/horticulture-icar-ecourse-pdf-books.html>
4. <https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6>
5. [https://www.researchgate.net/publication/316438576.Polyembryony in Horticulture and its significance](https://www.researchgate.net/publication/316438576.Polyembryony_in_Horticulture_and_its_significance)

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	2	1	3	3	3	3	3	3	3	2
CO3	3	1	3	3	3	3	3	2	3	3
CO4	3	3	3	1	1	2	2	3	1	3
CO5	3	3	3	3	3	3	2	3	3	2

**S - Strong (3)****M - Medium (2)****L - Low(1)**

Title of the Course	Mushroom cultivation						
Paper Number	Ability Enhancement Course – I						
Category	Ability Enhancement	Year	I	Credits	2	Course Code	21P1BOAC01
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		2	-	-	2		
<b>Pre-requisite</b>		Basic knowledge on structure and function of various groups of mushrooms.					
<b>Learning Objectives</b>		1. To teach the identification of mushrooms.					
		2. To differentiate the edible mushrooms with toxic and hallucinating fungi.					
		3. To study the cultivation technique of mushrooms					
		4. To learn the economic importance of mushroom in various fields.					
		5. To study how to establish mushroom cultivation as business enterprise.					
		6. To teach the identification of mushrooms.					
Unit	Contents						
<b>I</b>	<b>Introduction:</b> Mushroom, Edible and Poisonous Mushroom, commercial production, medicinal value of mushrooms, nutraceuticals and dietary supplements.						
<b>II</b>	<b>Morphological and microscopical identification of edible and poisonous mushrooms:</b> Keys for identification of edible mushrooms: <i>Agaricus bisporus</i> , <i>Pleurotus sajorajju</i> , <i>Volvariella volvcea</i> and <i>Calocybe indica</i> . Key for identifying hallucinogenic mushroom ( <i>Psilocybe</i> species.) Medicinal Mushroom – <i>Cordyceps</i> , <i>Ganoderma lucidum</i> and <i>Lentinus edodes</i> .						
<b>III</b>	<b>Cultivation:</b> Substrate sterilization, bed preparation, cropping room and maintenance, raising of pure culture and spawn preparation, factors effecting button mushroom production (Temp, pH, air and water management, competitor moulds and other disease).						
<b>IV</b>	<b>Post-harvest management:</b> Harvest, storage, quality assurance of mushrooms. Pestmanagement.						
<b>V</b>	World production edible mushroom, Legal and regulatory issues of introducing the medicinal mushrooms in different countries. Developing small scale industry and Government schemes. Mushroom Research Centres – International and National levels.						
Course Outcomes: CO	On completion of this course the student will be able to						Programme outcomes
CO1	Knowledge on identification of edible and toxic mushrooms belonging to Ascomycota and Basidiomycota.						K1, K3
CO2	Outline the nutraceutical properties of edible mushrooms.						K2, K4
CO3	Knowledge on cultivation techniques of edible and medicinal mushrooms.						K3, K6
CO4	Understand the harvest and post-harvest techniques of mushroom crops.						K4
CO5	Knowledge on the production and marketing strategies for mushrooms.						K5

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

**Recommended Text:**

1. Cheung, P. C.K. 2008. Mushrooms as functional food. A John Wiley & Sons, Inc., Publication.
2. Dijksterhuis, J. and Samson, R.A. 2007. Food Mycology: A multifaceted approach in fungi and food. CRC press, Newyork.
3. Hall., R.I., Stepheson, S.L., Buchanan, P.K., Yun, W. and Cole, A.L.J. 2003. Edible and poisonous mushrooms of the world. Timber Press, Portland, Cambridge.
4. Ting, S. and Miles, P.G. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and nutritional environmental impact. CRC press, Newyork.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

**Reference books:**

1. Tiwari., SC., Pandey K. 2018. Mushroom cultivation. Mittal Publisher, New Delhi.
2. Philips, G., Miles, Chang, S-T. 2004. Mushrooms: Cultivation, nutritional value, medicinal effect and environmental effect. 2<sup>nd</sup> ed. CRC Press.
3. Diego, C.Z., Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell publishers.
4. Nita Bahl. 2002. Handbook on Mushroom 4<sup>th</sup> edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr. C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

**Web resources:**

1. <https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X>
2. <http://nrcmushroom.org/book-cultivation-merged.pdf>
3. [http://agricoop.nic.in/sites/default/files/ICAR\\_8.pdf](http://agricoop.nic.in/sites/default/files/ICAR_8.pdf)
4. <http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/>
5. [https://books.google.co.in/books/about/Mushroom\\_Cultivation\\_in\\_India.html?id=6AJx99OGTKEC&redir\\_esc=y](https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y)

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	3	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

S - Strong (3)

M - Medium (2)

L - Low (1)

Title of the Course		Nursery and Gardening					
Paper Number		Skill Enhancement Course – I					
Category	Skill Enhancement	Year	I	Credits	2	Course Code	23P1BOS01
		Semester	I				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		2	1	-	3		
<b>Pre-requisite</b>		Students should know nursery and gardening practices.					
<b>Learning Objectives</b>		1. To recognize the importance of nursery and gardening					
		2. To gain an understanding of nursery management.					
		3. To develop skills necessary to manage a wholesale nursery.					
		4. To acquire knowledge regarding theory and practice of rising plants.					
		5. To develop an interest to become an entrepreneur.					
Unit	Contents						
<b>I</b>	<b>Nursery:</b> Definition, objectives and scope and building up of infrastructure for nursery, planning and seasonal activities - Planting - direct seeding and transplants.						
<b>II</b>	<b>Seed:</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.						
<b>III</b>	<b>Vegetative propagation:</b> Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings - Hardening of plants - green house - mist chamber, shed root, shade house and glasshouse.						
<b>IV</b>	<b>Gardening:</b> definition, objectives and scope - different types of gardening - landscape and home gardening - parks and its components - plant materials and design - computer applications in landscaping.						
<b>V</b>	<b>Gardening operations:</b> Soil laying, manuring, watering, management of pests and diseases and harvesting. Sowing/raising of seeds and seedlings: Transplanting of seedlings - Study of cultivation of different vegetables: cabbage, brinjal, lady's finger, onion, garlic, tomatoes, and carrots - Storage and marketing procedures.						
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>						<b>Programme outcomes</b>
CO1	Recognize the basic process required for growing and maintaining plants in nurseries.						K1
CO2	Explain the different methods of plant propagation and various gardening styles.						K2
CO3	Apply techniques for effective hardening of plants and computer						K3 &

