B.SC.,
BOTANY

SYLLABUS

2024– 2025

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

Programme:	**B.Sc.Botany**
ProgrammeCode:	
Duration:	**3years**
ProgrammeOut comes(PO)	
TheB.Sc. Botanyprogramis designedtoachievethefollowingobjectives	
PO1	Apply the knowledge of science and technology fundamentals for findings solution for complex problems.
PO2	Toprovideuptodate theoreticalknowledgeonvariousformsofplants,theirinteractions with biotic and abiotic entities in the ecosystem and relevant practicalskills.
PO3	TocomprehendandinterpretvariousfacetsofBotanyincludingtheimportanceandjudiciousutilization ofplant sources.
PO4	Exploration of diverse plant life-forms and to nature the conservation of biodiversity.
PO5	Tounderstandtheprinciplesandapplicationsofvarioustraditionalandmoderntechniquesused in Botany.
PO6	TodisseminateknowledgeonthedesignandexecutionofexperimentsinBotanywithemphasis on the operation ofrelevantsophisticated instruments.
PO7	Toimpartknowledgeontheeconomicimportanceofplant/microbialresourcesandtheirproducts and to promoteentrepreneurship skill.
PO8	To promote proficiency in designing the research problems, review of literature,laboratory experiments, data analyses and preparation of reports with professionalethics.
PO9	Tomotivatethestudentstotakeupinnovativeandcutting-edgeresearchinfrontierareasof Botany and related biology subjects.
PO10	Toenablethestudentstotakeupvariousqualifyingexaminationsconcerning Botanyandto facethe challenges in career opportunities.
Program specific Outcomes(PSO)	
OnsuccessfulcompletionoftheB.Sc.Botanyprogram,thestudentsare expectedto	
PSO1	Implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.
PSO2	Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany
PSO3	Develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data
PSO4	Designscientificexperimentsindependentlyandtogenerateusefulinformationtoaddressvarious issues in Botany.
PSO5	Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings
PSO6	Design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations
PSO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PSO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PSO9	Follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom.

PSO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively

1. Introduction

Programe Outcome, Programe Specific Outcomes and Course Outcomes

Students completing this programme will be able to present their core under-graduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in various other public and private enterprises.

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: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze 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.

PO3: 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 earning to real-life situations.

PO4: 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.

PO5: 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.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different areas of the discipline.

PSO2: Understand, formulate, develop relevant arguments logically and use analytical thinking to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision-making and leadership skill that will facilitate startups and high potential organizations.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grids:

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1. **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, practical training for providing solutions to industry / real-life situations. The curriculum also facilitates peer learning with advanced topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and discipline-based problem-solving skills are included as mandatory components in the 'Training for Competitive Examinations' course in 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 Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real-world experience focussing on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. Industrial training, project and internships will give students an edge over counterparts in the job market.

- State-of art techniques in multi-disciplinary, cross-disciplinary and inter-disciplinary nature are incorporated as Elective courses, ranging from conventional topics to the latest Artificial Intelligence.

2. 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 at the tertiary level	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Digital skills will improve the knowhow of solving real-life problems using ICT tools
		• Entrepreneurial skill training will provide opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training girls leads to women empowerment
III, IV, V & VI	**Elective papers-** An open choice of topics categorized under Generic and Discipline Centric	• Strengthening domain knowledge • Introducing state-of-art techniques in multi-disciplinary, cross-disciplinary and inter-disciplinary nature • Emerging topics in higher education / industry / communication network / health sector etc., are introduced with hands-on-training
IV	**Industrial Botany**	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	**Internship / Industrial Training**	• Practical training at the Industry/ Banking Sector / Private/Public sector organizations/Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	**Project with Viva – voce**	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI	**Introduction of**	• Curriculum design accommodates all category of

Semester	**Professional Competency component**	learners; For example, "Botany, Tamil, Zoology for Advancement" component will comprise advanced topics in Botany, Tamil, Zoology 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 via, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners/Honours 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.

Choice Based Credit System (CBCS), Learning Outcomes Based Curriculum Framework (LOCF) Guideline Based Credit and Hours Distribution System for all UG courses including Lab Hours

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	13	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	4
Part-3	Core Courses & Elective Courses including laboratory [in Total]	13	14
Part-4	Skill Enhancement Course -SEC-2	1	2
	Skill Enhancement Course -SEC-3 (Discipline / Subject Specific)	1	2
	Naan Mudhalvan	2	2
		23	**30**

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	12	12
Part-4	Skill Enhancement Course -SEC-	2	2

	4(Discipline / Subject Specific)		
	EVS	2	2
	Naan Mudhalvan	2	2
		24	**30**

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	12	12
Part-4	Skill Enhancement Course -SEC-5(Discipline / Subject Specific)	2	2
	Value Education	2	2
	Naan Mudhalvan	2	2
		24	**30**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project Viva voce / Elective Based	22	28
Part -4	Naan Mudhalvan	2	2
	Internship / Industrial Visit / Field Visit	1	-
		25	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	18	28
Part-4	Naan Mudhalvan	2	2-
	Extension Activity	1	-
		21	**30**

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	12	12	22	18	90
Part IV	4	4	6	6	3	2	25
Part V	-	-	-	-	-	1	1
Total	23	23	24	24	25	21	**140**

***Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V have to be completed during the duration of the programme as per the norms, to be eligible for obtaining the UG degree.**

Internal & External Assessment

25% internal assessment & 75% external assessment (Semester-end examination)

Methods of Evaluation Theory		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
External Evaluation	End Semester Examination	75 Marks
	Total	**100 Marks**
Internal Evaluation	**Methods of Evaluation Practicals**	
	Continuous Internal Assessment Test	50 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	50 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**

CBCS - COURSE PATTERN AND SYLLABUS

UG - BOTANYSEMESTERWISE PAPERS
(For students who join the programme from 2024-2025 onwards)

SEMESTER I	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part I Part II	Part -I - Language – Paper I	6	3
	Part - II - English– Paper I	*6	3
Part III Core I	Part - III - Core – Plant Diversity I –Algae	5 (3+2)	5
Core II	Plant Diversity I Algae - Practical-I	3 (1+2)	3
Elective Course EC 1 Discipline Specific/Generic	Part -III - Allied: Zoology - Paper – I	4 (3+1)	3
	Allied practical	2	2
Part - IV Skill Enhancement Courses SEC1	1. Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping	2	2
Foundation Course FC	Basics of Botany	2	2
	Total	**30**	**23**

SEMESTER II	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial)	CREDIT
Part I Part II	Part -I - Language – Paper I I	6	3
	Part - II - English– Paper II	4	3
Part III	Part - III - Core - Plant Diversity II –		

Core III	Fungi, Bacteria, Viruses, Plant pathology and Lichens	5 (3+2)	5
Core IV	Plant Diversity II - Fungi, Bacteria, Viruses, pathology and Lichens – Practical II	3 (1+2)	3
Elective Course EC 2 Discipline Specific/Generic	Part -III - Allied: Zoology Paper – II	4 (3+1)	3
	Allied practical	2	2
Part - IV Skill Enhancement Courses SEC 2	1. Mushroom cultivation 2. Herbal Medicine 3. Global Climate change	2	1
Skill Enhancement Courses SEC 3	Botanical garden and landscaping	2	1
	Naan Mudhalvan	2	2
	Total	**30**	**23**

SEMESTER III	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial)**	**CREDIT**
Part I	Part – I – Language – Paper III	6	3
Part II	Part – II –English– Paper III	6	3
Part III Core V	Part – III – Core – Plant Diversity III - Bryophytes and Pteridophytes	4 (3+1)	4
Core VI	Part – III – Core – Plant Diversity III Bryophytes and Pteridophytes – Practical-III	2 (1+1)	2
Elective Course EC 3	Part -III - Allied: Chemistry Paper – I	4 (3+1)	4

	Allied Practical	2 (1+1)	2
Part - IV Skill Enhancement Courses SEC 4	Herbal Technology	2	2
	EVS	2	2
	.Naan Mudhalvan	2	2
Total		**30**	**24**

SEMESTER IV	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial**	**CREDIT**
Part I Part II	Language – Paper IV	6	3
	English– Paper IV	6	3
Part - III Core VII	Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	4 (3+1)	4
Core VIII	Part - III - Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV	2 (1+1)	2
Elective Course EC 4	Part -III - Allied: Chemistry Paper – II	4 (3+1)	4
	Allied Practical	2 (1+1)	2
Part IV Skill Enhancement Courses SEC 5	Fermentation technology	2	2
	Value education	2	2
	Naan Mudhalvan	2	2

Total		**30**	**24**
SEMESTER V	**NAME OF THE COURSE**	**HoursPer/ Week (Lecture/Tutorial**	**CREDIT**
Part III Core IX	Part - III - Core - Plant Morphology, Taxonomy and Economic Botany	5 (4+1)	4
Core X	Part - III - Core –Cell Biology, Plant Anatomy and Embryology	5 (4+1)	4
Core XI	Plant Morphology, Taxonomy and Economic Botany – Practical V	3 (2+1)	2
Core XII	Cell Biology, Plant Anatomy and Embryology – Practical VI	2 (1+1)	2
CoreXII**I**	Project with Viva-voce	5 (4+1)	3
Elective Course 5	EC5 1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial botany	4 (3+1)	3
Elective course 6	EC6 1 Plant Bioresources 2 Seed Biology 3 Pomology	4 (3+1)	3
Part IV	Naan Mudhalvan	2	2
Part V	Internship / Industial Training / Field Work / Knowledge updation Activity	-	2
	Total	**30**	**25**
SEMESTER VI	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial**	**CREDIT**

Part III Core XIV	Part - III - Core –Plant Physiology and Biochemistry	6 (4+2)	4
Core XV	Part - III - Core Genetics and Plant Ecology	6 (4+2)	4
Core XVI	Plant Physiology and Biochemistry – Practical	3 (2+1)	2
Core XVII	Genetics and Plant Ecology – Practical	3 (2+1)	2
Elective Course	**EC 7** 1. Horticulture and Plant Breeding 2. Natural Resource Management 3. Forensic Botany	5 (3+2)	3
Elective Course	**EC 8** 1Plant biotechnology and Molecular biology 2. Forestry 3. Computer application in Botany	5 (3+2)	3
Part IV	Naan Mudhalvan	2	2
PART V	Extension activity (NSS, NCC, Sports)	-	1
Total		**30**	**21**
	TOTAL CREDITS	--- -	**140**

*Core practical exams will be conducted at the end of every semester.

