SYLLABUS FOR UG BOTANY PROGRAMME

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

Under

Choice Based Credit System (CBCS)

DEPARTMENT OF BOTANY

GOVERNMENT ARTS COLLEGE (AUTONOMOUS),

(Re-Accredited by NAAC with 'A' Grade)

KUMBAKONAM – 612 002. THANJAVUR – Dt.

JULY - 2023

Contents

LEARNING OUTCOMES - BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**B.Sc. BOTANY**
Programme Code:	
Duration:	**3 Years (UG)**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

	PO4: Problem solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision,

	building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including „learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.
Programme Specific Outcomes:	On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to: **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory. **PSO2: Critical Thinking:** Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities. **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models. **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects. **PSO6: Self-directed & Lifelong Learning:** Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.

PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

2. Highlights of the Revamped Curriculum:

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, advanced programming packages allied with the discipline topics, practical training, devising statistical models and algorithms for providing solutions to industry / real life situations. The curriculum also facilitates peer learning with advanced statistical topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and Statistics based problem solving skills are included as mandatory components in the 'Training for Competitive Examinations' course at the final semester, a first of its kind.
- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problems and train the students on designing a mathematical model to provide solutions to the industrial problems.
- The Internship during the second year vacation will help the students gain valuable work experience, that connects classroom knowledge to real world experience and to narrow down and focus on the career path.
- The state of art technologies in conducting a Explain in a scientific and systematic way and arriving at a precise solution is ensured. Such innovative provisions of the industrial training, project and internships will give students an edge over the counterparts in the job market.
- State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature are incorporated as Elective courses, covering conventional topics to the latest DBMS and Computer software for Analytics.

Value additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning abstract Statistics and simulating mathematical concepts to real world.	• Instil confidence among students • Create interest for the subject
II, III, IV, V & VI	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposure on latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involving data collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide an opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training to girls leads to women empowerment
		• Discipline centric skill will improve the Technical knowhow of solving real life problems using ICT tools
V & VI	Elective papers- An open choice of topics categorized under Generic and Discipline Centric	• Strengthening the domain knowledge • Introducing the stakeholders to the State-of Art techniques from the streams of multi-disciplinary, cross disciplinary and inter disciplinary nature • Students are exposed to Latest topics on Computer Science / IT, that require strong statistical background

		• Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners / Honors degree		• To cater to the needs of peer learners / research aspirants

Skills acquired from the Courses	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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

B.Sc., Botany Programme Course Structure

SEM	Part	COURSE	Credits	INST. Hours/week	Marks		Total
					Internal	External	
I	I	Tamil - I	3	6	25	75	100
	II	English - I	3	6	25	75	100
	III	Core Course – I (CC) Plant Diversity I - Algae	5	5	25	75	100
		Core Practical - I - Plant Diversity I - Algae	3	3	40	60	100
		Allied Course - I Zoology - I	4	4	25	75	100
		Allied Practical - I Zoology	-	2	-	-	-
	IV	Value Education	2	2	25	75	100
		Foundation Course - I Basics of Botany	2	2	25	75	100
Total			**22**	**30**	**Total Marks**		**700**
II	I	Tamil - II	3	6	25	75	100
	II	English - II	3	6	25	75	100
	III	Core Course – II (CC) Plant Diversity II - Fungi, Bacteria, Viruses, Plant Pathology and Lichens	5	5	25	75	100
		Core Practical - II Plant Diversity II - Fungi, Bacteria, Viruses, Plant Pathology and Lichens	3	3	40	60	100
		Allied Course - II Zoology - II	4	4	25	75	100
		Allied Practical - I Zoology	2	2	40	60	100
	IV	Environmental Studies	2	2	25	75	100
		Skill Enhancement Course SEC - I Botanical Garden and Landscaping / Naan Mudhalvan	2	2	25	75	100
Total			**24**	**30**	**Total Marks**		**800**
III	I	Tamil - III	3	6	25	75	100
	II	English - III	3	6	25	75	100
	III	Core Course – III (CC) Plant Diversity III Bryophytes and Pteridophytes	5	5	25	75	100
		Core Practical - III Plant Diversity III Bryophytes and Pteridophytes	3	3	40	60	100
		Allied Course - III Chemistry - I	4	4	25	75	100
		Allied Practical - II Chemistry	-	2	-	-	-
	IV	Skill Enhancement Course SEC - II Herbal Technology	2	2	25	75	100
		Skill Enhancement Course SEC - III Entrepreneurial Opportunities in Botany / Naan Mudhalvan	2	2	25	75	100
Total			**22**	**30**	**Total Marks**		**700**

IV	I	Tamil - IV	3	6	25	75	100
	II	English - IV	3	6	25	75	100
	III	Core Course – IV (CC) Plant Diversity IV Gymnosperms, Paleobotany and Evolution	5	5	25	75	100
		Core Practical - IV Plant Diversity IV Gymnosperms, Paleobotany and Evolution	3	3	40	60	100
		Allied Course - IV Chemistry - II	4	4	25	75	100
		Allied Practical - II Chemistry	2	2	40	60	100
	IV	Skill Enhancement Course SEC - IV Soft Skills Development	2	2	25	75	100
		Skill Enhancement Course SEC - V Fermentation Technology / Naan Mudhalvan	2	2	25	75	100
Total			**24**	**30**	**Total Marks**		**800**
V	III	Core Course – V (CC) Plant Morphology, Taxonomy and Economic Botany	5	5	25	75	100
		Core Course – VI (CC) Plant Anatomy and Embryology	4	5	25	75	100
		Core Course – VII (CC) Cell Biology, Genetics and Plant Breeding	4	4	25	75	100
		Core Practical - V Covering Core V,VI & VII	3	6	40	60	100
		Major Based Elective Course – I Bio-Analytical Techniques	3	4	25	75	100
		Major Based Elective Course – II Horticulture	3	4	25	75	100
		Skill Enhancement Course SEC - VI Aquatic Botany/ Naan Mudhalvan	2	2	25	75	100
		Internship/ Industrial Visit/ Field Visit	2				
	Total		**26**	**30**	**Total Marks**		**700**
VI	III	Core Course – VIII (CC) Plant Ecology and Phytogeography	5	6	25	75	100
		Core Course – IX (CC) Plant Physiology and Plant Biochemistry	4	5	25	75	100
		Core Practical - VI Covering Core VIII & IX	3	5	40	60	100
		Major Based Elective Course – III Plant Biotechnology and Molecular Biology	3	5	25	75	100
		Major Based Elective Course – IV Forensic Botany	3	5	25	75	100
	IV	Skill Enhancement Course SEC - VII Organic Farming / Naan Mudhalvan	2	2	25	75	100
		Extension Activity	1				
	V	Gender Studies	1	2	25	75	100
Total			**22**	**30**	**Total Marks**		**700**
Net Total Credits			**140 +1**	**180**	**Net Total Marks**		**4400**

COURSE PATTERN - SUMMARY			
PART	**Subject**	**TOTAL PAPERS**	**CREDITS**
Part I	Tamil	4	12
Part II	English	4	12
Part III	Core Course	9	42
	Core Practical	6	18
	Allied Course	4	16
	Allied Course - Practical	2	4
	Major Based Elective Course	4	12
Part IV	Foundation Course - I	1	2
	Value Education	1	2
	Environmental Studies	1	2
	Skill Enhancement Course SEC / Naan Mudhalvan	7	14
	Internship/ Industrial Visit/Field Visit		2
	Extension Activity		1
Part V	Gender Studies	1	1
NET TOTAL		**44**	**140**

CORE - I PLANT DIVERSITY - I ALGAE

Title of the Course		**PLANT DIVERSITY - I ALGAE**					
Paper Number		**CORE I**					
Category	Core	**Year**	**I**	**Credits**	**5**	**Course Code**	
		Semester	**I**				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		5	**-**	**--**	**5**		
Pre-requisite		Students should be familiar with the basics of different classes of algae.					