	applications for creative gardening.	K6
CO4	Compare and contrast cultivation of different vegetables and growth of plants in nursery and gardening.	K4
CO5	Develop new strategies to enhance growth and quality of nursery plants.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>1. Bose T.K and Mukherjee, D. 1972. Gardening in India, Oxford &amp; IBH Publishing Co., New Delhi.</li> <li>2. Sandhu, M.K. 1989. Plant Propagation, Wile Eastern Ltd., Bengaluru.</li> <li>3. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.</li> <li>4. Edmond Musser and Andres. 1957. Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.</li> <li>5. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. N.L. Patel, S.L. Chawla, T.R. Ahlawat: Commercial Horticulture, 2016, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,</li> <li>2. Prasad S &amp; Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.</li> <li>3. George Acquaah, 2002, Horticulture-principles and practices. Prentice-Hall of India Pvt. Ltd., New Delhi.</li> <li>4. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.</li> <li>5. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.</li> </ol>		
<b>Web resources:</b>		
<ol style="list-style-type: none"> <li>1. <a href="https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil">https://www.kopykitab.com/Nursery-And-Gardening-SEC-by-Prof-C-D-Patil-Dr-G-M-Rane-Dr-S-A-Patil</a></li> <li>2. <a href="https://www.wonderslate.com/nursery-and-gardening-management/ebook-details?siteName=books&amp;bookId=38078&amp;preview=true">https://www.wonderslate.com/nursery-and-gardening-management/ebook-details?siteName=books&amp;bookId=38078&amp;preview=true</a></li> <li>3. <a href="https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=nfDDwAAQBAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Nursery_Hindi_Book_Bonsai_Plants_Nursery.html?id=nfDDwAAQBAJ&amp;redir_esc=y</a></li> <li>4. <a href="https://www.amazon.in/Gardening-Books/b?ie=UTF8&amp;node=1318122031">https://www.amazon.in/Gardening-Books/b?ie=UTF8&amp;node=1318122031</a></li> <li>5. <a href="https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648">https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648</a></li> </ol>		

**Mapping with Programme Outcomes:**

<b>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	1	3	2	1	2	2	3	2
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3
<b>CO3</b>	2	2	3	3	1	2	1	3	3	1
<b>CO4</b>	3	3	3	3	3	2	3	3	3	1
<b>CO5</b>	3	3	2	3	2	3	1	2	3	2

**S - Strong (3)**

**M - Medium (2)**

**L - Low(1)**

Title of the Course		Taxonomy of Angiosperms and Economic Botany					
Paper Number		Core Course – IV					
Category	Core	Year	I	Credits	4	Course Code	23P2BOC03
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		
Pre-requisite		Prior knowledge on morphological, anatomical characteristics and uses of plants.					
Learning Objectives		1. To be familiar with the basic concepts and principles of plant systematics.					
		2. To develop a suitable method for correct characterization and identification of plants.					
		3. To understand the importance of taxonomic relationships in research of plant systematics.					
		4. To provide information on various classification systems					
		5. To know about the economic importance of plants.					
Unit	Contents						
I	<b>Taxonomy and Systematics:</b> Botanical exploration and contribution with special reference to India by William Roxburgh, J.D. Hooker, Robert Wright, Nathaniel Wallich and Gamble, J.S. Principles of classification as proposed – Artificial – Linnaeus, Natural – Bentham and Hooker, Phylogenetic system - Hutchinson, Modern – Takhtajan. Botanical gardens and herbaria of world, preparation and maintenance of Herbarium, Botanical survey of India – its organization and role.						
II	<b>Modern trends in taxonomy:</b> Modern trends in taxonomy, chemotaxonomy, numerical taxonomy, biosystemics. ICBN uninominal systems- genesis binomial nomenclature, importance and principle. Important articles, typification, principles of priority, effective and valid publication, author citation, brief account on ICN.						
III	<b>Systematic analysis of plants – I</b> Polypetalae – Nymphaeaceae, Sterculiaceae, Portulacaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Turneraceae.						
IV	<b>Systematic analysis of plants – II</b> Gamopetalae – Sapotaceae, Oleaceae, Boraginaceae, Scrophulariaceae, Bignoniaceae, Convolvulaceae, Acanthaceae, Verbenaceae. Monochlamydeae – Nyctaginaceae, Aristolochiaceae, Casuarinaceae. Monocots – Orchidaceae, Amarylidaceae, Liliaceae, Commelinaceae, Cyperaceae.						
V	<b>Economic Botany:</b> General account on utilization of selected crop plants: (i) Cereals (rice and wheat) – (ii) Pulses (red gram and black gram), (iii) Drug yielding plants ( <i>Withania somnifera</i> and <i>Coleus aromaticus</i> ) (iv) Oil yielding plants (Groundnut, sunflower). (v) Sugar yielding plants (sugarcane and sugar beet), (vi) Spices and condiments (cardamom, cinnamon). (vii) Commercial crops - fibre (jute), (viii) Timber (Teak and red sanders wood), (ix) Resins and gums (Asafoetida and gum arabic) – (x) Essential oils (lemon grass and menthol), (xi) Beverages (tea, coffee), (xii) Plants used as avenue trees for shade, pollution control and aesthetics (xiii) Energy plantation - uses of <i>Casuarina</i> .						