CORE-I PLANT DIVERSITY I ALGAE

TitleoftheCourse		**PLANT DIVERSITY I ALGAE**					
PaperNumber		**COREI**					
Category	Core	**Year**	I	**Credits**	5	**Course Code**	
		Semester	I				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		3	2		--	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 thallus organization in various algal groups	
C3	To understand methods of reproduction and life histories of different algal groups.	
C4	To understand the methods of large scale cultivation of algae	
C5	To comprehend the beneficial role of algae.	
Course outcomes	**On completion of this course, students will be able to:**	
CO1	Relate thegeneral characterestics of algae and under the system of classification.	K1
CO2	Demonstrateknowledgeinstructuralorganization of the thallus.	K2
CO3	understandingthevarious life cycle patterns and the methods of reproduction in algae.fundamental concepts in algal growth.	K3
CO4	.Explain the benefits of large scale cultivation of algae	K4
CO5	Determine the emerging areas of Algal Biotechnology for identifying commercial algal products and their uses.	K5
UNIT	**CONTENTS**	
I	General chaacters, distribution, Classification (Fritsch-1935-1945),	
II	Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Gracilaria*).	
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-*, Chara* diplontic- *Sargassum*, diplohaplontic-*Ulva*)	

IV	Algal cultivation methods, indoor cultivation methods (any two)and large-scale cultivation of algae, (any two), harvesting of algae.
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Application of algae as fuel, bio fertilizer and pharmaceutical. Role of algae as indicator of water pollution.
ExtendedProfessional Component (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts:	
1	Dehradun. Edwardlee,R.2018. Phycology,5th Ed.,CambridgeUniversityPress, London.
2	Kumar,H.D.1999. IntroductoryPhycology.Affiliated East-WestPress,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/

MappingwithProgrammeOutcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	`1	3	3
CO3	2	2	1	1	2	2	1	3	2	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

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

CORE-II PLANT DIVERSITY I ALGAE - PRACTICAL-I

Title of the Course	**PLANT DIVERSITY – I: ALGAE Practical –I**						
Paper Number	CORE II						
Category	Core	**Year**	I	**Credits**	3	**CourseCode**	
		Semester	I				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		1	-	2	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 species of algae.						
C5	To understand importance of algae to animals and humans						
Course outcomes: CO	**On completion of this course, the students will be able to**					**Programme outcomes**	
CO1	Recall and identify algae using key 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	Identify algae in natural habitats						

PRACTICALS

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) SCP (v) Agar Agar (vi) Alginate (vii) Diatomaceous earth.
5. Field visit to study fresh water/marine water algal habitats.

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Kumar,H.D.1999. IntroductoryPhycology.Affiliated East-WestPress,Delhi. 2. Bendre,M.AshokandAshokKumar,A. 2020.TextBookofPracticalBotany-1(10th ed).RastogiPublications, 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.
ReferenceBooks:	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,5th Ed.,CambridgeUniversityPress, 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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY-I

Title of the Course	**ALLIED BOTANY-I**						
Paper Number	Core-Allied-I						
Category	Core	**Year**	I	**Credits**	3	**CourseCode**	
		Semester	I				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	1	-	4

Pre-requisite	To study the basics of botany.

Learning Objectives

C1	To study morphological and anatomical features of algae
C2	To familiarize with the general characters and economic uses of fungi, bacteria and virus
C3	To familiarize with the general characters and life histories of bryophytes, pteridophytes and gymnosperms
C4	To comprehend on the ultra structure of cell organelles
C5	Toexplain the concept of genetics and plant biotechnology

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies.	K2
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Compare the structure and function of various cell organelles.	K4
CO5	Understand the core concepts and fundamentals of genetics an plantbiotechnology	K5

UNIT	**CONTENTS**
I	**Algae:** General characters of algae - Structure, reproduction and life cycle of the following genera - *Sargassum* , economic importance of algae.
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of the following genera - Penicilliumand economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV.
III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Marchantia* General characters of Pteridophytes, Structure and life cycle of *Selaginella*

	General characters of Gymnosperms, Structure and life cycle of *Cycas*.
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus.
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Law ofindependent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - MS medium, plant tissue culture protocol. Application in biotechnology.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Singh,V.,Pande,P.C andJain,D.K. 2021. ATextBookofBotany.RastogiPublications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY PRACTICALS

Title of the Course	**ALLIED BOTANY PRACTICALS**					
Paper Number	Core-Allied Practicals-I					
Category	Core	**Year**	I	**Credits**		**Course Code**
		Semester	I	**2**		
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**
				-	2	2
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.					

Learning Objectives	
C1	To develop skill-based detection of the morphology and microstructure of different plant groups
C2	To comprehend the ultra structure of various cell organelles
C3	To be familiar with the basic concepts of mendelian genetics and laws of inheritance.
C4	To Understand the methods involved in plant tissue culture

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Gain knowledge on the internal organization of various plant groups	K1
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K2
CO3	Analyse the ultra structure of different cell organelles	K3
CO4	Understand the fundamental concepts of Genetics	K4
CO5	Apply the methods in plant tissue culture	K5

PRACTICALS

1. Make suitable micro preparation and observation of slides/ specimen of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.

2. Micro photographs of the cell organelles - ultra structure.

3. Simple genetic problems.- Monohybrid and dihybrid
4. Microphotographs related to plant tissue culture.
5. Field trip (Minimum 2 days) to places under the guidance of teachers to study plants in their natural habitat and submit a report.

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta,MacMillanIndia Ltd,NewDelhi. 2. Sharma,O.P.2012. Pteridophyta,Tata McGraw-Hills Ltd,NewDelhi. 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. MedicinalChemistry.OxfordUniversityPress&WileyPublications.

	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=gymnosperms&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

ELECTIVE ALLIED BOTANY PRACTICALS

MappingwithProgrammeOutcomes:

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

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

Title of the Course	ORGANIC FARMING						
Paper Number	Non-Major Elective-I						
Category	Elective	Year		I	Credits		CourseCode
		Semester		I			
InstructionalHours perweek	Lecture	Tutorial	LabPractice	Total			
	2	-	-	2			
Pre-requisite	Students to gain knowledge on the scope of organic farming and its significance.						

Learning Objectives		
C1	To enable students to gain knowledge on the properties and importance of soil	
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.	
C3	To understand the significance of organic and green manures	
C4	To know about the importance of biofertilizers	
C5	To study methods of recycling of biodegradable wastes.	
Course outcomes: CO	On completion of this course, the students will be able to:	Programme Outcomes
CO1	Recognize the different forms of soils and ill effects of chemical fertilizers	K1
CO2	Explain and interpret the components, patterns, and processes of organic manuring and compostingK2	
CO3	Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	K3
CO4	Analyze and decipher the significance of biofertilizers K4	
CO5	Develop new strategies for recycling of solid organic wastes	K5
UNIT	CONTENTS	
I	Soil – physical, chemical properties. Ill effects of oil, chemicals –fertilizers, pesticide and herbicides	
II	Organic farming – definition, basic concept of organic farming, Sustainable agriculture practices-crop rotation, mixed cropping.	
III	Management of organic wastes and green manures: Farm manures, Composts and Mulches importance of organic manure, importance of green manure, , oil cake.; vermicompost-methods, production and utilization.	

IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.
ExtendedProfessional Component (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/ NET/ UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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=726365635751333&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

	4.

SKILL ENHANCEMENT COURSE - SEC - 1

1. ORGANIC FARMING

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 1

2. ENVIRONMENTAL BIOTECHNOLOGY

Title of the Course	**ENVIRONMENTAL BIOTECHNOLOGY**					
Paper Number	Non-Major Elective-I					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**
		Semester	I			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		2	-	-	2	
Pre-requisite	To understand the various applications of environmental biotechnology.					
Learning Objectives						
C1	To introduce the student to the various developed and applications of environmental biotechnology.					
C2	To provide knowledge about the scope of bioremediation and bioleaching					

	using GMOs.
C3	To study about pollution of water bodies.
C4	To know about bioremediation.
C5	To study about biomineralization.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Recognize the various causes of pollution and control measures.	K1
CO2	Explain about the beneficially role of GMOs on environment.	K2
CO3	Reflect upon various sustainable environmental protection strategies.	K3
CO4	Analyze the different methods of air, water, and soil quality monitoring process.	K4
CO5	Evaluate the implications of international legislations and policies for environmental protection.	K5