Learning Objectives		
C1	To provide a comprehensive knowledge on the biology of algae.	
C2	To provide a basis for better understanding of the evolution higher of plants.	
C3	To understand reproductive biology, ecology of plants by studying the simpler systems in algae.	
C4	To understand the role of algae in ecosystems as primary producers of nutrition.	
C5	To understand importance of algae to animals and humans.	
Course outcomes	On completion of this course, students will;	
CO1	Relate to the structural organization, reproduction and significance of algae.	K1
CO2	Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	K2
CO3	Explain the benefits of various algal technologies on the ecosystem.	K3
CO4	Compare and contrast the thallus organization and modes of reproduction in algae.	K4
CO5	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	K5

UNIT	**CONTENTS**
I	General characters of Algae, Classification (Fritsch-1935-1945), criteria for classification, algal distribution.
II	Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum, Gracilaria*).
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic - *Gracilaria*) (Examples may be changed according to the availability of the specimens).

IV	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.

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 Texts:

1	Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
2	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4	Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
5	Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.

References Books:

1	Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
2	Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
3	Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera.
4	Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
5	Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
6	Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
7	Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.

Web Resources:

1	https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
2	https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
3	https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
4	https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678

5	https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh
6	https://www.wileyindia.com/a-textbook-of-algae.html
7	https://www.kobo.com/in/en/ebook/algae-biotechnology
8	https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	3	2	2	3	3	2	`1	3	3
CO 3	2	2	1	1	2	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

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

CORE PRACTICAL – I PLANT DIVERSITY I ALGAE

Title of the Course	**PLANT DIVERSITY – I : ALGAE PRACTICAL - I**						
Paper Number	**CORE PRACTICAL – I**						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		Semester	I				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	-	3	3

Pre-requisite	Students should be familiar with the basics of algae.

Learning Objectives		
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.	
C2	To identify microalgae in a mixture.	
C3	To develop skills to prepare the microslides of algae.	
C4	To study the economic importance of few species.	
C5	To understand importance of algae to animals and humans	
Course outcomes:	On completion of this course, the students will be able to CO	**Programme outcomes**
CO1.	Recall and identify algae using key identification characters	**K1**
CO2	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	**K2**
CO3	Describe the internal structure of algae prescribed in the syllabus	**K3**
CO4	Decipher the algal diversity in fresh/marine water and their economic significance.	**K4**
CO5	Evaluate the various techniques used to culture algae for commercial purposes	**K5**

EXPERIMENTS	
1. Micro-preparation of the types prescribed in the syllabus. 2. Identifying the micro slides relevant to the syllabus. 3. Identifying types of algal mixture. 4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth. 5. Field visit to study fresh water/marine water algal habitats. 6. Visit to nearby industry actively engaged in algal technology.	
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 Texts	1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (10^{th} ed).Rastogi Publications, Meerut. 3. Round, FE. 1984.The Ecology of Algae. Cambridge University Press. 4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. 5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books:	1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying 2. manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London. 4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. 5. Dehradun. Edwardlee, R. 2018. Phycology, 5^{th} Ed., Cambridge University Press, London.
Web resources:	1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id= 8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ 5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&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	3	2	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	2	2	3	3	3	2	3

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

FOUNDATION COURSE FOR BOTANY

BASICS OF BOTANY

Title of the Course	**BASICS OF BOTANY**						
Paper Number	Foundation Course						
Category	Elective	**Year**	**I**	**Credits**	2	**Course Code**	
		Semester	**I**				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**-**		**-**	**2**	
Pre-requisite		To recall the students about the basic aspects of botany.					

Learning Objectives	
C1	To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
C2	To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
C3	To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
C4	Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
C5	Understanding of laws of inheritance, genetic basis of loci and alleles.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
4. Compare the structure and function of cells and explain the development of cells.	K4
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	CONTENTS
I	**BIODIVERSITY** Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.
II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) – Light, Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane, Plastids, Ribosomes.
III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance.
V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations - Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
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 Texts	1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi. 6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference books	1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi. 2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd. 3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi. 4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi. 5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. 6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.

Web Resources	1.https://www.kobo.com/us/en/ebook/the-algae-world 2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/ 5.https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 6. https://www.us.elsevierhealth.com/medicine/cell-biology 7. https://www.us.elsevierhealth.com/medicine/genetics

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	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	1	3
CO 4	3	3	2	3	3	3	3	2	3	3
CO 5	3	2	2	2	2	2	2	1	2	2

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

SEMESTER – II

CORE COURSE - II PLANT DIVERSITY II

FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Title of the Course		**Plant Diversity – II Fungi, Bacteria, Viruses, Plant Pathology And Lichens**					
Paper Number		CORE COURSE - II					
Category	Core II	**Year**	**I**	**Credits**	**5**	**Course Code**	
		Semester	**II**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		5		**-**	**--**	**5**	
Pre-requisite		Students should be familiar with the basics of fungi, bacteria, viruses and lichens.					

Learning Objectives	
C1	To describe the common characteristics of fungi as being heterotrophic, unicellular/ multicellular.
C2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles
C3	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.
C4	To identify the main groups of plant pathogens, their symptoms.
C5	To understand the various types of plant diseases.

Course outcomes:	**On completion of this course, the students will be able to: CO**	**Programme outcomes**
CO1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
CO 2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.	K2
CO 3	Identify the common plant diseases, according to geographical locations and device control measures.	K3
CO 4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
CO 5	Determine the economic importance of microbes, fungi and lichens.	K5

UNIT	EXPERIMENTS
I	**FUNGI** Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of the following classes. Zygomycotina (*Mucor*), Ascomycotina (*Peziza*), Basidiomycotina (*Puccinia*) and Deuteromycotina (*Cercospora*). Mycorrhiza and its importance in association.
II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Mycotoxins. Food spoilage.
III	**BACTERIA, VIRUS:** General characters, Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction of TMV.
IV	**PLANT PATHOLOGY:** Classification of plant diseases, symptoms of diseases, Koch's postulates, defense mechanism in plants and the study of the following diseases. **Bacterial diseases –** Citrus canker and Bacterial wilt of Banana **Viral diseases –** Tobacco Mosaic and Vein clearing of Papaya **Fungal diseases –** Blast disease in rice and Tikka disease
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction, with special reference to *Usnea*. **Economic importance of Lichens**: Food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicinal importance, biodegradation agent, air pollution and biomonitoring, soil formation, Harmful aspects, poison from lichens.
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 Texts	1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology. 2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi. 3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India. 7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore. 2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge. 3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi. 4. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London. 5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi. 6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi. 7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi. 8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi. 9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH. 10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company
Web Resources	1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE 2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html 3. http://www.freebookcentre.net/Biology/Mycology-Books.html 4. https://www.kobo.com/us/en/ebook/introduction-to-fungi 5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html 6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

Mapping with Programme Outcomes:

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

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

CORE- PRACTICAL - II PLANT DIVERSITY II
FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Title of the Course	**PRACTICAL - II PLANT DIVERSITY** – II **FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**						
Paper Number	CORE PRACTICAL - II						
Category	Core	**Year**	**I**	**Credits**	**3**	**Course Code**	
		Semester	**II**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	**-**	**3**	**3**

Pre-requisite	Students should be familiar with the basics of fungi and lichens.

Learning Objectives	
C1	To enable students to identify microscopic and macroscopic fungi.
C2	To prepare microslides of fungi and lichens.
C3	To know the presence of pathogen inside the plant tissues through microscopic sections.
C4	To identify the bryophytes based on the morphology, and microslides.
C5	To know the economic importance of the microbes studied.

Course outcomes On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Identify microbes, fungi and lichens using key identifying characters	K1
2. Develop practical skills for culturing and cultivation of fungi.	K2
3. Identify and select suitable control measures for the common plant diseases.	K3
4. Analyze the characteristics of microbes, fungi and plant pathogens	K4
5. Access the useful role of fungi in agriculture and pharmaceutical industry.	K5

EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations.
2. Identifying the micro slides relevant to the syllabus.
3. Herbarium specimens of bacterial diseases/photograph.
4. Inoculation techniques for fungal culture (Demonstration only).
5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
6. Visit to fungal biotechnology laboratories.
7. Ultra structure of bacteria.
8. Structure of bacteriophage.
9. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
10. Study of thallus and reproductive structures (apothecium) through permanent slides.
11. Economic importance of Lichens - Dye and perfume.