Course outcomes: CO	On completion of this course, the students will be able to:	Programme outcomes
CO1	Recollect the basic concepts of morphology of leaves, flowers. Identify the types of compound leaves, inflorescence and fruits Describe their characteristic features.	K1, K2 K3
CO2	Explain the principles of taxonomy. Summarize the taxonomic hierarchy. Define Binomial nomenclature. Group Activity – Construct key preparation.	K1, K2 K5, K6
CO3	Explain the various types of classification. Distinguish its advantages and disadvantages Construction of floral formula and floral diagram.	K1, K2 K3, K4
CO4	Illustrate and explain the characteristic features and list out the economic importance of the families Field trip to local botanical garden and regional botanical garden.	K1, K2 K3, K4
CO5	Illustrate and explain the characteristic features and list out the economic importance of the families.	K1, K2 K3, K5
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>Pandey, B.P. 2013. Taxonomy of Angiosperms, S. Chand Publishing, New Delhi.</li> <li>Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.</li> <li>Singh, G. 2007. Plant systematics theory and practices. Oxford and IBH Publishing Co.</li> <li>Jain, S.K and Rao R.R. 1993. A handbook of field and herbarium methods. Today and Tomorrow Publ.</li> <li>Pandurangan, A.G., Vrinda, K.B and Mathew Dan. 2013. Frontiers in plant taxonomy. JNTBGRI, Thiruvananthapuram, Kerala.</li> <li>Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.</li> <li>Subramaniam, N.S. 1997. Modern plant taxonomy. Vikas Publishing House, New Delhi.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Wallis, T.E. 1999. Text book of Pharmacognosy. CBS Publishers and Distributors, New Delhi.</li> <li>Kumaresan, V and Annie Regland. 2004. Taxonomy of Angiosperms systematic Botany, Economic Botany, Botany &amp; Ethnobotany.</li> <li>Anonymous, 2004. Cultivation of Selected Medicinal Plants. National Medicinal Plants Board, Govt. of India, New Delhi.</li> <li>Vallabh. 2000. Practical Pharmacognosy, Kolkata. New Delhi.</li> <li>Acharya Vipul Rao. 2000. Herbal cure for common diseases. Diamond books, Pvt. Ltd.</li> <li>Dey, A.C. 1998. Indian medicinal plants used in Ayurvedic preparations, Bishen Singh Mahendra Pal Singh.</li> <li>Sathya, S., Jaiganesh, K.P and Sudha, T. 2019. Current Trends in Herbal Drug Technology. Pharmacy Council of India New Delhi.</li> <li>Mohamad Ali. 2009. Pharmacognosy and Phytochemistry. CBS Publications&amp; Distribution, New</li> </ol>		



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9. Lewis, W.H and M.P.F. Elwin Lewis. 1976. Medical Botany. Plants affecting Man's Health. A Wiley Inter Science Publication. John Wiley and Sons, New York.

**Web resources:**

1.<https://www.ipni.org/>

2.<http://www.theplantlist.org/>

3.<https://www.amazon.in/plant-taxonomy-Sharma/dp/0070141592>

4.<https://www.tropicos.org/home>

5.<http://apps.kew.org/herbcat/gotoHerbariumGrowthPage.do>

6.<https://www.absbooksindia.com/shop/science/botany/textbook-of-economic-botany>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	3	3	3
CO2	3	3	2	3	3	2	2	1	2	2
CO3	3	3	2	3	1	3	2	3	3	1
CO4	3	2	3	3	2	3	3	1	3	3
CO5	3	3	2	2	1	2	1	3	2	1

**S - Strong (3)**

**M - Medium (2)**

**L – Low (1)**

Title of the Course	<b>Anatomy and Embryology of Angiosperms</b>						
Paper Number	<b>Core Course - V</b>						
Category	Core	Year	I	Credits	4	Course Code	23P2BOC04
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		2	2	-	4		
<b>Pre-requisite</b>		To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					
<b>Learning Objectives</b>		1. Learn the importance of plant anatomy in plant production systems.					
		2. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.					
		3. Understand the mechanism underlying the shift from vegetative to reproductive phase.					
		4. Trace the development of male and female gametophyte.					
		5. Understand the recent advances in palynology.					
Unit	Contents						
<b>I</b>	<b>Cell Wall:</b> Morphological and physico-chemical changes; Plasmodesmata- types of pits – growth of cell wall – formation of intercellular spaces; Meristems: Classifications: Theories of shoot and root apices, Cytological zonation in shoot apex. Vascular Cambium: Composition and organization – multiplicative and additive divisions. Xylem: Primary and secondary xylem – tracheary elements and vessels – vesselless dicots – xylem rays and axial parenchyma of angiosperm wood; Dendrochronology – grain, texture and figure in wood; reaction wood; ring porous and diffuse porous wood. Phloem: Ultra structure and ontogeny of sieve tube elements and companion cell. Evolution of tracheary elements.						
<b>II</b>	<b>Periderm:</b> Structure, organization and activity of phellogen. Polyderm and Rhytiderm – wound periderm. Normal secondary thickening in Dicots; Anomalous secondary growth in Dicots (Amaranthaceae, Aristolochiaceae, Bignoniaceae, Piperaceae, Nyctaginaceae) and arborescent Monocots. Primary thickening in palms; Ontogeny of leaf, Structure and types of Stomata; Leaf abscission; Major nodal types; Kranz anatomy and its significance. Microtechnique: Principle of killing and fixation, dehydration and rehydration of botanical specimens. Stains: Principle of double staining (fast-green and light green) of free hand sections; Protocol for serial sectioning of paraffin wax impregnated specimens; Mounting and mounting media.						
<b>III</b>	<b>Microsporangium and male gametophyte:</b> Structure and development of Anther; Ultra structure and physiology of anther tapetum; Male gametophyte; Palynology: Morphology and ultra structure of pollen wall, pollen kitt, pollen analysis, pollen storage, pollen sterility and pollen physiology.						
<b>IV</b>	<b>Megasporangium and female gametophyte:</b> Structure and development of Megasporangium; Types of ovules, Endothelium, obturator and nucellus. Megasporogenesis: Female gametophyte: Structure, types, haustorial behavior						

	and Nutrition of embryo sacs. Fertilization: Double fertilization and triple fusion; Endosperm: Development of endosperm, types, physiological efficiency of endosperm haustoria and functions; Ruminant endosperm. Embryogeny: Development of monocot (Grass) and dicot (Crucifer) embryos.	
V	<b>Polyembryony:</b> Causes of Polyembryony, classification, induction and practical application. Apomixis and its significance. Seed and Fruit development and role of growth substances. Parthenocarpy and its importance.	
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>	<b>Programme outcomes</b>
CO1	Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.	K1 & K2
CO2	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants.	K1 & K4
CO3	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K2 & K6
CO4	Understand the various concepts of plant development and reproduction.	K3 & K6
CO5	Profitably manipulate the process of reproduction in plants with a professional and entrepreneurial mindset.	K5
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>1. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.</li> <li>2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.</li> <li>3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.</li> <li>4. Pandey.S.N and Ajanta Chandha. 2006. Plant Anatomy and Embryology. Vikas Publishing House Pvt. Ltd, New Delhi.</li> <li>5. Narayanaswamy, S. 1994. Plant Cell and Tissue Culture. Tata McGraw Hill Ltd. New Delhi.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Krishnamurthy, K.V. 1988. Methods in Plant Histochemistry. S. Viswanathan &amp; Co., Madras.</li> <li>2. Swamy, B.G.L and Krishnamurthy. K.V 1990. From flower to fruits, Tata – McGraw Hill publishing Co Ltd, New Delhi.</li> <li>3. Pullaiah, T., Lakshiminarayana, K and Hanumantha Rao, B. 2006. Text book of Embryology of Angiosperms. Regency Publications, New Delhi.</li> <li>4. Bierhorst, D.W. 1971. Morphology of Vascular Plants. Macmillan publishers, New York.</li> <li>6. Crang, R., Lyons-Sobaski, S and Wise, R. 2018. Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants. Springer International Publishing.</li> <li>7. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell</li> </ol>		

Publishing, Malden, USA.