UNIT	**CONTENTS**
I	**Introduction:** The environment-soil, water and air, Pollution and its causes (outline only)
II	**Source and treatment of polluted waters and effluents:** Pollution of water bodies by heavy metals and pesticides – removal of heavy metals and pesticides by Biosorption. Removal of oil spills by using microbes. Biological treatment of sewage – characteristics of sewage and objectives in sewage treatment – Anaerobic digestion.
III	**Soil and air pollution and their treatment:** Soil pollution by Xenobiotics. Degradation of Xenobiotics – pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.
IV	**Bioremediation:** Introduction to bioremediation, *ex situ* and *in situ* bioremediation.
V	**Biometallurgy and related topics:** Biomineralization – bioleaching - Biofilms and biocorrosion.
Extended Professional Component (is a part ofinternal component only,Not to be included	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

in theExternalExamination questionpaper)	
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited. 2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication. 3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication. 4. Keeshav Thehan. 1997. Biotechnology, New age international)P) Limited, New Delhi. 5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.
Reference Books:	1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi. 2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K. 3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology. 4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of Science Communication and Information Resources, CSIR New Delhi. 5. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
Web Resources	1. https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8 2. http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html 3. https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI 4. https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&redir_esc=y 5. http://library.umac.mo/ebooks/b28045907.pdf

MappingwithProgrammeOutcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3

CO2	3	3	2	2	2	3	2	3	2	2
CO3	2	2	3	3	1	2	1	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	2	3

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

SKILL ENHANCEMENT COURSE - SEC - 1

3. NURSERY AND LANDSCAPING

Title of the Course		**NURSERY AND LANDSCAPING**					
Paper Number		Non-Major Elective-I					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	I				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		2		-	-	2	
Pre-requisite		Students should know about the fundamental concepts of nursery and landscaping.					
Learning Objectives							
C1		To recognize the importance of growing plants in nursery and their role in landscaping.					
C2		To study and practice the methods of propagation					
C3		.To gain knowledge on the types of garden					
C4		To know about the types of structures in nursery					
C5		To learn about composting methods					
Course outcomes: CO		**On completion of this course, the students will be able to:** **Programme Outcomes**					
CO1		Recognize the basic principles and nursery and landscaping					K1
CO2		Explain and practice plant propagation techniques.K2					
CO3		Apply techniques for design various types of gardens according to the culture and art of bonsai. K6					K3 &
CO4		Analyse the importance of plant growing structures					K4.
CO5		Explain the methods of composting					K5

UNIT	CONTENTS
I	Introduction, prospects and scope of nursery and landscaping.
II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.

III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.
IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.
V	Manures, composting – vermicomposting.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi. 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). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.
Reference Books	1.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi. 2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co.,San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788 3. https://www.amazon.in/Gardening/b?ie=UTF8&node=163707703

	1 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

MappingwithProgrammeOutcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	1	3
CO2	3	3	2	2	3	3	2	2	2	2
CO3	2	2	3	1	1	1	1	3	3	1
CO4	3	2	2	1	3	2	1	3	2	1
CO5	3	3	2	3	2	1	2	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	**CourseCode**	
		Semester	I				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**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 Enable the learners to understand various cell structures and functions of prokaryotes and eukaryotes and the salient features and functions of cellular organelles.						
C3	To gain knowledge on the morphology of various plant parts and their modifications						
C4	To Understandof laws of inheritance, genetic basis of loci and alleles.						
C5	To become familiar with important plant physiological processes like absorption and transpiration						
Course outcomes CO	**On completion of this course, the students will be able to**					**Programme Outcomes**	
CO1	Develop a critical understanding on the distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.					K1	
CO2	Compare the structure and function of prokaryotic and eukaryotic cell					K2	
CO3	Develop critical understanding on morphology of various plantparts					K3	
CO4	Understand the basic concepts of geneticsK4						
CO5	Understand the core concepts and fundamentals of plant physiology					K5	

UNIT	CONTENTS

I	**BIODIVERSITY** Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.
II	**CELL BIOLOGY** Cell as the basic unit of life -Ultra Structureof Prokaryotic and Eukaryotic Cell (PlantCell) - Cell Wall - Cell Membrane,Chloroplasts, Ribosomes.
III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Inflorescences – racemose and cymose types. Fruits types.
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance. Monohybrid and dihybrid cross.
V	**PLANT PHYSIOLOGY** Water relations -: Diffusion, Osmosis, Plasmolysis, Imbibition . Transpiration –Types, significance -
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Singh,V.,Pande,P.C andJain,D.K. 2021. ATextBookofBotany.RastogiPublications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.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. 1. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. **2.** 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 3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

MappingwithProgrammeOutcomes:

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

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

CORE-III 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 III						
Category	Core III	**Year**	I	**Credits**	5	**CourseCode**	
		Semester	II				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	2	--	5

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

Learning Objectives	
C1	To describe the general 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 learn the structure and reproduction in Bacteria and viruses
C4	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
C5	To identify the main groups of plant pathogens, their symptoms various types of plant diseases.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recognize the general characteristics of fungi	K1
CO2	Develop an understanding on the economic uses of fungi	K2
CO3	Comprehend the structure and reproduction in bacteria and virus K3	
CO4	Analyze the structure and reproduction in Lichens and their role in agricultural and pharmaceutical applications.	K4
CO5	Identify the common plant diseases and device control	

	measuresK5
UNIT	**Contents**
I	**FUNGI** Characteristic features of Fungi, Classification of fungi (Alexopoulos and Mims, 1979),.thallus organization, mode of nutrition, structure, reproduction and life-history of Zygomycotina - Mucor, Ascomycotina - Peziza, Basidiomycotina - Puccinia and Deuteromycotina - Cercospora. .
II	**ECONOMIC IMPORTANCE OF FUNGI:** Fungi as food; Fungi in agriculture application – bio-fertilizers; Mycotoxins - biopesticides; Production ofindustrially important products from fungi -- ethanol, organic acids - citric acid,Applications of fungi in pharmaceuticals -Penicillin. Importance of VAM fungi. Harmful effects of Fungi (any five)
III	**BACTERIA, VIRUS:** Classification- outline (Bergey, 1994),Ultra structure and reproduction - vegetative and sexual in bacteria., Viruses: general characters, structure and reproduction of bacteriophage.
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Disease cycle. Prevention and control of the following plantdiseases: Bacterial diseases - Citrus canker and Bacterial wilt of Banana Viral diseases-Tobacco Mosaic and Vein clearing of Ladies finger. Fungal diseases - Blast disease in rice and Tikka disease of Groundnut.
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Study of growth forms of lichens (crustose, foliose and fruticose), . Structure,distribution and reproduction of *Usnea*. Economic importance of Lichens.-Food, Medicine, Dye, Ecological importance, ,
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis	Knowledge,ProblemSolving,Analyticalability,Professional

Course	Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

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

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

Title of the Course	**PLANT DIVERSITY** – I: **FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II**						
Paper Number	CORE IV						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		Semester	II				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		1	-		2	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 know about the economic uses of fungi
C3	To know the ultra structure of bacteria and virus through photomicrographs
C4	To identify the lichens based on the morphology, and microslides.
C5	To identify the symptoms of plant diseases caused by microbes

Course outcomes On **CO**	**Completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Develop practical skills for Identifying fungi using key characters	K1
CO2	Access the useful role of fungi in agriculture and pharmaceutical industry	K2
CO3	Identify the type of bacteria through grams staining procedure.	K3
CO4	Analyze the characteristics of various types of lichens pathogens	K4
CO5	Recognize the symptoms of plant diseases caused by pathogens	K5

PRACTICALS

1. Micro preparation of vegetative and reproductive structures of fungi prescribed in the syllabus.
2. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides,, edible mushroom/Yeast, organic acids (citric acid), and antibiotics (Penicillin)
3. Mycorhiza: Eecto-mycorhiza and endo-mycorrhiza (Photographs)
4. Grams staining procedure for identification of bacteria.

5. Micro photograph for ultra structure of Bacteria and Bacteriophage

6. Vegetative and reproductive structure of Usnea- Micro-preparation
7. Visit to agricultural Farms..

Recommended Texts:

1. Chmielewski, J.G andKrayesky,D. 2013.GeneralBotany laboratory Manual.AuthorHouse, Bloomington, USA.
2. Das,SandSaha,R.2020.MicrobiologyPracticalManual.CBSPublishersandDistributors (P) Ltd., New Delhi,India.
3. Webster,J andWeber,R.2007.IntroductiontoFungi,3rdEd.CambridgeUniversityPress, 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.

ReferenceBooks:

1. Alexopoulos, JandMims,W. 1985. IntroductoryMycology,WileyEastern Limited NewDelhi.
2. Bendre,M.AshokandAshokKumar,A. 2020.TextBookofPracticalBotany 1 (10thed).RastogiPublications, 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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY-II

Title of the Course	ALLIED BOTANY-II					
Paper Number	Core-Allied-II					
Category	Core	**Year**	I	**Credits**	3	**Course Code**
		Semester	II			
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**
		3	1		-	4
Pre-requisite	To study basics of botany.					

Learning Objectives

C1	To be familiar with the basic concepts of morphology of plant parts
C2	To Learn the vegetative and floral characters of angiosperm families
C3	To Understand the internal structure of vegetative plant parts
C4	To become familiar with the concepts of embryology of flowering plants
C5	To learn about the physiological processes that underlie plant metabolism.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Understand the fundamental concepts of morphologyK1	
CO2	Analyze and recognize the different families of flowering plantsK2	
CO3	Understand the internal organization and tissue components of vegetative partsK3	
CO4	Know the structure of anther, Classify the types of ovule and the method of fertilization in angiosperms	K4
CO5	Understand the mechanism of photosynthesis and respiration in plants	K5

UNIT	**CONTENTS**
I	**MORPHOLOGY OF FLOWERING PLANTS:** Structure of root, stem and leaf. Leaf types- simple and compound. Phyllotaxy. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.
II	**TAXONOMY:** Study of the vegetative and floral characters and economic importance of the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Poaceae
III	**ANATOMY** Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot root, stem and leaf.