Recommended Texts:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers andDistributors (P) Ltd., New Delhi, India.
3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge UniversityPress, Cambridge.
4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.

Reference Books:

1. Alexopoulos, J and Mims, W. 1985. Introductory Mycology, Wiley Eastern Limited New Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10th ed).Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.

Web resources:

1. https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4
2. https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_esc=y
3. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfhs9b
4. https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y
5. https://www.kobo.com/us/en/ebook/introduction-to-fungi

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - I / NAAN MUDHALVAN

BOTANICAL GARDEN AND LANDSCAPING

<table>
<tr><td>Title of the Course</td><td colspan="8">BOTANICAL GARDEN AND LANDSCAPING</td></tr>
<tr><td>Paper Number</td><td colspan="8">Skill Enhancement- 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC-I</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2" colspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2">2</td><td>-</td><td>-</td><td colspan="3">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">Students should know about the fundamental concepts of gardening and landscaping.</td></tr>
<tr><td colspan="9">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="8">To know about the fundamental concepts of gardening and landscaping.</td></tr>
<tr><td>C2</td><td colspan="8">To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.</td></tr>
<tr><td>C3</td><td colspan="8">To illustrate the significance of garden adornments and propagation structures.</td></tr>
<tr><td>C4</td><td colspan="8">To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.</td></tr>
<tr><td>C5</td><td colspan="8">To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.</td></tr>
<tr><td>Course outcomes:
On completion of this course, the students will be able to:CO</td><td colspan="8">Programme Outcomes</td></tr>
<tr><td>1. Recognize fundamental concepts of gardening and landscaping.</td><td colspan="8">K1</td></tr>
<tr><td>2. Explain about significance of garden adornments and propagation structures.</td><td colspan="8">K2</td></tr>
<tr><td>3. Apply techniques of landscaping for</td><td colspan="8">K3
& K6</td></tr>
</table>

aesthetic purposes and gardening for recreation.	
4. Distinguish between formal, informal and free style gardens and their applications.	K4
5. Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	K5 & K6

UNIT	CONTENTS
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.
II	Flower arrangement: importance, production EXPERIMENTS and cultural operations, constraints, postharvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.
III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.
IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).

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 Texts	1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd. 3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency 4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I – IV, Deep And Deep Publ. Pvt. Ltd. 5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
Reference Books	1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books. 2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). 4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 5. Edment Senn Andrews. 1994. Fundamentals of Horticulture.Tata. McGraw Hill Publishing Co., Ltd., Delhi.
Web resources	1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden 2. https://www.overdrive.com/subjects/gardening 3. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers 4. https://www.scribd.com/book/305542619/Botanic-Gardens 5. https://www.overdrive.com/subjects/gardening

Mapping with Programme Outcomes:

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

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

SEMESTER - III
CORE COURSE –III
PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES

<table>
<tr><td>Title of the Course</td><td colspan="7">PLANT DIVERSITY-III
BRYOPHYTES AND PTERIDOPHYTES</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE COURSE - III</td></tr>
<tr><td>Category</td><td>Core</td><td>Year</td><td>II</td><td>Credits</td><td>5</td><td>Course Code</td><td></td></tr>
<tr><td></td><td></td><td>Semester</td><td>III</td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">5</td><td>-</td><td colspan="2">-</td><td>5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Students should be familiar with the basics of Bryophytes and Pteridophytes.</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="7">To enable the students to have an overview of Non-vascular and Vascular cryptogams.</td></tr>
<tr><td>C2</td><td colspan="7">To understand the morphological diversity of Bryophytes and Pteridophytes.</td></tr>
<tr><td>C3</td><td colspan="7">To know the evolution of Bryophytes and Pteridophytes.</td></tr>
<tr><td>C4</td><td colspan="7">To understand the economic importance of the Bryophytes and Pteridophytes.</td></tr>
<tr><td>C5</td><td colspan="7">To understand anatomy and reproduction of Bryophytes and Pteridophytes.</td></tr>
<tr><td>Course outcomes:
On completion of this course, the students will be able to:
CO</td><td colspan="7">Programme Outcomes</td></tr>
<tr><td>1. Recognize morphological variations of Bryophytes and Pteridophytes.</td><td colspan="7">K1</td></tr>
<tr><td>2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.</td><td colspan="7">K2</td></tr>
<tr><td>3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and</td><td colspan="7">K3</td></tr>
</table>

Pteridophytes.	
4. Decipher the stages of plant evolution and their transition to land habitat.	K4
5. Access the useful role of Bryophytes and Pteridophytes.	K5

UNIT	EXPERIMENTS
I	**BRYOPHYTES** General characters of Bryophytes, classification (Watson, 1971) (up to family). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Riccia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*). Evolution of Bryophytes
III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homospory and heterospory.
IV	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*).
V	Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance of Pteridophytes.
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 Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101. 3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press. 4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India. 5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
Reference Books	1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai. 2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad. 3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai 4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai. 5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK. 6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad. 7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Central Book Depot, Allahabad.
Web Resources:	1. http://www.bryoecol.mtu.edu/ 2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx 5. http://www.botany.ubc.ca/bryophyte/mossintro.html 6. aeTIUC&redir_esc=y

Mapping with Programme Outcomes:

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

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

CORE PRACTICAL - III
PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	**PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III**						
Paper Number	CORE PRACTICAL - III						
Category	Core	**Year**	**II**	**Credits**	**3**	**Course Code**	
		Semester	**III**				
Instructional Hours per week	**Lecture**		**Tutorial**	**Lab Practice**		**Total**	
	-		**-**	**3**		**3**	
Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.						

Learning Objectives	
C1	To enable students gain expertise in hand sectioning technique.
C2	To study diversity of Bryophytes and Pteridophytes.
C3	To understand the anatomical structure of the Bryophytes and Pteridophytes.
C4	Develop comprehensive skills in sectioning and micro preparation.
C5	Describe the structure of fossil forms prescribed in the syllabus.
Course outcomes: On successful completion of this course the student will be able to: CO	**Programme Outcomes**
1.Recognize the major groups of Non-vascular and Vascular cryptogams	K1
2.Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2
3.Identify and illustrate the morphological	K3

and anatomical features of bryophytes and Pteridophytes.	
4.Develop comprehensive skills in sectioning and micro preparation.	K4
5.Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5

EXPERIMENTS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida *Riccia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*) (need not study developmental aspects).

Pteridophytes

3. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus.
   Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*).
4. Identifying the micro slides relevant to the syllabus.
5. Botanical excursion.

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 Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. 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. 4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India. 5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.
Reference Books	1. 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. 2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi. 4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai. 5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.
Web resources	1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4 2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html 4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual 5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES SEC - II

HERBAL TECHNOLOGY

Title of the Course	**HERBAL TECHNOLOGY**						
Paper Number	Skill Enhancement Course SEC - II						
Category	Elective	**Year**	**II**	**Credits**	2	**Course Code**	
		Semester	**III**				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		2	-	-	2		
Pre-requisite		To understand the importance of herbal technology.					