8. Eames, A.J and Mac Daniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.

**Web resources:**

1. <https://www.ipni.org/>
2. <http://www.theplantlist.org/>
3. [https://faculty.etsu.edu/liuc/plant\\_anatomy\\_sites.htm](https://faculty.etsu.edu/liuc/plant_anatomy_sites.htm)
4. [http://aryacollegeludhiana.in/E\\_BOOK/Botany/plant\\_anatomy.pdf](http://aryacollegeludhiana.in/E_BOOK/Botany/plant_anatomy.pdf)
5. <https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf>
6. [http://greenlab.cirad.fr/GLUVED/html/P1\\_Prelim/Bota/Bota\\_typo\\_014.html](http://greenlab.cirad.fr/GLUVED/html/P1_Prelim/Bota/Bota_typo_014.html)
7. <https://www.askiitians.com/>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S	3	3	3	3	3	3	3	3	3
CO2	3	1	3	3	3	3	3	3	3	3
CO3	3	1	3	3	3	3	3	2	3	1
CO4	3	3	3	1	1	2	3	2	2	1
CO5	3	3	3	3	3	3	2	3	3	2

**S - Strong (3)**

**M - Medium (2)**

**L – Low (1)**

<b>Title of the Course</b>	<b>Ecology, Phytogeography, Conservation Biology and Intellectual Property Rights</b>						
<b>Paper Number</b>	<b>Core Course - VI</b>						
<b>Category</b>	<b>Core</b>	<b>Year</b>	<b>I</b>	<b>Credits</b>	<b>4</b>	<b>Course Code</b>	<b>23P2BOC05</b>
		<b>Semester</b>	<b>II</b>				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		<b>2</b>	<b>2</b>	<b>-</b>	<b>4</b>		
<b>Pre-requisite</b>		Understanding the environmental factors impacting biodiversity is crucial after taking this course and Basic understanding of how laws are structured and interpreted.					
<b>Learning Objectives</b>		1. To analyze and comprehend the fundamental ideas of plant ecology as a scientific study of environment.					
		2. To study the plant communities and plant succession stages.					
		3. To be aware of the causes, impacts and control measures of pollution.					
		4. To study biodiversity management and conservation.					
		5. To enhance the knowledge of the students and equip them in evaluate and protecting invaluable components of nature and interactions with the environment.					
<b>Unit</b>	<b>Contents</b>						
<b>I</b>	<b>Ecological Principles:</b> Introduction – History, scope, concepts. Diversity of plant life; growth form, life form. Basic concepts of population ecology– population dynamics – Regulation of population density. Basics concepts of community – characteristics, composition, structure, origin and development – community dynamics – trends of succession.						
<b>II</b>	<b>Ecosystem ecology and resource ecology:</b> Introduction – kinds – major types – functional aspects of ecosystem: Food chain and food web, energy flow, laws of thermodynamics. Productivity – primary and secondary productivity – GPP & BPP. <b>Resource Ecology:</b> Energy resources; renewable and non-renewable. <b>Soil:</b> Formation, types and profile - erosion and conservation, Water resources – conservation and management. <b>Environment Deterioration:</b> Climate change - Greenhouse effect and global warming, ozone depletion and acid rain. Waste management - Solid and e-waste, recycling of wastes. Eco-restoration/remediation ecological foot prints - carbon foot print - ecolabeling - environmental auditing						
<b>III</b>	<b>Phytogeography:</b> Phytogeographical Zones - Vegetation types of India and Tamil Nadu, Distribution: Continuous, Discontinuous and Endemism. Theories of discontinuous distribution: Continental drift, Age and area hypothesis. Geographical Information System (GIS) Principles of remote sensing and its applications.						

<b>IV</b>	<b>Biodiversity and Conservation:</b> Definition, types of biodiversity – values of biodiversity – Hot spots – Threats to biodiversity: habitat loss. Poaching of wild life – Invasion of exotic species, man and wild life conflicts - endangered and endemic plant species of India, Red list categories of IUCN, Biotechnology assisted plant conservation- <i>in situ</i> and <i>ex situ</i> methods.	
<b>V</b>	<b>Intellectual Property Rights:</b> Intellectual Property Rights – Introduction, Kinds of Intellectual Property Rights- Patents, Trademarks, Copyrights, Trade Secrets. Need for intellectual property right, Advantages and Disadvantages of IPR. International Regime Relating to IPR – TRIPS, WIPO, WTO, GATTs. IPR in India genesis and development. Geographical Indication – introduction, types. Patent filing procedure for ordinary application.	
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>	<b>Programme outcomes</b>
CO1	Understand the scope and importance of population ecology, plant communities and ecosystem ecology.	K1 & K2
CO2	Understand the applied aspect of environmental botany.	K1 & K4
CO3	Students will spot the sources and pollution and seek remedies to mitigate and rectify them.	K2 & K6
CO4	Identify different plant communities, categorize plant biomes and identify threatened, endangered plant species and create awareness program in protection of biodiversity.	K3 & K6
CO5	Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions.	K5
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.</li> <li>Pushpa Dahiya and Manisha Ahlawat. 2013. Environmental Science- A New Approach, Narosa Pub. House, New Delhi.pp.2.1-2.60.</li> <li>Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.</li> <li>Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.</li> <li>Neeraj Nachiketa. 2018 Environmental &amp; Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.</li> <li>Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.</li> <li>Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.</li> </ol>		

5. Ahuja, V.K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
6. Nithyananda, K.V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.
7. Venkataraman M. 2015. An introduction to Intellectual property rights. Create space Independent Pub.North Charleston, USA.
8. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
9. Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxford University Press, Oxford.