IV	**EMBRYOLOGY** Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization.
V	**PLANT PHYSIOLOGY** Absorption of water- Mechanism .Photosynthesis -Light reaction, dark reaction (Calvin cycle). Respiration - Glycolysis - Krebs cycle - electron transport system.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended 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 5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY PRACTICALS

Title of the Course	**ALLIED BOTANY PRACTICALS**						
Paper Number	Core-Allied Practicals-II						
Category	Core	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	II				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**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 arrangement of leaves on stem and identification of inflorescence types
C2	To learn the skill of floral dissection
C3	To be familiar with the physiological experiments related to photosynthesis and respiration
C4	To develop the skill for micro preparation of vegetative plant parts
C5	To learn about the structure of anther and ovule

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Identify the type of phyllotaxy and inflorescence types.	K1
CO2	Develop critical understanding on the floral features of angiosperm families through floral dissection	K2
CO3	Demonstrate simple experiments related to photosynthesis and respiration	K3
CO4	Understand the internal organization of vegetative parts of the plant K4	
CO5	Comprehend the structure of anther and ovule.	K5

PRACTICALS

1.Phyllotaxy types – Alternate, Opposite and Whorled

2. Inflorescence types- Racemose and Cymose
3. Dissect out and draw thefloral parts of the plants belonging to the families prescribed in the syllabus.

4. Demonstration experiments:

1. Ganong's Light screen 2. Fermentation – Kuhn's experiment 5.To make suitable micro preparations of vegetative plant parts prescribed in the syllabus. 6. Permanent microslides / photographs for Observation of anther and ovule.	
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta,MacMillanIndia Ltd,NewDelhi. 2. Sharma,O.P.2012. Pteridophyta,Tata McGraw-Hills Ltd,NewDelhi. 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	6. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 7. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 8. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 9. Aler Gingauz.2001. MedicinalChemistry.OxfordUniversityPress&WileyPublications. 10. Steward, F.C. 2012. Plant Physiology Academic Press, US
Web sources	8. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 9. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover

	10. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ 11. https://medlineplus.gov/genetocs/understanding/basics/cell/ 12. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf 13. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf 14. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

1. MUSHROOM CULTIVATION

Title of the Course	**MUSHROOM CULTIVATION**						
Paper Number	Non-Major Elective-II						
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	II				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		2		-	-	2	
Pre-requisite	Basicknowledgeonstructureandfunction ofvarious groupsof mushrooms.						

Course Objectives		
C1	To learn about morphology and importance of mushrooms	
C2	To understand the structure and life cycle of mushrooms	
C3	To know about methods involved in growth and harvesting of mushrooms	
C4	To recognize the techniques of mushroom cultivation.	
C5	To study about the diseases of mushrooms and post harvest technology	
Course outcomes: CO	**On completion of this course, the students will be able to**:	**Programme Outcomes**
CO1	Recall various types and nutritive values of mushroom.	K1
CO2	Explain about the morphology and life cycle of mushrooms.	K2
CO3	Know the strategies for marketing of mushrooms K3	
CO4	Apply techniques for cultivation of various types of mushroom K4	
CO5	Understand the diseases and pests of mushroomsK5	
UNIT	**CONTENTS**	
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values.	
II	Structure and Life cycle of *Pleurotusspp* and *Agaricus spp.* .	
III	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.	
IV	Mushroom cultivationmethods :Bag method, Bed method. Prospects and scope of Mushroom cultivation in small scale Industry.	
	Diseases -, Insect pests, nematodes, mites, viruses, fungal competitors. Post	

V	harvest technology
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquired fromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovementwith their marketing.DayaPublishingHouse.
Reference Books	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. 5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web Resources	1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/ 5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html ?id=6AJx99OGTKEC&redir_esc=y

MappingwithProgrammeOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S			S	M	L	M	M
CO2	S			M		S	M	S
CO3	M			S		M		S
CO4	S	S	S	S		M		S
CO5	S	S	M				S	S

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

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Somasundaram, S. 1997. Medicinal botany (Maruthuvar Thavaraviyal) – (Tamil Medium Book). 2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. & A. Churchill Ltd., London, 3. Jains, S.K.. 1996. Medicinal Plants. Deep Publications, New Delhi. 4. Srivastava, A.K. 2006, Medicinal Plants, International Book Distributors, Dehradun. 5. Agarwal,O.P. 1985, Vol. II, Chemistry of organic – natural products. S Chand & Company, New Delhi. 6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency, Madras Volumes. 7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.
Reference Books	1. Nair, N.C and Henrry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India. 2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of Indian Medicinal Plants. 3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994, Indigenous drugs of India. 4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous plants in

	India. 5. Miller, L and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass*, *Fourth edition.* 6. 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	1. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu 2. https://www.springer.com/gp/book/9783540791157 3. https://www.gpatonline.com/gpat/book-reference-pharmacognosy 4. https://www.researchgate.net/publication/334670695_Book_review-_Herbal_Drug_Technology 5. http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

2. HERBAL MEDICINE

Title of the Course		**HERBAL MEDICINE**					
Paper Number		Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	II				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		2		-	-	2	
Pre-requisite		To understand the importance of herbal medicine.					

Learning Objectives	
C1	To understand the nuances of medicinal plants and their phytoconstituents of commercial value
C2	To design and develop medicinal garden.
C3	To apply the knowledge to cultivate medical plants.
C4	To know the pharmacological importance of medicinal plants.
C5	To enlist phytochemicals and secondary metabolites of market and commercial value.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Define and describe the principle of cultivation of herbal products.	K1
CO2	Explain about the phytochemistry of economically important medicinal herbs.	K2
CO3	Apply techniques for evaluation of drug adulteration through biological testing.	K3
CO4	Formulate the value added processing / storage / quality control for the better use of herbal medicine.	K4
CO5	Develop the skills for cultivation of plants and their value added processing/storage/quality control.	K5 & K6

UNIT	**CONTENTS**
I	Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.

II	Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening- cultivation of Aloe vera, Gloriossa superba, Vinca, Tulsi
III	Extraction methods – Water distillation, and steam distillation. .Extraction of Eucalyptus oil, Sandal oil, Rose oil, Clove oil
IV	Botanical description, active principles and uses of Root drugs – Vetiveria zizanioides, Vinca rosea; Rhizomes – Ginger and Acorus; wood –Sandal and bark drugs - Cinnamon
V	Botanical description active principles and uses of leaves – Aloe, Coleus;seed – Pepper, Neem and entire plants – Phyllanthus, Andrographis paniculata

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press. 2.Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall. 3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru. 4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut. 5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
Reference Books	1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA. 2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry. 3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234. 5. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity-Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New

	Delhi. 6. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
Web Resources	1. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/ 2. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html 3. https://www.smashwords.com/books/category/4727/newest/0/free/any 4. https://www.free-ebooks.net/environmental-studies-academic/Global-Warming 5. https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

3. GLOBAL CLIMATE CHANGE

Title of the Course	**GLOBAL CLIMATE CHANGE**					
Paper Number	Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**
		Semester	II			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		2	-	-	2	
Pre-requisite	To understand the implications of carbon and ecological footprint.					

Learning Objectives	
C1	To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.
C2	To understand the implications of carbon and ecological footprint.
C3	To apply the knowledge to green house effects.
C4	To know the rain and its effects on plants.
C5	To know about Global Environmental change issues.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
1.	Relate to the anthropogenic pressure on the environment and carbon footprint.	K1
2.	Explain about the physical basis of natural green gas house effect on man and materials.	K2
3.	Evaluate human influenced driver of our climate system and its applications.	K3
4.	Analyze the causes and effects of depletion of the stratospheric ozone layer.	K4
5.	Develop new strategies to mitigate issues of global environmental change.	K5 &K6

UNIT	**CONTENTS**
I	Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.
II	Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals,

	human health and materials; Global efforts for mitigation ozone layer depletion.
III	Climate change: Green house effects; causes; Green house gases and their sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.
IV	Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.
V	Acid rain and its effects on plants, animals, microbes and ecosystems.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press. 2.Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall. 3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru. 4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut. 5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
Reference Books	1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA. 2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry. 3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234. 7. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity-Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi. 8. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
Web Resources	6. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/ 7. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html 8. https://www.smashwords.com/books/category/4727/newest/0/free/any

	9. https://www.free-ebooks.net/environmental-studies-academic/Global-Warming 10. https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSE 3

BOTANICAL GARDEN AND LANDSCAPING

Title of the Course	**BOTANICAL GARDEN AND LANDSCAPING**						
Paper Number	Skill Enhancement-3						
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	II				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		2	-	-	2		
Pre-requisite	Students should know about the fundamental concepts of gardening and landscaping.						
Learning Objectives							
C1	To know about the fundamental concepts of gardening and its importance						
C2	To provide an overview of various components of a garden						
C3	To illustrate the significance of garden adornments like rockery						
C4	To provide an insight into indoor gardening						
C5	To create entrepreneurial skills for landscaping.						
Course outcomes: CO	**On completion of this course, the students will be able to Programme Outcomes**						
CO1	Recognize fundamental concepts of gardening and						K1
CO2	Explain about significance of garden componentsK2						
CO3	Apply techniques for creation of garden adornmentsK3						
CO4	Identify methods for preparation and maintenance of Topiary and Bonsai						
CO5	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.						K5 & K6

UNIT	CONTENTS
I	Types of gardening – Formal and Informal garden, Ornamental garden, Importance of garden making. Principles of designing a garden.
II	Garden components – Green house, Lawn, Planting trees, shrubs, climbers and creepers.Flower beds and borders

III	Ornamental hedges,Edges ,Pergola, Rockery and water garden.
IV	Topiary, indoor gardening, Bonsai -preparation of soil and its composition, manuring, watering and maintenance,
V	Basic principles of landscape design – components of landscape design – plant materials and structural materials. Vertical gardens. Landscaping of residential and public areas.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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

MappingwithProgrammeOutcomes:

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

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

CORE-V PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	**PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES**						
Paper Number	CORE V						
Category	Core	**Year**	II	**Credits**	4	**CourseCode**	
		Semester	III				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	1	-	4

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.