Learning Objectives	
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
C4	To apply the knowledge to cultivate medical plants.
C5	To know the pharmacological importance of medicinal plants.
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Define and describe the principle of cultivation of herbal products.	K1
2. List the major herbs, their botanical name and chemical constituents.	K2
3. Apply techniques for monitoring	K3

drug adulteration through the biological testing.	
4. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
5. Develop the skills for cultivation of plants and their value added processing / storage	K5 & K6
UNIT	**CONTENTS**
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and a brief outline of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.
II	Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.
III	Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Andrographis paniculata, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.
IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (*Withania somnifera*, neem and tulsi),

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 Texts	1. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India. 2. Evans, W.C. 2009: Trease and Evans PHARMACOGNOSY. 16th Edition, SAUNDERS / Elsevier. 3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources.. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages. 4. Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition . 5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pune.
Reference Books	1.Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17. 2. Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur. 3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88. 4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000. 5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.
Web resources	https://www.kopykitab.com/Herbal-Science https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/ N-ry0Z8qaZ11iu http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404 https://www.dattanibookagency.com/books-herbs-science.html https://www.springer.com/gp/book/9783540791157

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
CO 2	3	3	3	3	3	3	3	1	3	1
CO 3	3	3	3	3	3	3	3	2	3	2
CO 4	3	3	3	3	3	3	3	1	3	1
CO 5	3	3	3	3	3	3	3	1	3	1

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

SKILL ENHANCEMENT COURSES SEC - III
NAAN MUDHALVAN / ENTREPRENEURIAL SKILL

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course	**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**						
Paper Number	Skill Enhancement Course SEC - III						
Category	Elective	**Year**	**II**	**Credits**	**2**	**Course Code**	
		Semester	**III**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		**-**	**-**	**2**	
Pre-requisite		To understand the concept of Entrepreneurial Opportunities in Botany.					

C1	To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.
C2	To create a mindset among students to start their own companies for income generation.
C3	The students may understand about various fields of botany.
C4	To develop the concept of Entrepreneurial Opportunities in Botany.
C5	Describe the new strategies to describe marketing and business management strategy.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to how various fields of botany could be understood with an Entrepreneurial approach.	K1
2. Explain the concept of Entrepreneurial Opportunities in Botany.	K2
3. Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	K3
4. Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
5. Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	K5 & K6

UNIT	**CONTENTS**
I	**INTRODUCTION TO ENTREPRENEURSHIP** Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.

II	**TOOLS AND TECHNIQUES** Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.
III	**NEW VENTURE CREATION** Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
IV	**PRODUCT DEVELOPMENT AND COMMERCIALIZATION** Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
V	**BIO-BUSINESS PLANS, IPR AND BIOETHICS** Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
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 Texts	1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India. 2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications.

	Chennai, India. 3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA. 4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture. 5. Sathe,T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
Reference books	1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK. 2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4.Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge UniversityPress, Cambridge
Web sources	1.https://www.brainkart.com/article/Entrepreneurial-Botany_38321/ 2.https://www.youtube.com/watch?v=hnBla1FfcLo 3.https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation 4.http://www.brainkart.com/article/Economically-Useful-Plants-andEntrepreneurial-Botany_38301 4. https://www.ebooks.com/en-us/subjects/gardening/ 5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes:

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

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

SEMESTER – IV

CORE COURSE -IV

PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**						
Paper Number	CORE COURSE - IV						
Category	Core	**Year**	**II**	**Credits**	**5**	**Course Code**	
		Semester	**IV**				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	5	**-**	**-**	**5**			
Pre-requisite	Students should know about the fundaments of Gymnosperms, fossil records and evolution.						
Learning Objectives							
C1	To enable the students to understand thallus organization,						
C2	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.						
C3	to acquaint students with evidences of the past history of plant groups and significance of the fossilization.						
C4	To know the scope of palaeobotany, types of fossils and geological time scale.						
C5	Understand the various fossil genera representing different fossil groups.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
1. Relate to the general characteristics of Gymnosperms and fossil forms	K1						
2. Explain about the morphology and anatomy Gymnosperms.	K2						
3. Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3						
4. Analyze	K4						

the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	
5. Determine the various fossilization methods and their significance in paleobotany.	K5

UNIT	CONTENTS
I	**GYMNOSPERMS** Classification of Gymnosperms (Sporne, 1965). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
II	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).
III	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni
IV	P**ALEOBOTANY** Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
Extended Professional Component	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)

(is a part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra. 2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi. 3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India. 4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Reference Books	1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi. 2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi. 3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press. 4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Web Resources	1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false 2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y 3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC 4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 5. https://www.palaeontologyonline.com/

Mapping with Programme Outcomes:

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

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

CORE PRACTICAL - IV

PLANT DIVERSITY - IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the Course		**PLANT DIVERSITY - IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL - IV**					
Paper Number		CORE VIII					
Category	Core	**Year**	**II**	**Credits**	**3**	**Course Code**	
		Semester	**IV**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**		**Total**
		-		**-**	**3**		**3**
Pre-requisite		Students should be familiar with the fundamentals of Gymnosperms, Paleobotany.					
Learning Objectives							
C1		To enable students observe and record the morphological features of selected species of Gymnosperms.					
C2		To enable students observe and record the anatomical features of selected species of Gymnosperms.					
C3		To develop the skill of preparation of microslides of the gymnosperm samples.					
C4		To enable students to gain insights into the basics of paleobotany and methods of fossilization.					
C5		To understand the anatomy of the fossil plants through microscopy.					
Course outcomes: On completion of this course, the students will be able to: CO		**Programme Outcomes**					
1. Analyze and observe and record the morphological features of selected species of Gymnosperms..		K1					
2. Describe the structure of fossil forms prescribed in the syllabus.		K2					
3. Identify		K3					

and Illustrate the morphological and anatomical features of gymnosperms.	
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in gymnosperms.	K5

EXPERIMENTS

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas*, *Pinus* and *Gnetum.*

2. Identifying the micro slides relevant to the syllabus.

3. Field visit to study the habitat (Hill station).

Study the following fossil members: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* and *Williamsonia sewardiana* through permanent slides.

2. Photograph of evolution scientists.

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 Texts	1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan. 2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New

	Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
Reference Books	1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi. 2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.
Web resources	1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover 2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721 3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ 4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES - SEC – V
NAAN MUDHALVAN / FERMENTATION TECHNOLOGY

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">FERMENTATION TECHNOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Skill Enhancement Course – SEC - V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>II</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>IV</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td colspan="2">-</td><td>-</td><td colspan="2">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="7">To students to know about the various fermentation technology.</td></tr>
<tr><td colspan="9">Learning Objectives</td></tr>
<tr><td colspan="2">C1</td><td colspan="7">To appreciate the significance of microbes synthesizing fermented products.</td></tr>
<tr><td colspan="2">C2</td><td colspan="7">To gain insights on safety and quality control in large scale production of fermentative products.</td></tr>
<tr><td colspan="2">C3</td><td colspan="7">To design and operation of industrial practices in mass production of fermented products.</td></tr>
<tr><td colspan="2">C4</td><td colspan="7">To know about the various fermentation technology.</td></tr>
<tr><td colspan="2">C5</td><td colspan="7">To learn about the bioproduct recovery.</td></tr>
<tr><td colspan="2">Course outcomes:

On completion of this course, the students will be able to:
CO</td><td colspan="7">Programme Outcomes</td></tr>
<tr><td colspan="2">1. Enumerate the significance of industrially useful microbes.</td><td colspan="7">K1</td></tr>
<tr><td colspan="2">2. Explain the design and operation of industrial practices in mass production of fermented products.</td><td colspan="7">K2</td></tr>
<tr><td colspan="2">3. Explain the process of</td><td colspan="7">K3</td></tr>
</table>

maintenance and preservation of microorganisms.	
4. Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
5. Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6

UNIT	CONTENTS
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
IV	Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.
Extended Professional Component (is a part of internal	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)

component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK. 2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA. 3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA. 4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India. 5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK. 6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
Reference Books	1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK. 2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press. 3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA. 4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany. 5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK. 6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY. 7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.
Web resources	1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html 2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ 3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W 4. https://www.pdfdrive.com/principles-of-fermentation-technology-

	e189052809.html 5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

Mapping with Programme Outcomes:

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

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

CORE COURSE – V

PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	**CORE COURSE – V**						
Category	Core	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**V**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**		**Total**
		5		**-**	**-**		**5**
Pre-requisite		Prior knowledge on morphological, anatomical characteristics and uses of plants.					
Learning Objectives							
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.						
C2	Students will know about the basic concepts of classification of plants.						
C3	Understand major evolutionary trends in Angiospermic plants.						
C4	To know the characteristic features of the selected families.						
C5	To know the economic importance of plants.						
Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**						
1. Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1						
2. Classify systems of plant classification and recognize the importance of herbarium and virtual	K2						

herbarium.	
3. Describe the core concepts of economic Botany and relate its applications in human life.	K3
4. Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
5. Assess terms and concepts related to Phylogenetic Systematics.	K5

UNIT	CONTENTS
I	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.
II	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification and APG IV. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.
III	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
V	Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).