**Web resources:**

1. <https://www.intechopen.com/chapters/56171>
2. <https://plato.stanford.edu/entries/biodiversity/>
3. <https://sciencing.com/four-types-biodiversity-8714.html>.
4. <https://www.iaea.org/topics/plant-biodiversity-and-genetic-resources>
5. [http://www.bsiennis.nic.in/Database/Status\\_of\\_Plant\\_Diversity\\_in\\_India\\_17566.aspx](http://www.bsiennis.nic.in/Database/Status_of_Plant_Diversity_in_India_17566.aspx)
6. <https://www.youtube.com/watch?v=qtTLiQoYTyQ>
7. <https://www.youtube.com/watch?v=208B6BtXOPs>
8. <https://www.youtube.com/watch?v=6p1TpVJYTds>
9. <https://www.amazon.in/Intellectual-Property-Rights-Vijay-Durafe-ebook/dp/B08N4VRQ86>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	2	1	2	3
CO2	3	3	2	3	3	2	3	3	2	3
CO3	3	2	3	2	2	3	1	1	2	1
CO4	3	3	2	3	3	2	2	3	1	3
CO5	3	3	3	3	3	3	3	3	3	2

**S - Strong (3)**

**M - Medium (2)**

**L – Low (1)**

Title of the Course		Laboratory Course – II (Covering Core – IV, V and VI)					
Paper Number		Core Course – VII					
Category	Core	Year	I	Credits	4	Course Code	23P2BOCP02
		Semester	II				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	
		2		-		2	
Pre-requisite		Theoretical understanding of plant taxonomy, ecology and anomaly graphy, plant anatomy and embryology as well as basic laboratory skills for the relevant core course.					
Learning Objectives		1. Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation.					
		2. Expedite skilled workers to carry out research in frontier areas of plant science.					
		3. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants					
		4. Learn the importance of plant anatomy in plant production systems.					
		5 Know about different vegetation sampling methods.					
Unit	Experiments						
I	<b>Taxonomy and Economic importance of Angiosperms:</b> Preparation of artificial keys. Description of a species, based on virtual herbarium and live specimens of the families mentioned in the theory. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family. Solving nomenclature problems. <b>Field trip:</b> A field trip at least 3-4 days to a floristically rich area to study plants in nature and field report submission of not less than 20 herbarium sheets representing the families studied.						
II	<b>Anatomy:</b> 1. Study of shoot apex of <i>Hydrilla</i> . 2. Observation of cambial types. 3. Sectioning and observation of nodal types. 4. Study of anomalous secondary growth of the following: Stem – <i>Nyctanthus</i> , <i>Boerhaavia</i> , <i>Aristolochia</i> , <i>Bignonia</i> , <i>Piper</i> petal and <i>Mirabilis</i> . ROOT: <i>Achyranthes</i> 5. Observation of stomatal types by epidermal peeling. 6. Maceration of wood and observation of the components of xylem. 7. Double staining technique to study the stem anomaly.						
III	<b>Embryology:</b> 1. Observation of T.S. of anther. 2. Observation of ovule types. 3. Observation of mature embryo sacs.						



	4. Dissection and observation of embryos (globular and cordate embryos). 5. Study of pollen morphology 6. Study of in vitro pollen germination. 7. Observation of endosperm types.	
<b>IV</b>	<b>Ecology:</b> 1. Determination of the quantitative characters of a plant community by random quadrat method (abundance, density, dominance, species diversity, frequency) in grazing land, forests. 2. Estimation of above ground and below ground biomass in a grazing land employing minimum size of quadrat. 3. To determine soil moisture, porosity and water holding capacity of soil collected from varying depth at different locations. 4. Determination of pH of soil and water by universal indicator (or) pH meter. 5. Determination of dissolved oxygen. 6. Estimation of carbonate. 7. Estimation of bicarbonate.	
<b>V</b>	<b>Phytogeography, Conservation Biology and Intellectual Property Rights:</b> 1. Mapping of world vegetation. 2. Mapping of Indian vegetation. 3. Remote sensing – Analyzing and interpretation of Satellite photographs- Vegetation/ weather. 4. Visit to remote sensing laboratory (at Anna University, Regional Meteorological Centre at Numgambakkam).	
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>	<b>Programme outcomes</b>
CO1	To gain recent advances in plant morphological and floral characteristics.	K1
CO2	Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation.	K2
CO3	Recall or remember the information including basic and advanced in relation with plant anatomy and embryology.	K4 &K5
CO4	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3
CO5	Know about different vegetation sampling methods.	K3
Extended Component (is a part of internal component only, Not to be included in the External Examination question paper)	Professional Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1 <sup>st</sup> Edition. ISBN: 9351642062.		

3. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi. ISBN: 9788120414143.
4. Cutler, D.F., Botha, C.E.J., Stevenson, D.W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.
5. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. Pvt. Ltd., New Delhi.
6. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
7. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.

**Reference books:**

1. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
2. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
3. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
4. Harborne. J.B. 1998. Phytochemical methods. A guide to modern techniques of Plant Analysis, Chapman and Hall publication, London.
5. Traditional plant medicines as sources of new drugs. P.J Houghton in Pharmacognosy. Trease and Evan's. 16 Ed .2009.
6. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1<sup>st</sup> ed, Anmol Publications, ISBN-812610668.
7. Katherine Esau. 2006. Anatomy of Seed Plants. 2<sup>nd</sup> edition, John Wiley and Sons.

**Web resources:**

1. <https://www.kobo.com/gr/en/ebook/phytochemistry-2>
2. <https://www.amazon.in/Textbook-Pharmacognosy-Phytochemistry-Kumar-Jayaveera-ebook/dp/B06XKSY76H>
3. <https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ>
4. <https://studyfrnd.com/pharmacognosy-and-phytochemistry-book/>
5. <https://www.worldcat.org/title/textbook-of-pharmacognosy-and-phytochemistry/oclc/802053616>
6. <https://www.worldcat.org/title/phytochemistry/oclc/621430002>

**Mapping with Programme Outcomes:**

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	3	3	3	3	3	S	3	3
<b>CO2</b>	3	3	2	3	3	2	1	2	3	2
<b>CO3</b>	3	3	3	3	3	3	3	3	3	3
<b>CO4</b>	3	3	3	3	3	3	3	1	2	3
<b>CO5</b>	3	2	2	3	3	3	3	2	3	3