Learning Objectives	
C1	To enable the students to have an overview of General characters classification and economic importance of Bryophytes
C2	To understand the morphological diversity,structure and reproduction of Bryophytes.
C3	To know the General characters and classification of Pteridophytes.
C4	To understand the morphological diversity,structure and reproduction of Pteridophytes.
C5	To gain knowledge on the economic uses of Pteridophytes

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
.CO1	Recognize morphological variations and uses of Bryophytes	K1
CO2	Explain the anatomy and reproduction of Bryophytes belonging to different classesK2	
CO3	Identify the distinguishing features of Pteridophytes	K3
CO4	Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Pteridophytes.	K4
CO5	Access the useful role Pteridophytes.K5	

UNIT	**Contents**
I	**BRYOPHYTES** . General characters of Bryophytes, classification (Rothmaler 1951. Upto the order level) .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 (Marchantia);, Anthoceratopsida (Anthoceros) and Bryopsida (Polytrichum).
III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Sporne, 1951).. Apogamy and apospory, homospory and heterospory.
IV	Morphology, anatomy and reproduction of the forms belonging to the following classes: Psilotopsida (Psilotum), Lycopsida (Selaginella),
V	Morphology, anatomy and reproduction of the forms belonging to the class Pteropsida (Marsilea). Economic importance of Pteridophytes- Medicinal uses, horticulture, industrial and ecological uses. ..
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.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

MappingwithProgrammeOutcomes:

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

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

CORE-VI PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES – PRACTICAL-III

Title of the Course	**PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III**						
Paper Number	CORE VI						
Category	Core	**Year**	II	**Credits**	3	**Course Code**	
		Semester	III				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
		-	2	2

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.

Learning Objectives

C1	To enable students to learn the skill of hand sectioning .
C2	To study diversity of morphological diversity,structure and reproduction of Bryophytes..
C3	To understand the morphological diversity,anatomical structure and reproduction Pteridophytes
C4	To Develop skills in micro preparation of reproductive structures of Bryophytes and Pteridophytes
C5	To identify Bryophytes and Pteridophytes in natural habitats.

Course outcomes: CO	**On successful completion of this course the student will be able to:**	**Programme Outcomes**
CO1	Recognize the major groups of Non-vascular and Vascular Cryptogams. K1	
CO2	Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2
CO3	Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes.	K3
CO4	Develop comprehensive skills in sectioning and micro preparation.	K4
CO5	Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5

PRACTICALS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of

Bryophytes generaincluded in the theory syllabus. **Pteridophytes** 2. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes generaincluded in the theory syllabus. 3.Botanical excursion- Field Study & Submission of report .	
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta,MacMillanIndia Ltd,NewDelhi. 2. Sharma,O.P.2012. Pteridophyta,Tata McGraw-Hills Ltd,NewDelhi. 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.
ReferenceBooks	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/

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSES SEC - 4

HERBAL TECHNOLOGY

Title of the Course	**HERBAL TECHNOLOGY**						
Paper Number	Skill Enhancement-4						
Category	Elective	**Year**	II	**Credits**	2	**CourseCode**	
		Semester	III				
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**			
	2	-	-	2			
Pre-requisite	To understand the importance of herbal technology.						
Learning Objectives							
C1	To provide an overview of Herbal medicines.						
C2	To gain an insight into the commercially important secondary products .						
C3	To understand the basic concept of Pharmacognosy						
C4	To recognize the phytochemical screening methods.						
C5	To know the methods of processing and storage of herbal drugs						
Course outcomes: CO	On completion of this course, the students will be able to: **Programme Outcomes**						
CO1	Define and describe the principle of cultivation of herbal products. K1						
CO2	List out the categories of commercially important herbal medicines K2						
CO3	Understand the botany and importance of chemical constituents in herbal medicinesK3						
CO4	Apply phytochemical tests for identification of secondary metabolites K4						
CO5	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs. K5						
UNIT	**CONTENTS**						
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation, harvesting, processing and storage of herbs and herbal products.						

II	Major herbs used as herbal medicines-, Ocimum. Nutraceuticals- Embilica officinale,, cosmeticals- Aloe vera, and biopesticides-Neem,, their Botanical names, plant parts used, major chemical constituents and their uses.
III	Pharmacognosy - Binomial, botany of the plant part used and active principles of the following herbs: Curcuma, Fenugreek, Catharanthus roseus, Withania somnifera, Centella asiatica, Tinospora.
IV	Analytical pharmacognosy: Phytochemical screening tests for secondary metabolites - alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds.
V	Processing - storage of herbs and herbal products, quality control for use in herbal formulations.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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	1. https://www.kopykitab.com/Herbal-Science 2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE 3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural- healing/herbal-medicine/_/N-ry0Z8qaZ11iu 4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404 5. https://www.dattanibookagency.com/books-herbs-science.html 6. https://www.springer.com/gp/book/9783540791157

MappingwithProgrammeOutcomes:

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

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

CORE-VII PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**						
Paper Number	CORE VII						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	
		Semester	IV				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		3	1	-	4		
Pre-requisite		Studentsshouldknowaboutthefundamentsof Gymnosperms, fossil records and evolution.					

Learning Objectives		
C1	To enable the students to understand the general characters, classification and economic importance of gymnosperms	
C2	To enable the students to understand the morphology, internal structure and reproductionin Gymnosperms.	
C3	To acquaint students with evidences of the past history of plant groups and significance of the fossilization.	
C4	To understand the various fossil genera representing different fossil groups.	
C5	To know about basic concepts on evolution and origin of life	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Relate to the general characteristics of Gymnosperms and their economic importance.K1	
CO2	Explain about the morphology , anatomy and reproduction in Gymnosperms. K2	
CO3	Determine the various fossilization methods and their significance in paleobotany	K3
CO4	Compare the structures of various fossil forms	K4
CO5	Understand the process of evolution of lifeK5	
UNIT	**CONTENTS**	
I	**GYMNOSPERMS** General characteristics,.classification of Gymnosperms (Sporne,1954) (up to order)., Economic importance of Gymnosperms with special reference to oil, resin, timber, Ornamental and medicinal values..	

II	Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: 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.. Contributions of Birbal Sahni.
IV	Study of the following fossils: Rhynia, Lepidodendron and Lyginopteris
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquired fromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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	1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications,

Books	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/

MappingwithProgrammeOutcomes:

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

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

CORE-VIII PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV**						
Paper Number	CORE VIII						
Category	Core	**Year**	II	**Credits**	3	**CourseCode**	
		Semester	IV				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		-	-	2	2		
Pre-requisite		Studentsshould be familiar withthefundamentalsofGymnosperms, 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 identification of fossil forms	
C4	To enable students to gain knowledge on the contributions of evolutionary scientists	
C5	To enable the students to identify gymnosperms in the natural habitats.	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Analyze and observe and record the morphological features of selected species of Gymnosperms.	K1
CO2	Identify and Illustrate the morphological and anatomical features of gymnosperms . .	K2
CO3	Describe the structure of fossil forms prescribed in the syllabus.	K3
CO4	Develop skills in sectioning and micro preparation. K4	
CO5	Interpret the significance evolutionary mechanisms	K5

PRACTICALS

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

3. Study the following fossil forms: *Rhynia*, *Lepidodendron* and, *Lyginopteris* through permanent slides/photographs

4.Photograph of evolution scientists mentioned in the syllabus.

5.Field visit to study the habitat.	
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfrom this course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. SharmaO.P and S, Dixit.2002.Gymnosperms.PragatiPrakashan. 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.
ReferenceBooks	1. Smith, G.M. 1955. CryptogamicBotanyVol.II.TataMcGrawHill. NewDelhi. 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.

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 6

FERMENTATION TECHNOLOGY

Title of the Course	**FERMENTATION TECHNOLOGY**						
Paper Number	Skill Enhancement						
Category	Elective	**Year**	II	**Credits**	2	**CourseCode**	
		Semester	IV				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		2	-		-	2	
Pre-requisite	To students to know about the various fermentation technology.						

Learning Objectives	
C1	To appreciate the significance of microbes synthesizing fermented products.
C2	To gain insights in the principles of fermentation
C3	To design and operation of industrial practices in mass production of fermented products.
C4	To know about the various methods in fermentation technology.
C5	To learn about the bioproduct recovery.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Enumerate the significance of microbes in fermentation technology. K1	
CO2	Explain the principles of fermentation.K2	
CO3	Explain the process of maintenance and preservation of microorganisms.	K3
CO4	Analyze the various aspects of fermentation in the production Of preservatives and antibiotics .K4	
CO5	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- Yeast, Lactobacillus.
II	Principles of fermentation: Submerged,solid state, batch, fed-batch and continuous culture

III	Production of fermented products, Maintenance and preservation of microorganisms involved in - cheese and bread.
IV	Fermentative production of Vinegar, Beer, Gluconic acid and Streptomycin
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.
Extended ProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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/

MappingwithProgrammeOutcomes:

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

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

CORE IX PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	CORE IX						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	4	1		5

Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.