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 Texts	1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London. 4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Weslley Publicating Co. Ind USA. 5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. 6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey. 7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
Reference Books	1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London. 2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta 3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh. 4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York. 5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London. 6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA. 7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.
Web Resources	1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y

	2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y 3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y 4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y 5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&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	1	2
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	3	2	1
CO 4	3	3	3	3	3	2	3	2	2	3
CO 5	3	3	2	3	2	3	3	3	3	3

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

CORE COURSE - VI PLANT ANATOMY AND EMBRYOLOGY

Title of the Course	**PLANT ANATOMY AND EMBRYOLOGY**						
Paper Number	**CORE COURSE - VI**						
Category	Core	**Year**	**III**	**Credits**	**4**	**Course Code**	
		Semester	**V**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		5		**-**	**-**	**5**	
Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.						
Learning Objectives							
C1	To know fundamental concepts of plant anatomy and embryology.						
C2	To understand the internal tissue organization of various plant organs.						
C3	To differentiate normal and abnormal secondary growth.						
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.						
C5	To know embryology of plants.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1						
2. Describe the internal tissue organization of various plant organs.	K2						

3. Elucidate the stages of normal and abnormal secondary growth.	K3
4. Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
5. Access the various anatomical adaptations in plants.	K5
UNIT	**CONTENTS**
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in oot and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- *Boerhaavia*, *Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule**,** types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac.
V	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

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 Texts	1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas. 2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4^{th} revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge. 4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York. 5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi. 6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi. 7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi. 8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.
Reference Books	1. Esau, K. 1985. Anatomy of Seed Plants –John Willey. 2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co.. 3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd., 4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd. 5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA. 6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA. 7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA. 8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the

	Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency. 9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi
Web Resources	1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2 2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811 6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&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	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

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

CORE COURSE - VII CELL BIOLOGY, GENETICS AND PLANT BREEDING

Title of the Course	**CELL BIOLOGY, GENETICS AND PLANT BREEDING**						
Paper Number	**CORE COURSE - VII**						
Category	Core	**Year**	**III**	**Credits**	**4**	**Course Code**	
		Semester	**V**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**-**	**-**	**4**

Pre-requisite	To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.

Learning Objectives

C1	To enable students to gain insights into cell wall organization and its functions.
C2	To familiarize with various cell organelles and their functions.
C3	To gain knowledge in classical genetics.
C4	To know about sex linked inheritance.
C5	To have knowledge about plant breeding techniques for crop improvement.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Enumerate the structure and functions of cells, cellular structures and organelles.	K1
2. Explain about cell cycle, cell division and laws of inheritance with suitable examples.	K2
3. Elucidate concepts of sex determination and sex linked inheritance.	K3
4. Analyze the importance of genes interactions at population and evolutionary levels.	K4
5. Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.	K5

UNIT	**CONTENTS**
I	Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.
II	Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin,

	heterochromatin, Polytene and Lampbrush chromosomes-, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.
III	Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalaba.* Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex determination in plants.
IV	Sex linked inheritance – Haemophilia and colour blindness. Polyploidy origin, types and significance. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation . Extra nuclear inheritance and its significance - Male sterility in corn , Maternal inheritance – Plastid Inheritance in *Mirabilis jalaba*. Genetics of *Neurospora*. Population genetics – Hardy – Weinberg principle.
V	Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects. Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.
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 Texts	1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55. 2. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi. 3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co. 4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA. 5. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.

Reference Books	1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York. 3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California. 4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA. 5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco. 6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A. 7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223. 8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
Web Resources	1. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html 2. https://www.us.elsevierhealth.com/medicine/cell-biology 3. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A 4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html 5. https://www.us.elsevierhealth.com/medicine/genetics 6. https://libguides.uthsc.edu/genetics/ebooks 7. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding 8. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson

Mapping with Programme Outcomes:

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

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

CORE PRACTICAL – V - COVERING CORE PAPERS - CORE V, VI AND VII

<table>
<tr><td>Title of the Course</td><td colspan="7">PRACTICAL - V</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE PRACTICAL – V</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>V</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td colspan="2">-</td><td>-</td><td>6</td><td colspan="2">6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Theoretical understanding of anatomy, embryology, cell biology, genetics and plant breeding as well as basic laboratory skills for the relevant core course.</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td colspan="2">C1</td><td colspan="6">To study morphological characters of the families and able to describe the plant technically using the floral characteristics.</td></tr>
<tr><td colspan="2">C2</td><td colspan="6">To preserve the plants and prepare herbarium sheets and able to identify the local flora. To understand the economic importance of the plants.</td></tr>
<tr><td colspan="2">C3</td><td colspan="6">To study the anatomy of the plant organs and the embryology of the plant.</td></tr>
<tr><td colspan="2">C4</td><td colspan="6">To identify the structure of various cell organelles. To understand genetics through problem solving.</td></tr>
<tr><td colspan="2">C5</td><td colspan="6">To study various plant breeding techniques.</td></tr>
<tr><td colspan="2">Course outcomes:
On completion of this course, the students will be able to:
CO</td><td colspan="6">Programme Outcomes</td></tr>
<tr><td colspan="2">1. Recognize the distinguishing plant morphological characters. Identify locally available plants to their respective families</td><td colspan="6">K1</td></tr>
<tr><td colspan="2">2. Develop comprehensive skills in field identification,</td><td colspan="6">K2</td></tr>
</table>

collection of specimens, writing technical description, botanical drawings and herbaria preparation. Construct floral diagram and write floral formula for a given flower.	
3. Identify the structure of cell organelles and stages of cell division Classify the types of stomata and ovules.	K3
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization. Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.	K4
5. Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	K5

EXPERIMENTS

Taxonomy

1. Morphology of root, stem and leaf modification, types of inflorescence.
2. Plants of local flora included under theory syllabus and family identification and derivation based on reasoning.
3. Dissection, identification, observation and sketching the floral parts of the plants belonging to the families included in the syllabus.
4. Students must describe the floral parts, draw the L.S., floral diagram and write the floral formula of at least one flower from each family.
5. Twenty (20) Herbarium sheets, field notebook and bonafide record to be submitted.
6. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
7. Field trips to places for observation, study and collection of plants prescribed in the syllabus for 2 to 5 days under the guidance of faculties to any floristic regions with in India.

Anatomy

1. Study of simple and complex (Primary and Secondary) tissues by maceration.
2. Study the internal structure of primary (young) and secondary (old) stems. Internal structure of dicot and monocot stem. Internal structure of dicot and monocot root.
3. Anomalous secondary growth in the stems of *Boerhaavia, Nycthanthes* and *Dracaena*.
4. T.S of dicot and monocot leaves.
5. Study of stomatal types.

Embryology

1. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
2. Observation of pollinia (slide only).
3. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides).
4. Types of Endosperm - Nuclear, cellular and helobial.

Dissection and display of any two stages of embryo in *Tridax*

Cell biology

1. Study of the photomicrographs of cell organelles.
2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide.
3. Study the polytene and lamp brush chromosome structure through photograph.
4. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.

Genetics 1. Genetic problems – test cross, back cross and allelic interaction. 2. Construction of chromosome map – three point test cross **3.** Multiple alleles problems.	
Plant Breeding 1. Emasculation technique. 2. To test the viability of seeds using Tetrazolium chloride. 3. Genetic models of heterosis. 4. Phenotype of heterosis (Maize).	
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 Texts	1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi. 2. 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. 3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691. 4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut. 5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning. 6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
Reference Books	1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668. 2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons. 3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall. 4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John

	Wiley & Sons, New York. 5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA. 6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
Web resources	1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509 2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_ Em.html?id =Cq1KPwAACAAJ&redir_esc=y 3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219 4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X 5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498

Mapping with Programme Outcomes:

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

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

MAJOR BASED ELECTIVE COURSE - I

BIO-ANALYTICAL TECHNIQUES

Title of the Course	**BIO -ANALYTICAL TECHNIQUES**						
Paper Number	Major Based Elective - I						
Category	Elective	**Year**	**III**	**Credits**	**3**	**Course Code**	
		Semester	**V**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		4		-	-	4	
Pre-requisite		To impart expertise about analysis and research.					