**S – Strong (3)**

**M – Medium (2)**

**L – Low (1)**

Title of the Course		Research Methodology, Computer Applications and Bioinformatics					
Paper Number		Discipline Generic Elective - III					
Category	Elective	Year	I	Credits	3	Course Code	23P2BODE03
		Semester	II				
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total	
		2		2	-	4	
<b>Pre-requisite</b>		To impart expertise about analysis and research.					
<b>Learning Objectives</b>		1. To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.					
		2. To provide an overview on modern equipments that they would help students gain confidence to instantly commence research careers and/or start entrepreneurial ventures.					
		3. To develop interdisciplinary skills in using computers in botany to learn about the biological database.					
		4. Students aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.					
		5. Operate various software resources with advanced functions and its open office substitutes.					
Unit	Contents						
<b>I</b>	Literature collection and citation: bibliography —bibliometrics (scientometrics): definition-laws — citations and bibliography - *biblioscape— plagiarism— project proposal writing — dissertation writing – paper presentation (oral/poster) – E-learning tools- monograph — introduction and writing-Standard operating procedure (SOP) – introduction and preparation — Research Institutions – National and International.						
<b>II</b>	Basic principles and applications of pH meter, UV-visible spectrophotometer, centrifuge, lyophilizer, chromatography- TLC, Gas chromatography with mass spectrum (GC/MS), and HPLC-Scanning electron microscopy-Agarose gel Electrophoresis — Polyacrylamide Gel Electrophoresis –Polymerase chain reaction						
<b>III</b>	Introduction to computers and Bioinformatics. Types of hardware and software operating systems. Fundamentals of networking, operation of networks, telnet, ftp, www, Internet. Biological Research on the web: Using search engines, finding scientific articles.						
<b>IV</b>	Public biological databases, searching biological databases. Use of nucleic acid and protein data banks.						
<b>V</b>	NCBI, EMBL, DDBJ, SWISSPORT, Protein prediction and Gene finding tools. Techniques in Bioinformatics- BLAST, FASTA, Multiple Sequence Analysis .						
Course outcomes: CO	On completion of this course, the students will be able to:						Programme outcomes
CO1	Realize the need of centrifuges and chromatography and their uses in Research						K1 & K2
CO2	Learn the principles and applications of electrophoresis.						K2 & K3
CO3	Construct the phylogenetic trees for similar characteristic feature of plant genomes and study <i>de novo</i> drug design through synthetic						K5 & K6

	biology.	
CO4	Understand the concept of pair wise alignment of DNA sequences using algorithms.	K3 & K4
CO5	Interpret the features of local and multiple alignments.	K4 & K5
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)		Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>1. Veerakumari, L. 2017. Bioinstrumentation. MJP Publisher, India. P578.</li> <li>2. SreeRamulu, V.S.1988. Thesis Writing, Oxford&amp; IBH Pub. New Delhi.</li> <li>3. Kotheekar, V and T.Nandi. 2009. An introduction to Bioinformatics. Panima Publishing Company, New Delhi.</li> <li>4. Mani, K and N. Vijayaraj. 2004. Bioinformatics – A Practical Approach.1<sup>st</sup> Edn. Aparna Publication, Coimbatore.</li> <li>5. Gurumani, N. 2019. Research Methodology: For Biological Sciences, MP. Publishers.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. Jayaraman, J. 2000. Laboratory manual of Biochemistry, Wiley Eastern Limited, New Delhi 110 002.</li> <li>2. Pevsner, J. 2015. Bioinformatics and functional genomics. Hoboken, NJ: Wiley-Blackwell.</li> <li>3. Arthur Conklin W.M and Greg White, 2016. Principles of computer security. TMH. McGraw-Hill Education; 4 edition.</li> <li>4. Irfan Ali Khan and Attiya Khanum (eds.). 2004. Introductory Bioinformatics. Ukaaz Publications, Hyderabad.</li> <li>5. Arthur Conklin W.M., and Greg White. 2016. Principles of computer security. TMH., McGraw-Hill Education; 4<sup>th</sup> edition</li> <li>6. Mishra Shanthi Bhusan. 2015. Handbook of Research Methodology – A Compendium for Scholars &amp; Researchers, Ebooks2go Inc.</li> <li>7. Narayana, P.S.D. Varalakshmi, T. Pullaiah. 2016. Research Methodology in Plant Science, Scientific Publishers, Jaipur, Rajasthan.</li> </ol>		
<b>Web resources:</b>		

1. <https://www.kobo.com/in/en/ebook/bioinstrumentation-1>
2. <https://www.worldcat.org/title/bioinstrumentation/oclc/74848857>
3. <https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW>
4. <https://en.wikipedia.org/wiki/bioinstrumentation>
5. <https://www.britannica.com/science/chromatography>
6. <https://en.wikipedia.org/wiki/electrophoresis>

**Mapping with Programme Outcomes:**

<b>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	2	3	3	3	1	3	3
<b>CO2</b>	3	2	2	3	3	3	3	2	3	3
<b>CO3</b>	3	1	2	3	3	3	3	1	3	3
<b>CO4</b>	3	2	1	3	3	3	2	1	3	2
<b>CO5</b>	3	1	2	2	3	3	3	2	3	3

**S – Strong (3)**

**M – Medium (2)**

**L – Low (1)**

Title of the Course		Nanobiotechnology					
Paper Number		Discipline Generic Elective –IV					
Category	Elective	Year	I	Credits	3	Course Code	23P2BODE04
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		2	2	-	4		
Pre-requisite		To provide an insight into the principles of nanotechnology in biological and medical research.					
Learning Objectives		1. To introduce the learners to the basic concepts in the emerging frontiers of nanotechnology.					
		2. To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.					
		3. To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.					
		4. To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.					
		5. Incorporate sustainability in to account when you develop nanotechnology responsibly.					
Unit	Contents						
I	<b>Basic concepts in Nanobiology:</b> History of Nanotechnology, Difference between Nanoscience and Nanotechnology, Green nanotechnology, Bottom up and top down approaches.						
II	<b>Diversity in nanosystems:</b> Carbon based nanostructures - fullerenes, nanotubes, nanoshells, buckyballs – biomolecules and nanoparticles, nanosensors, nanomaterials - Classification based on dimensionality quantum dots, wells and wires – metal based nano materials (gold, silver and oxides) - Nanocomposites- Nanopolymers – Nanoglasses–Nano ceramics.						
III	<b>Methods of Nanobiotechnology:</b> Optical tools – Nanoforce and imaging – Surface methods – Mass spectrometry – Electrical Characterization and Dynamics of Transport – Microfluidics: Concepts and applications to the Life Sciences.						
IV	<b>Nanobiotechnology:</b> Nanodevices and nanomachines based on biological nanostructures - Protein and DNA nanoarrays, tissue engineering, and luminescent quantum dots for biological labeling.						
V	<b>Applications of Nanobiotechnology:</b> Real Time PCR – Biosensors : From the glucose electrode to the Biochip – DNA Microarrays – Protein Microarrays – Cell Biochips – Lab on a chip – Polyelectrolyte multilayers – Biointegrating materials – Pharmaceutical applications of nanoparticles carriers.						
Course outcomes: CO	On completion of this course, the students will be able to:						Programme Outcomes
CO1	Recall the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology.						K1
CO2	Formulate procedures for the synthesis of nanoparticles which are of medical importance which could be used to treat specific diseases.						K2