Learning Objectives	
C1	To provide knowledge on the morphology (vegetative structures and floral structures) of flowering plants.
C2	To enable the Students to know about the systems of classification of plants.
C3	To know the characteristic features of the selected families.
C4	To know and identify the key floral characteristics of the selected families
C5	To know the economic importance of plants.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Define the concepts in plant morphology and rules of ICN in botanical nomenclature	K1
CO2	Classify systems of plant classification and recognize the importance of herbarium.K2	
CO3	Define vegetative and floral features of selected familiesK3	
CO4	Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
CO5	Describe the core concepts of economic Botany Andrelateitsapplications in human life	K5

UNIT	**CONTENTS**
I	**Morphology** Morphology– root system – tap root,modifications. Shoot system – underground modifications. Leaf-Types-simple and compound- phyllotaxy, modifications-phylloclade, phyllode, tendrils, stipules. Inflorescences — racemose, cymose, and special types. Fruits – classification (outline only).
II	**Taxonomy** Systems of Angiosperm classification – Artificial , Natural and Phylogenetic. An outline of Bentham and Hooker system of classification, and Engler &Prantle Classification.Botanical nomenclature–rules, typification and author citation. Herbarium

	technique–collection, pressing, drying, mounting and preservation of plant specimens.
III	StudyofthefollowingfamiliesbasedontheNaturalsystemandtheireconomicimportance:Annonaceae,Nymphaeaceae,Rutaceae,Caesalpinaceae,Cucurbitaceae,Apocynaceae and Asclepiadaceae.
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Euphorbiaceae,Liliaceae,Arecaceae and Poaceae.
V	**Economic Botany** Economic importance of families prescribed in the syllabus with reference to: fruits, vegetables, cereals, spices, oils, timber, dye, medicine
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

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

CORE X CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY

Title of the Course	**CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY**						
Paper Number	**CORE X**						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		3	2	-	5		
Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.						
Learning Objectives							
C1	To Distinguish between prokaryotic and eukaryotic cells.						
C2	To know fundamental concepts of structure and function of cell organelles						
C3	To understandthe internal tissue organization of various plant organs.						
C4	.To familiarize with normal and anomalous secondary growth in plants						
C5	To comprehend the structural organization of reproductive organs with relevance to the process of pollination and fertilization						
Course outcomes: CO	**On completion of this course, the students will be able to:**					**Programme Outcomes**	
CO1	Relate to the fundamental concepts of cell structure and cell division					K1	
CO2	Describe the internal tissue organization of various plant organs					K2	
CO3	Elucidate the stages of normal and abnormal secondary growth.					K3	
CO4	.Analyse the patterns of normal and anomalous secondary growth					K4	
CO5	Compare the structural organization of reproductive organs in relation to the process of pollination and fertilization					K5	
UNIT	**CONTENTS**						
I	**CELL BIOLOGY** Ultra structure of Prokaryotic cell and Eukaryotic cell. Cell wall- Structure, and functions of cell wall, Plasma membrane - structure (fluid mosaic model) and function. Cell cycle, Cell division, Mitosis and Meiosis- their significance						
II	Structure and function of Endoplasmic reticulum, Ribosomes, Mitochondria, Chloroplast, Nucleus, and Chromosomes. Cell inclusions – starch grains,						

	crystals - cystolyth and raphide.
III	**ANATOMY** Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function,. Apical organization and theories: Tunica-Corpus theory. Root apex: Histogen theory .
IV	Primary structure of root and stem (Dicot and monocot). Secondary thickening in dicot root and stem. Anomalous secondary growth of stem- Boerhaavia, and Dracaena.
V	EMBRYOLOGY Structure of mature anther and ovule**,** types of ovules. Female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type in detail);Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial. Endosperm haustoria
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquired fromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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 (4th 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-BIOTECHNOLOGYebook/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.

MappingwithProgrammeOutcomes:

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

CO2	3	3	2	2	3	3	2	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	3	3	2	3	2	3	3	3	2	3

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

CORE XI - PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-PRACTICAL-V

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-PRACTICAL-V**						
Paper Number	CORE X						
Category	Core	**Year**	III	**Credits**	2	**CourseCode**	
		Semester	V				
InstructionalHours perweek	**Lecture**	**Tutorial**		**LabPractice**		**Total**	
		-		3		3	
Pre-requisite	Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.						

Learning Objectives	
C1	To study morphology of plant parts
C2	To enable the students to describe the plant technically using the floral characteristics.
C3	To preserve the plants and prepare herbarium sheets.
C4	To understand the economic importance of flowering plants
C5	To be able to identify the local flora.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the distinguishing plant morphological characters.	K1
2. Identify locally available plants to their respective families.	K2
3. Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.	K3
4. Understand the economic uses of flowering plants.	K4
5. Validate thelocal flora by analyzing and dissecting the vegetative and floral	K5

characters.	

PRACTICALS

1.Morphology of root, stem and leaf modification, types of inflorescence as mentioned in the theory.
2. Dissection, identification, observation of the floral parts of the plants belonging to the families included in the syllabus.

2. Preparation and submission of ten Herbarium sheets and field notebook
3. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
4. .Field trips to places for observation, study and collection of plants prescribed in the syllabus for 2 to 3 days under the guidance of faculties

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062. 3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education. 4. Pandely, B.P. 1987. Taxonomy of Angiosperms. 5. Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
ReferenceBooks	1. MannJ.Davidson,R.SandJ.B.Hobbs,D.V.Banthorpe,J.B.Harborne.1994.*NaturalProducts*.Longman Scientificand TechnicalEssex.

	2. Gopalan,C., B.V.RamasastriandS.C.Balasubramanian.1985.NutritiveValueofIndianFoods. NationalInstituteofNutrition,Hyderabad. 5. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London. 6. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London. 7. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.
Web resources	1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210 2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html 3. https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8 4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C 5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592 6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.

MappingwithProgrammeOutcomes:

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

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

CORE XII - CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY

PRACTICAL-VI

Title of the Course	**CELL BIOLOGY, PLANT ANATOMY AND EMBRYOLOGY PRACTICAL-VI**						
Paper Number	**CORE XII**						
Category	Core	**Year**	III	**Credits**	2	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
				-	2	2	
Pre-requisite	Theoretical understanding of anatomy, embryology, cell biology, genetics and plant breeding as well as basic laboratory skills for the relevant core course.						
Learning Objectives							
C1	To study the cell structure and cell organelles						
C2	To learn about cell inclusions and methods of cell division..						
C3	To identify the structure of plant tissues.						
C4	To understand about normal and anomalous secondary growth						
C5	To recognize the structure of anther, ovule and learn the skill of embryo dissection						

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Identify the structure of cell organelles and stages of cell division.	K1
2. identify types of planttissues	K2
3. Compare the functions of various ergastic substances present in plant tissues.	K3
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K4
5. Interpret the stages of embryo development through dissection	K5

PRACTICALS

. **Cell Biology** 1. Study of photo micrographs of cell organelles mentioned in the theory. 2. Observation of cell inclusions through permanent slides -starch grains, , crystals - cystolyth and raphide. 3. Identification of different stages of mitosis by using squash and smear techniques (acetocarmine) – onion root tip.	
Anatomy 4. Observation of Simple and complex (Primary and Secondary) tissues.through permanent slides. 5. Observation of Meristems – Shoot apex and Root apex through permanent slides 6. Sectioning: Internal structure of young root and stem of dicot and monocot plant. 7. Sectioning: Secondary structure of dicot and monocot root. 8. Sectioning of Anomalous secondary growth in the stems of *Boerhaavia,* and *Dracaena*. .	
Embryology 9. Sectioning mature anther- Datura 10. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides). 11. Types of Endosperm - Nuclear, cellular and helobial(photograph) 12. Dissection and display of anyone stage of embryo in *Tridax.*	
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

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

CORE XIII

2. PROJECT WITH VIVA-VOCE - GROUP PROJECT

Title of the Course	**PROJECT: GROUP PROJECT**						
Paper Number	**CORE XIII**						
Category	Skill Enhancement	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		1		-	4	5	
Pre-requisite	To allow students to demonstrate the personal abilities and skills required to produce and present an extended piece of work and as well as to practice writing thesis.						
Learning Objectives	1.To recognize the concept of research and its various forms in the context of botany.						
	2.To improve abilities relating to scientific experiments.						
	3.To become proficient in data collection and the documentation of scientific findings.						
	4.To prepare students for entry-level positions or professional training programmes in any field of Botany.						
	5.Compare the various reporting and writing styles used in science.						

UNIT	CONTENTS
I	1. EachstudentwillbeallottedaProjectGuidefromthefacultyofthe departmentconcerned by lot method. 2. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. 3. Afterthecompletionoftheprojectwork,thestudenthastosubmitfourcopiesof dissertation withreportcarryinghis/herprojectreport for evaluation by examiners. After evaluation, one copy is to be retained in the College Library. 4. Projectworkwillbeevaluated by boththeexternalandtheinternal(ProjectGuide)examiners for the maximum of 100marks in total on the scale of the maximum of 50marksforthe internal andthe externaleach. Viva-vocewillbeconductedbythepanelcomprising,ExternalexaminerandInternal Examiner for the maximum of 100 marks in total on the scale of the maximum of 50marksforthe internal andthe externaleach.