Learning Objectives	
C1	To understand the principle, operation and maintenance of various tools/equipment in the laboratory.
C2	Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.
C3	To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.
C4	To give an exposure to various forms of field research and data analysis techniques.
C5	To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the various biological techniques and its importance.	K1
2. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	K2
3. Apply suitable	K3&

strategies in data collections and disseminating research findings.	K6
4. Compare and contrast the significance of different types of chromatography techniques.	K4
5. Develop methodologies for extraction and analysis of biochemical compounds.	K5

UNIT	CONTENTS
I	**MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.
II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	**SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:** Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	**BIOSTATISTICS:** Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.
Extended Professional Component (is a part of internal compon	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)

ent only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi. 2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House. 3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications. 4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi. 5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications. 6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.
Reference Books	1.Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications. 2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A. 3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi. 4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi. 5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York. 6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London. 7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. Ltd. 8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi. 9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England Cliffs, New Jersy.
Web Resources	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://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-Khandpur-ebook/dp/B0129ZDO9W?ref=kindlecontentin50-21&tag=kindlecontentin50-21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpY8D9JNpJZsOc

	XQCQ4pZlRzTrYH2lopaVP1xxoClPgQAvD_BwE 5. https://www.kobo.com/us/en/ebooks/biostatistics 6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG

Mapping with Programme Outcomes:

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

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

MAJOR BASED ELECTIVE COURSE - II

HORTICULTURE

Title of the Course	**HORTICULTURE**						
Paper Number	Major Based Elective - II						
Category	Elective	**Year**	**III**	**Credits**	**3**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		4		-	-	4	
Pre-requisite	Students should know fundamental knowledge on horticulture applications.						
Learning Objectives							
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.						
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.						
C3	To know about hydroponic culture.						
C4	To develop the various horticultural crop protection.						
C5	To impart the knowledge on market preparation.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
1. Enumerate the concepts in horticulture and nursery management.	K1						
2. Demonstrate a working knowledge on biology of soil, compost making, designing and planning of	K2						

garden, pest, diseases and nutrient management practices.	
3. Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
4. Analyze different methods of weed control in horticultural crops.	K4
5. Develop their competency on pre and post-harvest technology in horticultural crops.	K5 & K6

UNIT	CONTENTS
I	Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management **-** Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures**:** Protected cultivation (greenhouses), environment controls.
II	Hydroponic culture**-**types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.
III	Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation **-** cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
IV	A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery

	plants, bonsai techniques. Landscaping, principles and basic components.
V	Technology of horticultural crops **-** market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and canning, drying and chemical preservation.
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 Texts	1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – principles and practices. Half of India. New Delhi. 2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash. 3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi. 4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi. 5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta. 6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore. 7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi
Reference Books	1.Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca. 2. Bailey, S. 1971. Perpectual flowering carnation, Fabner and Fabner, London. 3. Laurie, A., Kiplingr, D.D and Nelson, K.S. 1968. Commercial flower forcing. Mc Graw-Hill Book, London. 4. Cumming, R.W. 1964. The chrysanthemum Book. D.Van., Nostrand Inc. 5. Biswas, T.D. 1984. Rose growing – Principles and Practices – Assoc., Pub., Co., New Delhi. 6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall

	Ltd., New Delhi. 7. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum. 8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta. 9. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., London. 10. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening Chartwell Book, Inc., New Jercy.
Web Resources	1.https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK 2. https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/ 3. http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/ 4. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648 5. https://cbseportal.com/ebook/vocational-books-horticulture 6. http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

Mapping with Programme Outcomes:

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

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

SKILL ENCHANCEMENT COURSE SEC - VI / NAAN MEDHALVAN
AQUATIC BOTANY

Title of the Course	**AQUATIC BOTANY**						
Paper Number	SEC- IV						
Category	Elective	**Year**	**III**	**Credits**	**2**	**Course Code**	
		Semester	**V**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		**-**	**-**	**2**	
Pre-requisite		To understand ecological functions and economic uses of aquatic plants.					

Learning Objectives	
C1	To give an overview of the distribution of lower plants forms and its ecological significance.
C2	To enable students to understand the ecological functions and economic uses of aquatic plants.
C3	To equip students to collect, analyze and identify the planktons.
C4	To give an exposure to various forms seaweeds.
C5	To know about the values and uses of aquatic plants..
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize aquatic plants and their ecological importance.	K1
2. Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
3. Apply techniques for conservation of	K3

aquatic plants for value addition.	
4. Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
5. Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.	K5 & K6

UNIT	CONTENTS
I	**MARINE AND LIMNETIC MACRO ALGAE:** Common seaweeds of Indian subcontinent: *Ulva, Caulerpa, Sargassum, Gracilaria,* etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: *Anabaena, Chlorella, Scenedesmus.*
II	**MANGROVES:** Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including *Avicennia, Rhizophora, Acanthus* and *Aegiceras*. Ecological significance of mangroves.
III	**PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS:** Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.
IV	**AQUATIC ANGIOSPERMS:** Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
V	**VALUES AND USES OF AQUATIC PLANTS:** Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.
Extended	Questions related to the above topics, from various competitive examinations

Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	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 Texts	1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge. 2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International. 3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press. 5. Daubenmire, R.F.1973. Plant and Environment. John Willey. 6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi. 7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.
Reference Books	1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited. 2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands. 3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp. 4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp. 5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp. 6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf 2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf 3. https://www.springer.com/gp/book/9788132221777 4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf 5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

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	1
CO 2	3	2	1	1	2	3	2	3	2	3
CO 3	2	2	3	1	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	1	2	3	2
CO 5	3	2	1	1	2	3	3	3	2	3

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

CORE COURSE - VIII PLANT ECOLOGY AND PHYTOGEOGRAPHY

Title of the Course	**PLANT ECOLOGY AND PHYTOGEOGRAPHY**						
Paper Number	CORE COURSE - VIII						
Category	Core	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		6		-	-	6	
Pre-requisite	Understanding the environmental factors impacting biodiversity is crucial after taking this course.						
Learning Objectives							
C1	To relate to the significance of the biotic and abiotic components of the ecosystems.						
C2	To understand the energy flow in ecosystem.						
C3	To conceptualize the biodiversity.						
C4	To know implication of pollution on the environment.						
C5	To familiarize with the phytogeography.						
Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**						
1. Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1						
2. Summarize the phytogeographical division of India.	K2						
3. Explain the implication of pollution on the environment.	K3						

4. Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.	K4
5. Develop mitigations for the effective conservation of biodiversity and disaster management.	K5
Unit	**CONTENTS**
I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation. Loss of biodiversity – causes and conservation (*In situ* and *ex situ* methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.
IV	**Pollution:** Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.