CO3	Characterize the various types of nano particle synthesis and advocate promotes the use of nano materials and anno composites.	K3
CO4	Analyze and apply the important of nanoparticles in plant diversity.	K4
CO5	Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>Dupas, C, Houdy, P., Lahmani, M. 2007. Nanoscience: —Nanotechnologies and Nanophysicsl, Springer-Verlag Berlin Heidelberg.</li> <li>Sharon, M and Sharon, M. 2012. Bio-Nanotechnology- Concepts and Applications, CRC Press.</li> <li>Atkinson, W.I. 2011. Nanotechnology. Jaico Book House, New Delhi.</li> <li>Nalwa, H.S. 2005. Handbook of Nanostructured Biomaterials and Their Applications in Nanobiotechnology. American Scientific Publ.</li> <li>Lindsay, S.M. 2011. Introduction to Nanoscience, Oxford universal Press, First Edition.</li> <li>Jain K.K. 2006. Nanobiotechnology molecular diagnostics: Current techniques and application (Horizon Bioscience).Taylor &amp; Francis 1st edition.</li> <li>Pradeep, T. 2012. Textbook of Nanoscience and Nanotechnology, McGraw Hill Education (India) Private Limited.</li> <li>XiuMei Wang, Murugan Ramalingam, Xiangdong Kong and Lingyun Zhao. 2017.Nanobiomaterials: Classification, Fabrication and Biomedical Applications, Wiley VCH Verlag GmbH &amp; Co. KGaA.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub. Pvt. Ltd,</li> <li>Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience.</li> <li>Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.</li> <li>European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.</li> <li>Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ. of Queensland.</li> <li>Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.</li> <li>Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.</li> </ol>		
<b>Web resources:</b>		
<ol style="list-style-type: none"> <li><a href="https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453">https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453</a></li> <li><a href="https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4">https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4</a></li> <li><a href="https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179">https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179</a></li> <li><a href="https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php">https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php</a></li> <li><a href="https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html">https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html</a></li> </ol>		

6. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/>
7. <https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html>
8. <http://www.particle-works.com/applications/controlled-drug-release/Applications>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	2	1	2	3
CO 3	3	3	3	2	3	3	3	2	2	3
CO 4	3	3	3	3	3	3	3	3	3	3
CO 5	3	3	3	3	3	3	3	3	3	3

**S - Strong (3)**

**M - Medium (2)**

**L – Low (1)**



Title of the Course	Entrepreneurial Opportunities in Botany						
Paper Number	Ability Enhancement Course - II						
Category	Ability Enhancement	Year	I	Credits	2	Course Code	23P2BOAC02
		Semester	III				
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total	
		2		-	-	2	
Pre-requisite		To understand the importance of floriculture and nursery management.					
Learning Objectives		<p>1. Understand the different classifications of horticultural crops, nursery management, and use of technology in horticulture.</p> <p>2. Develop their competency on pre and post-harvest technology in horticultural crops.</p> <p>3. Analyze the different methods of weed control and harvest treatments of horticultural crops.</p> <p>4. Examine the economic implications of cultivation of tropical and sub-tropical vegetable crops.</p> <p>5. Evaluate the importance of floriculture and contribution spices and condiments on economy.</p>					
Unit	Contents						
I	Organic manures and fertilizers. Composition of fertilizer, NPK content of various fertilizers. Common organic manures bone meal, cow dung, poultry waste, oil cakes, organic mixtures and compost. Preparation of compost, aerobic and anaerobic – advantages. Vermicompost preparation, vermiwash. Panchakaviyam.						
II	Common garden tools. Methods of plant propagation by seeds. Vegetative propagation, cutting, grafting, budding and layering. Use of growth regulators for rooting.						
III	Gardening – types of garden, ornamental, indoor garden, kitchen garden, terrace garden, vegetable garden for marketing. Rockery and artificial ponds. Ornamental garden designing, garden components flower beds, borders, hedges, edges, drives, paths, garden adornments.						
IV	Packaging of fruits, vegetables. Preservation techniques drying, heat treatment, low temperature storage and by chemicals. Preparation of wine, vinegar and dairy products.						
V	Significance of mushrooms. Types of mushrooms (button mushroom, oyster mushroom). Spawn isolation and preparation. Cultivation. Value added products from mushroom – pickles, candies and dried mushrooms.						
Course outcomes: CO	On completion of this course, the students will be able to:					Programme outcomes	
CO1	Students can acquire knowledge about organic farming and their Advantages					K1	
CO2	Analyze both the theoretical and practical knowledge in understanding various horticultural techniques.					K2	