II	1. Dissertation/Thesis based on the work done by the student. 2. Soft copy of the project on CD/DVD. **PROJECT EVALUATION GUIDELINES:** **The project is evaluated on the basis of following heads:** For Viva-Voce maximum is 60 marks which will be conducted by both the internal and external examiners during end semester university practical examinations. **Internal:** 40 marks I Review – Selection of the field of study, topic and literature collection - 15 marks II Review – Research design and data collection - 10 marks III Review – Analysis and conclusion, preparation of rough draft - 15 marks **External:** 60 marks Thesis/ Dissertation - 30 marks Presentation - 15 marks Viva-voce - 15 marks
III	**Suggested areas of work:** Algae, fungi, microbiology, biocontrol agents, plant tissue culture, plant physiology, phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, sustainable agriculture, herbal formulations, cytogenetics, molecular biology, biotechnology, bioinformatics, nanotechnology and applied botany.
IV	**Methodology:** **Each project should contain the following details:** 1. Brief introduction on the topic 2. Review of Literature 3. Materials and Methods 4. Results and Discussion – evidences in the form of figures, tables and photographs. 5. Summary 6. Bibliography

Extended Professional Component (is a part of internal component only, Not to be included in the External	Questions related to the above topics, from various competitive

Examination question paper)	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. Wilson,KandJ.Walker(Eds).1994.PrinciplesandTechniquesofPracticalBiochemistry(4th Edition)CambridgeUniversityPress,Cambridge.
2. Bendre,A.MandAshokKumar.2009.AtextbookofpracticalBotany.Vol.I&II.RastogiPublication.Meerut. 9thEdition.
3. ManjuBala,SunitaGupta,Gupta,N.K.2012.PracticalsinPlantPhysiologyandBiochemistry.ScientificPublisher.
4. Wilson,KandJ.Walker.2005.PrinciplesandTechniquesofPracticalBiochemistry,5thEdition. CambridgeUniversitypress,NewYork.
5. RodneyBoyer.2000.ModernExperimentalBiochemistry, 3rdEdition.PublishedbyAddisonWesleyLongman. Singapore.

Reference Books:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. 1999. Plant microtechnique and microscopy. Oxford University Press, New York, U.S.A.
4. Wilson and Goulding. 1987. Principles of biochemical techniques, Oxford University Press.
5. Mukherji, S. and Ghosh, A.K. 2005. Plant Physiology. First Central Edition, New Central Book Agency (P) Ltd., Kolkata.
6. Taiz, L and Zeiger, E. 2010. Plant Physiology. 5th Edition. Sinauer Associates, USA.
7. Heldt, H.W and Piechulla, B. 2010. Plant Biochemistry, 4th Edition. Academic Press, NY.

Wilson, K and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology, Seventh edition, Cambridge University Press, USA.

Web resources:

1. https://handbook.monash.edu › units › BIO3011
2. https://www.amazon.in/Practical-Manual-on-Plant-Biochemistry/dp/6200539790
3. https://www.amazon.in/Laboratory-Manual-Physiology-Mukesh-Amaregouda/dp/6133993502
4. https://www.kopykitab.com/A-Laboratory-Manual-of-Plant-Physiology-Biochemistry-and-Ecology-by-Akhtar-Inam
5. https://kau.in/document/laboratory-manual-biochemistry

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE – 5

1. BIO-ANALYTICAL TECHNIQUES

Title of the Course	**BIO-ANALYTICAL TECHNIQUES**					
Paper Number	Elective-V					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**
		3	1		-	4
Pre-requisite	To impart expertise about analysis and research.					

Learning Objectives		
C1	To understand the principle, operation of micrscopes	
C2	To know the principle and application of chromatographic techniques	
C3	To equip students with understanding on pH metry and gel electrophoresis	
C4	To provide an overview of spectrophotometry and centrifugation techniques	
C5	To give an exposure to application of statistics in biological research	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Relate to the various techniques in microscopy and Micro measurements K1	
CO2	Explain the principles and application of chromatography for separation of biomoleculesK2	
CO3	Develop methodologies for extraction and analysis of biochemical compounds.	K3
CO4	Compare and contrast the significance of different types of separation techniques. K4	
CO5	Apply suitable strategies in data collections and disseminating research findings.	K5

UNIT	**CONTENTS**
I	**I MICROSCOPY:** Principles and structure of microscopy; Light microscopy; Fluorescent, Transmission and Scanning electron microscopy. Microscopic measurements-micrometry- Stage and ocular micrometer
II	**CHROMATOGRAPHY:** Principle and applications: Paper chromatography, Thin Layer Chromatography

	(TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS)
III	**ELECTROPHORESIS ANDPH METER:** Basic principle, construction and operation and applications 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:** Collection and interpretation of data, sampling; 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.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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_EGf73exaWpY8D9JNpJZsOcXQCQ4pZlRzTrYH2lopaVP1xxoClPgQAvD_BwE 5. https://www.kobo.com/us/en/ebooks/biostatistics 6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE – 5

2. BIO-ANALYTICAL TECHNIQUES

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE – 5

2. AQUATIC BOTANY

Title of the Course	**AQUATIC BOTANY**					
Paper Number	Elective-V					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**		
	3	1	-	4		
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: CO	**On completion of this course, the students will be able to: Outcomes**	**Programme**
CO1	Recognize aquatic plants and their ecological importance.	K1
CO2	Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
CO3	Apply techniques for conservation of aquatic plants for value addition.	K3
CO4	Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
CO5	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.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE - 5

3. ENTREPRENEURIALBOTANY

Title of the Course	ENTREPRENEURIAL BOTANY					
Paper Number	Elective-V					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	1	-	4

Pre-requisite	To develop innovative ideas to exploit the economically useful plant product for commercial purposes.

Learning Objectives	
C1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.
C2	To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.
C3	To comprehend the molecular processes.
C4	To expose the students a fundamental of the various value added products.
C5	To introduce the entrepreneurial opportunities.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	1.Recognizethesignificance of governmentagencies forentrepreneurship development. K1	
CO2	2.Explainaboutentrepreneurialvalues, riskassessmentand solutions.	K2
CO3	3.Makeuseof entrepreneurial opportunities.	K3
CO4	5. Analyse and decipherthesignificanceof bioventureand valueadded products.	K4
CO5	5. Devise innovativemethod for making value addedproducts.	K5

UNIT	**CONTENTS**
I	**INTRODUCTION:** Need-definitionandconcept-Typesandcharacterization-entrepreneurialvalues-motivationandbarriers-entrepreneurshipasinnovation,riskassessmentandsolutions.

	.
II	**BIOVENTURE:** Industry - overview of Spirulina, Pleurotus, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil(SVO)and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	**VALUEADDED PRODUCTS:** Canning of fruits - process and equipment, fruit and vegetable based products (squash) -ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam andjellies),PalmyrahPalmproducts,PerfumesfromRose/Jasmine-Bambooandcanebased products-virgincoconutoil,jasmineoilproduction,nutraceuticals,standardsandqualitymanagement.
IV	**ORGANIZATIONSANDAGENCIES:** TIIC,DIC,NABARD, MICROSTAT,DBT-casestudy-sarvodaya–SIDCO–Micro Small and Medium Enterprises–support structurefor promoting entrepreneurshoip–various governmentschemes.
V	**ENTREPRENEURIALOPPORTUNITIES:** Understanding a market and assessment, selection of an enterprise, business planning,mobilization of resources, Break Even Analysis, project proposal (guidelines, collectionof informationandpreparationofproject report),stepsinfilingpatents,trademarksand copyright,IntellectualPropertyRights,exportandimportlicense.
ExtendedProfessional Component (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Taneja,S.andGupta,S.L.2015.Entrepreneurshipdevelopment,Newventurecreation,Galgehapublicationcompany,New Delhi.ISSN:2321-8916. 2. Desai,V.,2015.Entrepreneurshipdevelopment,Firstedition.Himalayapublicationhouse,Mumbai. ISBN:9789350973837. 3. Khanna,S.S.2016.Entrepreneurialdevelopment.S.Chandcompanylimited,NewDelhi.ISBN:9788121918015. 4. Bendre,M.AshokandAshokKumar, A.

	2020.TextBookofPracticalBotany1(10th ed).RastogiPublications, Meerut. 5. Singh,RandU.C.Singh2020.Modernmushroomcultivation,3dEditionAgrobios(India),Jodhpur.Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi. 6. Thakur, R. S., H. S. Puri, and Husain, A. 1989. *Major medicinal plants of India*. Central Institute of Medicinal and Aromatic Plants, Lucknow, India
Reference Books	1. Manohar,D.1989.Entrepreneurshipofsmallscaleindustries,vol.III.Deepanddeeppublication,NewDelhi. ISSN:09735925. 2. Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservationoffruitsandvegetables.IndianCouncilof AgriculturalResearch (ICAR). ISSN:0101-2061. 3. Ranganna,S.,2001.Handbookofanalysisandqualitycontroloffruitsand Vegetable products,Secondedition,TataMcGraw hill,New Delhi.ISBN:780074518519. 4. Gupta.P.K.,1998.ElementsofBiotechnology.Rastogipublications,Meerut. 5. EdmondMusserandAndres,FundamentalsofHorticulture,McGrawHillBookCo.New Delhi.
Web resources	1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entrepreneurship/ 2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/value-added-products-microalgae-faizal-bux 3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3 4. https://www.elsevier.com/books/value-addition-in-food-products-and-processing-through-enzyme-technology/kuddus/978-0-323-89929-1 5. https://www.oreilly.com/library/view/selling-today- 6. partnering/9780134477404/xhtml/fileP700101194000000000000000001DEB.xhtm

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE – 6

1. PLANT BIORESOURCES

Title of the Course	**PLANT BIORESOURCES**					
Paper Number	Elective-VI					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**		
	3	1	-	4		
Pre-requisite	Knowledge gained on structure, reproduction & life cycle of different plant groups in XII Std & I yr UG.					