V	**Phytogeography Introduction**, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance.
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 Texts	1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition. 3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd., 4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd., 5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.
Reference Books	1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd., 4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems. 5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons. 6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA. 7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi. 8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK. 9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland. 10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS

	Publishers Distributors.
Web Resources	1. https://www.kobo.com/us/en/ebook/plant-ecology-3. 2. https://www.worldcat.org/title/plant-ecology/oclc/613206385 3. https://books.google.co.in/books/about/Plant_Ecology.html? 4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP 5. http://www.freebookcentre.net/Biology/Ecology-Books.html 6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X 7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity) 8. https://link.springer.com/journal/11258 (Plant Ecology)

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	1
CO 2	3	3	2	2	3	3	1	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	1	3	3	3	1
CO 5	3	3	2	3	1	2	3	1	1	2

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

CORE COURSE – IX PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**						
Paper Number	CORE COURSE - IX						
Category	Core	**Year**	**III**	**Credits**	**4**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		5	**-**		**-**	**5**	
Pre-requisite		Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.					
Learning Objectives							
C1	To relate to water relation of plants with respect to various physiological phenomenon.						
C2	To know the pathways of photosynthesis.						
C3	To familiarize with respiration and nitrogen metabolism.						
C4	To know about plant growth regulators.						
C5	To familiarize with plant biochemistry.						
Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**						
1. Relate to water relation of plants with respect to various physiological phenomenon.	K1						
2. Explain the process and significance of photosynthesis and respiration.	K2						
3. Elucidate properties of nutrients and their deficiency symptoms in plants.	K3						
4. Analyze	K4						

the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	
5. Decipher the phenomenon of seed dormancy and germination in plants.	K5

UNIT	CONTENTS
I	**WATER RELATIONS:** Properties of water—imbibition, diffusion, osmosis and plasmolysis- ascent of sap, mechanism of water absorption – active and passive, apoplast and symplast pathway. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of transpiration.
II	**PHOTOSYNTHESIS:** Radiant energy, Photosynthetic unit, photosynthetic pigments and their role, photo systems, path of carbon in photosynthesis - Light reaction, electron transport system in the chloroplast (Z-Scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespiration
III	**RESPIRATION** Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient. **NITROGEN METABOLISM** Biological nitrogen fixation, nitrogen cycle.
IV	**GROWTH:** Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid) - Practical applications - Photo morphogenesis – photoperiodism – vernalization – dormancy- phytochromes. **Stress Physiology:** Concepts of plant responses to stresses (water, salt, temperature).
V	**PLANT BIOCHEMISTRY:** Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.

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 Texts	1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi. 2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi. 3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi. 4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi. 5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi. 6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi. 7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay. 8. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.
Reference Books	1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA. 2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England. 3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA. 4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands. 5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA. 6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, NewYork, USA.

	7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA. 8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA. 9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi. 10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA. 11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.
Web Resources	1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants 2.https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6 3. https://www.kobo.com/us/en/ebook/plant-biochemistry 4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1 5.https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA 6.https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692 7.https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

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
CO 2	3	3	2	2	3	3	2	3	2	3
CO 3	2	2	3	3	1	2	1	3	1	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3

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

CORE PRACTICAL – VI (COVERING CORE PAPER VIII AND IX)

Title of the Course	**PRACTICAL - VI**					
Paper Number	**CORE PRACTICAL - VI**					
Category	Core	**Year**	**III**	**Credits**	**3**	**Course Code**
		Semester	**VI**			
Instructional Hours per week	**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
	-		-	**5**	**5**	
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants.					

Learning Objectives	
C1	To study morphological and anatomical adaptations of plants of various habitats.
C2	To demonstrate techniques of plant tissue culture.
C3	To familiarize with the structure of DNA, RNA.
C4	To carryout experiments related with plant physiology.
C5	To perform biochemistry experiments.
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the distribution and adaptions of plants pertaining to their habitat	K1
2. Demonstrate skills in green planning and callus culture.	K2
3. Elucidate the basic principles involved in the plant physiology and biochemistry experiments.	K3
4. Appreciate the structure and functions of DNA and RNA.	K4
5. Estimate the biochemical components and	K5

determine the factors controlling photosynthesis and transpiration of plants.	

EXPERIMENTS

Plant Ecology and Phytogeography

1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.

   Hydrophytes : *Nymphaea, Hydrilla*
   Xerophytes : *Nerium, Casuarina*
   Mesophytes : *Tridax, Vernonia*
   Halophytes : *Avicennia, Rhizophora*
   Epiphytes : *Vanda*
2. Map of the phytogeographical regions of India.
3. Quadrate study and line transect.
4. Plan for a green building.
5. Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub jungle/Pallikaranai Marsh/Siruthavur Scrub/Vedanthangal Bird Sanctuary/Kelampakkam Marsh/Adyar Poonga).

Plant Physiology and Plant Biochemistry

1. Determination of water potential by plasmolytic method.
2. Effect of chemicals on membrane permeability.
3. Effect of environmental factors on rate of transpiration by gravimetric method.
4. Separation of plant pigments by paper chromatography.
5. Study the rate of photosynthesis under different light intensities by using Willmott's bubble counter.
6. Study of rate of photosynthesis under different wavelengths (red & blue) of light.
7. Comparison of rate of respiration of different respiratory substrates.
8. Measurement of pH of expressed cell sap and different soils using pH meter.
9. Enzyme activity – catalase.

   Biochemical test for carbohydrates, proteins and lipids

Demonstration – Experiments

1. Study the rate of transpiration by using Ganong's photometer
2. Demonstration of stomatal movement.
3. Induction of roots in leaves by auxins.

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 Texts	1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut. 2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. 3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York. 4 Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi. 5 Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai. 6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited,New Delhi. 7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.
Reference Books	1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell. 2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual. 3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida. 4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India). 5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge. 6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition. 7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant

	Physiology andBiochemistry. Scientific Publisher.
Web resources	1. https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK 2. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009 3. https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9 4. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9386102633 5. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318

Mapping with Programme Outcomes:

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

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

MAJOR BASED ELECTIVE COURSE – III
PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

<table>
<tr><td>Title of the Course</td><td colspan="7">PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY</td></tr>
<tr><td>Paper Number</td><td colspan="7">MAJOR BASED ELECTIVE COURSE – III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>5</td><td colspan="2"></td><td>-</td><td colspan="2">5</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="7">To know various aspects of biotechnology</td></tr>
<tr><td>C2</td><td colspan="7">To know the concept and techniques of plant tissue culture.</td></tr>
<tr><td>C3</td><td colspan="7">To familiarize with the gene transfer techniques.</td></tr>
<tr><td>C4</td><td colspan="7">To know about DNA replication and repair.</td></tr>
<tr><td>C5</td><td colspan="7">To familiarize with gene regulation.</td></tr>
<tr><td>Course outcomes: On the completion of the course the students will be able to:
CO:</td><td colspan="7">Programme Outcomes</td></tr>
<tr><td>1. Recognize the fundamentals concepts of plant biotechnology and genetic engineering.</td><td colspan="7">K1</td></tr>
<tr><td>2. Explain various steps in transcription, protein</td><td colspan="7">K2</td></tr>
</table>

synthesis and protein modification.	
3. Elucidate gene cloning and evaluate different methods of gene transfer.	K3
4. Analyze the major concerns and applications of transgenic technology.	K4
5. Develop their competency on different types of plant tissue culture.	K5
UNIT	**CONTENTS**
I	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (*Aspergillus niger*) and Proteases production (*Bacillus sps*).
II	Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropogation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, *Agrobacterium* mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.
	Nature and function of genetic materials, Nucleic acid – base paring – Chargaff's rule, DNA – structure. Types, denaturation - renaturation.

IV	Replication of DNA in prokaryotes. RNA structure and types. DNA repair mechanism.
V	Transcription – Enzymology – RNA polymerase – classes of RNA molecules – transcription in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Gene regulation in Prokaryotes – *lac* operon and *trp* operon
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 Texts	1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice. 2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers. 3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi. 4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. 5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur. 6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag
Reference Books	1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C. 2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi. 3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein. 4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York. 5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York. 6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to

	genetic engineering, Black Well Science Ltd., New York. 7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York. 8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin. 9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin. 10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac million, New York. 11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.
Web Resources	1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html 2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C 3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183 6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html 7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3

Mapping with Programme Outcomes:

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

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

MAJOR BASED ELECTIVE COURSE – IV
FORENSIC BOTANY

Title of the Course	**FORENSIC BOTANY**						
Paper Number	**MAJOR BASED ELECTIVE - IV**						
Category	Elective	**Year**	**III**	**Credits**	**3**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		5		**-**	**-**	**5**	
Pre-requisite	The course will provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.						
Learning Objectives							
C1	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.						
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.						
C3	To learn classification of plants from forensic point of view.						
C4	To understand forensic importance of different parts of plants.						
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.						
Course outcomes: On completion of this course, the students will be able to:CO	**Programme Outcomes**						
1. Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1						
2. Summarize the forensic importance of different parts of plants.	K2						

3. Apply techniques for the collection and preserve of botanical evidences of crime.	K3
4. Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
5. Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6

UNIT	CONTENTS
I	General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.
II	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man–made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
III	Various types of poisonous plants: *Abrus precatorius*, *Aconitum napellus*, *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Claviceps purpuria*, *Croton tiglium*, *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana tabacum*, *Strychnos nux vomica*, *Thevetia nerifolia*. Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, *Psilocybin* mushrooms.
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.