CO3	To develop kitchen garden or terrace garden in their living area.	K3
CO4	Evaluate the horticultural techniques to students can develop self employment and economical improvement.	K4
CO5	Create and develop skills for mushroom cultivation.	K5 & K6
Extended Component (is a part of internal component only, Not to be included in the External Examination question paper)	Professional Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
<ol style="list-style-type: none"> <li>Chmielewski, J.G and Kravesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA.</li> <li>Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.</li> <li>Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.</li> <li>Webster, J and Weber, R. 2007. Introduction to Fungi, 3<sup>rd</sup> Ed. Cambridge University Press, Cambridge.</li> <li>Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 ( 10<sup>th</sup> ed).Rastogi Publications, Meerut.</li> <li>Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.</li> <li>Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.</li> <li>Peter, K.V. 2017. Basic Horticulture.</li> <li>Hartman, H.T. and D.F. Kestler. 1976. Plant propagation principles and practice. Prentice Hall of India, New Delhi.</li> <li>Jules Janick, 1982. Horticulture Science. Surjeet publications, New Delhi.</li> <li>Ignacimuthu, S.1998. Plant Biotechnology. Tata Mc Graw Hill Ltd., New Delhi.</li> <li>Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut.</li> <li>Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.</li> <li>Janick Jules. 1979. Horticultural Science. (3<sup>rd</sup> Ed.), W.H. Freeman and Co., San Francisco, USA.</li> </ol>		
<b>Web resources:</b>		
<ol style="list-style-type: none"> <li><a href="https://www.kobo.com/in/en/ebook/composting-process-organic-manures-through-eco-friendly-waste-management-practices">https://www.kobo.com/in/en/ebook/composting-process-organic-manures-through-eco-friendly-waste-management-practices</a></li> <li><a href="https://books.google.co.in/books/about/Plant_Propagation.html?id=K-gQh6OI7GcC&amp;redir_esc=y">https://books.google.co.in/books/about/Plant_Propagation.html?id=K-gQh6OI7GcC&amp;redir_esc=y</a></li> <li><a href="https://www.ebooks.com/en-us/subjects/gardening/">https://www.ebooks.com/en-us/subjects/gardening/</a></li> <li><a href="https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q">https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q</a></li> <li><a href="https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9">https://www.elsevier.com/books/food-preservation-techniques/zeuthen/978-1-85573-530-9</a></li> </ol>		

**Mapping with Programme Outcomes:**

<b>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	1	3	2	1	2	2	3	2
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3
<b>CO3</b>	2	2	3	3	1	2	1	3	3	1
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	2

**S - Strong (3)      M - Medium (2)      L – Low (1)**

<b>Title of the Course</b>		<b>Internship/Industrial Activity</b>					
<b>Paper Number</b>		<b>Skill Enhancement Course - II</b>					
<b>Category</b>	<b>Skill Enhancement</b>	<b>Year</b>	<b>I</b>	<b>Credits</b>	<b>2</b>	<b>Course Code</b>	<b>23P2BOS02</b>
		<b>Semester</b>	<b>II</b>				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		<b>2</b>	<b>1</b>	<b>-</b>	<b>3</b>		
<b>Pre-requisite</b>		The summer internship programme will give students the chance to experience real-world organizational situations, learn about processes and rules, and grasp the operations of the industry..					
<b>Learning Objectives</b>							
<b>C1</b>	The main goal of the internship programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen days in an industry/institution over the summer..						
<b>C2</b>	To comprehend how theoretical ideas are applied in many sectors and industries.						
<b>C3</b>	To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem-solving and management skills.						
<b>C4</b>	The internship must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.						
<b>C5</b>	Internships provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.						
<b>Unit</b>	<b>Contents</b>						<b>No. of Hours</b>
<b>I</b>	<p><b>Guidelines for Internship Programme:</b></p> <ol style="list-style-type: none"> <li>To give students the opportunity to spend at least fifteen days on their own during the II Semester vocation in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures.</li> <li>Individual instruction is provided for the internship. The internship programme must be completed in order to receive a credential.</li> <li>Students are required to indentify a research labs/industry/recognized institution for their Internship Programme Coordinator in consultation with and approval of their faculty guide. The choice of the research labs/industry/recognized institution should be intimated to the Internship coordinator before commencement of the Internship. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship Program.</li> <li>Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or shareholders, the nature of business, organizational structure,</li> </ol>						

	<p>reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter.</p> <p>5. Before leaving the research labs/industry/recognized institution, obtain the Internship Programme completion certificate on the letterhead of a research lab/industry/, or an accredited institution.</p> <p>6. Maintain Internship Programme record with details on activities and personal learning during their project period.</p> <p>7. The department head and the coordinator of the internship programme form a committee to ensure that the internship is followed.</p> <p>8. At least two copies of the report must be prepared by the intern at the conclusion of the internship program—one for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labelled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages.</p> <p>9. The internship training report should be submitted to the department within a month from the date of commencement of third semester.</p> <p>10. However, such submission shall not be accepted after the end of third semester Examinations.</p>	
<p style="text-align: center;"><b>II</b></p>	<p><b>Evaluation of the Internship:</b></p> <p>i. The internship program will be assessed by the assigned Internship Programme Coordinator from the host institute.</p> <p>ii. Evaluation will be done by the Internship Programme Coordinator of the host institute and through seminar presentation/viva-voce.</p> <p>iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information.</p> <p>iv. According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the internship coordinator.</p>	
<p style="text-align: center;"><b>III</b></p>	<p><b>College Guide Manual – Summer Internship Program:</b></p> <p>1. The Internship Programme Coordinator should give proper procedures to the intern before and after the Internship.</p> <p>2. The Internship Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the internship.</p> <p>3. The weekly report submitted by the student should be reviewed and reported to the Internship Programme coordinator.</p>	
<p style="text-align: center;"><b>IV</b></p>	<p><b>Internal:</b> 100 marks</p>	

	Internship Programme } Completion certificate }- 30 marks Internship report - 30 marks Presentation - 20 marks Viva-voce - 20 marks	
V	<b>Contents of the report:</b> Title page Page for supervisory committee Table of Acknowledgement Internship Certificate <b>Executive Summary</b> Introduction of the Report Overview of the Organization What I have Learned Analyses Summary Recommendations and Conclusion References Appendices	
<b>Course outcomes: CO</b>	<b>On completion of this course, the students will be able to:</b>	<b>Programme outcomes</b>
<b>CO1</b>	For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.	K1
<b>CO2</b>	Compile data and familiarize yourself with techniques for planning and carrying out tests.	K2
<b>CO3</b>	Collect data and educate yourself on how to e the analysis results of your scientific studies.	K3 & K5
<b>CO4</b>	This in-the-moment industrial exposure helps them become more Knowledgeable and skilled in the latest technology.	K4
<b>CO5</b>	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an Entrepreneur.	K5 & K6
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill	
<b>Recommended Text:</b>		
1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi. 2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.		

**Mapping with Programme Outcomes:**

<b>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>CO 1</b>	3	3	3	1	3	3	3	3	3	2
<b>CO 2</b>	3	3	3	3	3	3	2	1	3	3
<b>CO 3</b>	3	3	3	3	3	3	2	1	3	3
<b>CO 4</b>	3	2	3	3	3	3	3	2	3	3
<b>CO 5</b>	3	3	3	3	3	3	3	3	2	3

**S - Strong (3)**

**M - Medium (2)**

**L - Low(1)**