V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.
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 Texts	1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press. 2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition. 3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom. 4. Jane H Bock, David Norris.2015. Forensic Plant Science. Elesvier. 5. Patricia E. J. Wiltshire.2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation. Criminal and Environmental Soil Forensics pp 129–149
Reference Books	1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition. 2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press. 3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley

	Backwell. 4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell. 5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.
Web Resources	1. https://www.kobo.com/us/en/ebook/forensic-botany 2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574 3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/ 4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299 5. http://docshare02.docshare.tips/files/25818/258183613.pdf

M**apping with Programme Outcomes:**

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

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

SKILL ENHANCEMENT COURSE - SEC – VII / NAAN MUDHALVAN

ORGANIC FARMING

<table>
<tr><td>Title of the Course</td><td colspan="7">ORGANIC FARMING</td></tr>
<tr><td>Paper Number</td><td colspan="7">SKILL ENHANCEMENT COURSE - SEC – VII / NAAN MUDHALVAN</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">SEC</td><td>Year</td><td>III</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td>2</td><td>-</td><td>-</td><td colspan="3">2</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Students to gain knowledge on the scope of organic farming and its significance.</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="7">To enable students to gain knowledge on the scope of organic farming and its significance.</td></tr>
<tr><td>C2</td><td colspan="7">To impart practical insights sustainable agriculture, green manuring, recycling and composting.</td></tr>
<tr><td>C3</td><td colspan="7">To understand the physical and chemical properties of soil.</td></tr>
<tr><td>C4</td><td colspan="7">To study sustainable agriculture.</td></tr>
<tr><td>C5</td><td colspan="7">To know about the importance of biofertilizers.</td></tr>
<tr><td>Course outcomes:

On completion of this course, the students will be able to:
CO</td><td colspan="7">Programme Outcomes</td></tr>
<tr><td>1. Recognize the different forms of biofertilizers and their uses.</td><td colspan="7">K1</td></tr>
<tr><td>2. Explain and</td><td colspan="7">K2</td></tr>
</table>

interpret the components, patterns, and processes of bacteria for growth in crop production.	
3. Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	**K3**
4. Analyze and decipher the significance of biofertilizers in soil fertility.	**K4**
5. Develop new strategies to enhance growth and quality check of medicinal herbs	**K5**

considering the practical issues pertinent to India.	
UNIT	**CONTENTS**
I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.
II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost-methods, production and utilization.
IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla* and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.
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 Texts	1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services. 2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. 3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech. 4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta

	Prakashan, Nadiad. 5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
Reference Books	1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers. 3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi. 4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh 5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi
Web Resources	1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY 2. https://www.e-booksdirectory.com/listing.php?category=323 3. http://www.freebookcentre.net/Biology/Agriculture-Books.html 4.https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf 5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

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

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

ELECTIVE ALLIED BOTANY-I

Title of the Course	**ALLIED BOTANY-I**						
Paper Number	Allied Course – Allied Botany - I						
Category	Allied	**Year**	**I**	**Credits**	4	**Course Code**	
		Semester	**I**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**-**	**-**	**4**

Pre-requisite	To study the basics of botany.
Learning Objectives	
C1	To study morphological and anatomical adaptations of plants of various habitats.
C2	To demonstrate techniques of plant tissue culture.
C3	To familiarize with the structure of DNA, RNA.
C4	To carryout experiments related with plant physiology.
C5	To perform biochemistry experiments.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
4. Compare the structure and function of cells and explain the development of cells.	K4
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	**CONTENTS**
I	**Algae:** General characters of algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.
III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.

IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application.

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 Texts	1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference Books:	1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi. 2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd. 3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi. 4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi. 5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. 6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi. 7. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.
Web Resources	1. https://www.kobo.com/us/en/ebook/the-algae-world 2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/ 5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf

	6. https://www.us.elsevierhealth.com/medicine/cell-biology 7. https://www.us.elsevierhealth.com/medicine/genetics 8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

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	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	3	3
CO 4	3	3	2	3	3	3	2	3	2	3
CO 5	3	2	2	2	2	2	2	1	2	1

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

ALLIED BOTANY - II

Title of the Course	**ALLIED BOTANY - II**						
Paper Number	**Allied Course - II**						
Category	**Allied**	**Year**	**I**	**Credits**	**4**	**Course Code**	
		Semester	**II**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4		**-**	**4**

Pre-requisite	To study basics of botany.

Learning Objectives	
C1	To be familiar with the basic concepts and principles of plant systematics.
C2	Learn the importance of plant anatomy in plant production systems.
C3	Understand the mechanism underling the shift from vegetative to reproductive phase.
C4	To learn about the physiological processes that underlie plant metabolism.
C5	To know the energy production and its utilization in plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Understand the fundamental concepts of plant anatomy and embryology.	**K1**
2. Analyze and recognize the different organs of plants and secondary growth.	**K2**
3. Understand water relation of plants with respect to various physiological processes.	**K3**
4. Classify aerobic and anaerobic respiration.	**K4**
5. Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	**K5**

UNIT	**CONTENTS**
I	**MORPHOLOGY OF FLOWERING PLANTS:** Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.
II	**TAXONOMY:** Outline of Bentham and Hooker's system of classification**,** Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae
III	**ANATOMY** Tissue and tissue systems (epidermal, fundamental and vascular): Simple (parenchyma, collenchymas, sclerenchyma) and complex tissues (xylem and phloem). Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.

IV	**EMBRYOLOGY** Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.
V	**PLANT PHYSIOLOGY** Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.

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

Recommend Texts

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2. 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.
3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.

Reference books

1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi.

Web Resources

1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG

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	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	2

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

ALLIED BOTANY PRACTICAL - I

Title of the Course	**ALLIED BOTANY PRACTICAL - I**						
Paper Number	**Allied Practical - I**						
Category	**Allied**	**Year**	**I**	**Credits**	**2**	**Course Code**	
		Semester	**II**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	-	**-**	**2**	**2**

Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.

Learning Objectives

C1	To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, and fungi.
C2	To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
C3	To be familiar with the basic concepts and principles of plant systematics.
C4	Understanding of laws of inheritance, genetic basis of loci and alleles.
C5	To learn about the physiological processes that underlie plant metabolism.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. To study the internal organization of algae and fungi.	**K1**
2. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
3. To study the classical taxonomy with reference to different parameters.	**K3**
4. Understand the fundamental concepts of plant anatomy and embryology	**K4**
5. To study the effect of various physical factors on photosynthesis.	**K5**

EXPERIMENTS

1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
2. Micro photographs of the cell organelles ultra structure.
3. Simple genetic problems.
4. To dissect a flower and describe in technical terms along with floral diagram and floral formula.
5. Demonstration experiments
    1. Ganong's Light screen
    2. Ganong's respiroscope
6. To make suitable micro preparations of anatomy materials prescribed in the syllabus.
7. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy,

Embryology, Cell biology and Biotechnology.	
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 Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England. 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
Reference Books	1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications. 5. Steward, F.C. 2012. Plant Physiology Academic Press, US
Web sources	1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover 3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ 4. https://medlineplus.gov/genetocs/understanding/basics/cell/ 5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf 6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf 7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

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	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	1	3
CO 4	3	3	2	3	3	3	3	2	3	3
CO 5	3	2	2	2	2	2	2	1	2	2

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