Learning Objectives	
C1	To know the existing usages of various plant Bioresources
C2	Gain knowledge on various production process & applications of the plant Bioresources
C3	Encourage research and enterpreuner ideas about plant Bioresources & its utilization in different fields.
C4	
C5	

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Understand algae as bioresourses in field of soil fertility, medicine and research; role of algae in pollution studies.	K1
CO2	Learn about algal commercial products.	K2
CO3	Appreciate industrial uses of Fungi.	K3
CO4	Explore the use of Lichens, Bryophytes, Pteridophytes and Gymnosperms.	K4
CO5	Expose to production of Industrial products.	K5

UNIT	**CONTENTS**
I	**AGRICULTURE USES OF ALGAE:** Algae- Role of algae in soil fertility, green manure, nitrogen fixation,. Medicinal uses, biofuels, research tools. Algae as pollution indicators, water blooms, eutrophication, and parasitic algae.
II	**INDUSTRIAL USES OF ALGAE:** Role of algae as food and fodder. Commercial products- Agar- Agar, Carrageenan, Alginic acid, diatomite and their uses in various industries. Algae and space travel. Methods of cultivation of seaweeds.

III	**INDUSTRIAL USES OF MICROBES** Fungi and bacteria: Role in medicine, food, industrial uses –alcohol, enzyme, organic acid, hormones, cheese, proteins, vitamins, antibiotics, probiotics. Harmful effects of fungi on man and plants (outline only).
IV	**ORGANIC FARMING & BIO-REMEDIATIONS:** Organic farming- definition and basic concepts, farm manures, mulches, mycorhizal association, types.VAM and its uses. Recycling of biodegradable municipal, agricultural and industrial wastes, bio composting.
V	**USES OF CRYPTOGAMS AND GYMNOSPERMS:** Selection of an enterprise, business planning, mobilization of resources, project proposal (guidelines, collection of information and preparation of project report), steps in filing patents, trademarks and copyright, Intellectual Property Rights, export and import license.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Vashishta, B.R., Sinha, A.K. and Singh, V.P. 2008. Botany for Degree Students: Algae. S. Chand & Company Ltd., New Delhi. 2 Vashishta, B.R. 1990. Botany for Degree Students: Fungi. S. Chand & Company Ltd., New Delhi. 3. Vashista, P.C. 1997. Botany for Degree StudentsPteridophyta. S. Chand and Company Ltd., New Delhi. 4 Vashishta, P.C. 1996. Botany for Degree Students-Gymnosperms (2nd Edn.,). S. Chand and Company Ltd., New Delhi. 5. Pandey, B.P. 2001. College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd., New Delhi.
Reference Books	1. Kumar, H.D. 1999. Introductory Phycology (2nd edition). Affiliated EastWest Press Pvt. Ltd. Delhi. 2. Sharma OP. 1989. Text Book of fungi. Tata McGraw Hill, New York. 3. Hale, 1996. The biology of Lichens, New Age International Publishers, New Delhi. 4. Smith, G.M. 1955. Cryptogamic Botany Vol. II Bryophytes and Pteridophytes (2nd edn.). Tata McGraw Hill Publishing Co., New Delhi.

	5. Pandey. 1998. A Text Book of Botany Vol. II. S. Chand & Co. Ltd. 1980. 6. Palaniappan, S.P and K. Annadurai. 2018. Organic farming theory and practice, Scientific Publishers Jodhpur, India.
Web resources	1. https://www.mooc-list.com/course/introduction-algae-coursera 2.https://swayam.gov.in/nd2_cec20_bt11/preview 3. https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,-Oil,-Fibre,- Timber-yielding-plant_1095/ 4. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118460566 5.

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE - 6

2. SEED BIOLOGY

Title of the Course	**SEED BIOLOGY**					
Paper Number	Elective-VI					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**
		3	1		-	4
Pre-requisite		**Knowledge on seeds, germination, viability and seed dormancy gained during lower classes.**				

Learning Objectives	
C1	To study the morphology, structural details of economically important seeds.
C2	To Know about Physico-chemical aspects of seed germination .
C3	To enable the students to perform seed germination test.
C4	Understand seed viability, tetrazolium test and seed vigour test.
C5	Learn dormancy, it's various kinds and factors to break dormancy.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Understand seed biology and morphology of different seeds.	K1 & K2
CO2	Learn about seed germination process and changes associated with it.	K3
CO3	Know about tests required for seed germination	K4
CO4	Gain knowledge on various seed germination tests and seed vigour.	K5
CO5	Overview what is dormancy, its kind, significance and how to break it.	K6

UNIT	**CONTENTS**
I	**INTRODUCTION TO SEED BIOLOGY:** Morphology and structural details of seeds: Cereals : Paddy Pulses : Dolichos ,Oil seeds : Castor; Fibers : Cotton Vegetables : Cucurbita
II	**SEED GERMINATION:** Germination - General account. Factors affecting germination. Changes that take place during germination (physical and chemical) Treatments given to quicken germination (Physical and chemical)
III	**SEED GERMINATION TEST AND EVALUATION:** Seed germination test under laboratory conditions. Using paper (BP & TP)

	sand and soil. The environmental test conditions. Evaluation of germination test.
IV	**SEED VIABILITY:** Seed viability; Topographical Tetrazolium Test. Seed vigour: Definition, concept, Direct and Indirect vigour tests.
V	**SEED DORMANCY:** Dormancy – Primary and secondary dormancies.,Causes and methods used to break dormancy.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Mayer A. M & Poljakoff Mayer. 1975. Germination of seeds. Springer. Pergamon Press, Oxford—New York—Toronto—Sydney—Paris 2.Bryant, J. A.1985. Seed physiology -–Edward Arnold. London. 3. Agarwal, R.L. 1982. Seed Technology -. Oxford and IBH Publishing Company, New Delhi. 4. Bewley, J.D and M. Black.1978. Seed Biology Vol. I & II Academic press, New York. 5. Agarwal, R.L. Seed Technology. 2020. CBS Publishers and Distributors Pvt Ltd.
Reference Books	1. Mayer, AM and Poljakoff-Mayber, A. 1989. The Germination of Seeds 4th edn. Pergamon Press, England. 2 Baskin, C.C and Baskin, J.M. 2001. Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination, Academic Press, San Diego. 3 Bedell, PE. 1998. Seed Science and Technology: Indian Forestry Species.Allied Publishers Limited, New Delhi. 4 Bewley, J.D and Black, M. 1994. Seeds: Physiology of Development and Germination. 2nd edn. Plenum Press, New York. 5 Khan, A.A. (Latest Edition) (Ed.). 1977. The Physiology and Biochemistry of seed Dormancy and germination. North-Holland Publishing Company: AmsterdamNew York- Oxford.
Web resources	1. https://swayam.gov.in/nc_details/NPTEL 2 https://swayam.gov.in/NPTEL 3 2.https://swayam.gov.in/explorer 4 3.https://www.classcentral.com/course/swayam-principles-of-seed-technology-17741 4. https://www.classcentral.com/course/swayam-plant-groups-19787 6

	5.https://www.kanchiuniv.ac.in/assets/SWAYAM-BOOKLET.pdf 7 6.https://www.hindiyojana.in/swayam-free-online-course-registration/ 8 7.https://www.aicte-india.org/sites/default/files/SWAYAM_1.pd

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE - 6

3. POMOLOGY

Title of the Course	**POMOLOGY**					
Paper Number	Elective-VI					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		3	1	-	4	
Pre-requisite	Basic knowledge on fruit cultivation, harvesting and disease management gained during Class XII.					

Learning Objectives	
C1	Understand pomology, tropical fruit cultivation, its status, fruit growing regions of India and in Tamil Nadu.
C2	Find out the overall strategies and techniques to grow different commercial fruits.
C3	Impart knowledge on cultivation methods of some prominent fruit varieties.
C4	Learn about the cultivation methods of subtropical and tropical fruits.
C5	Study about temperate fruits and their propagation methods.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Gain information about cultivation of Indian fruits.	K1
CO2	Understand pomology, tropical fruit cultivation of India.	K2
CO3	Identify methods for producing subtropical humid zone fruits.	K3 & K4
CO4	Get a thorough knowledge about classification and production methods of temperate fruits.	K5
CO5	Learn about the production of export varieties of fruits.	K6

UNIT	**CONTENTS**
I	**INTRODUCTION TO TROPICAL FRUITS:** Tropical fruits cultivation - Past and present status of tropical fruits in India. General appraisal of fruit growing regions / Zones in India and Tamil Nadu.
II	**TROPICAL FRUIT CULTIVATION:** Climate and soil requirements - propagation techniques - planting. Nutrition-nutrient deficiency and management – flowering, fruit set, bearing problems - special horticultural technique. Harvesting techniques – post harvest handling & post-harvest treatments - ripening of fruits - storage and processing of Mango, Banana.

III	**EDAPHIC FACTOR FOR FRUIT CULTIVATION:** Soil type and structure, texture, pH, salinity, moisture and temperature. Manures and manuring of Papaya, Guava, Sapota, Lemon, Sweet orange, Jack fruit and Pine apple.
IV	**MANAGEMENT OF FRUIT CROPS:** Subtropical and humid zones of India and Tamil Nadu – importance and scope of fruit crops in these zones – management of nutrient – water needs – weed management –pruning method – physiology of flowering, use of plant growth regulators – harvesting procedures – post harvest aspects of the following crops: Mandarin, Avocado, Litchi, Carambola.
V	**PRODUCTION AND POST HARVEST MANAGEMENT OF FRUIT CROPS:** Classification of temperate fruits – detailed study of area, production, varieties– harvesting – post harvest handling and storage in the following crops: Apple, Pear, Plum, Strawberry, Cherries.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Bose, T. K.S K. Mitra, and D. S. Rathore. 1998. Temperate Fruits – Nayaprakash, Calcutta. 2. Bose, T.K. 1996. Fruits of India – Tropical and sub – tropical. Nayaprakash, Calcutta. 3. Bose T.K. S. K. Mitra and M. K. Sadhu. 1988. Mineral Nutrition of Fruit Crops. Naya Prokash, Calcutta. 4. Bose, T. K., S. K. Mitra and D. Sanyal, 2001. Fruits: Tropical and subtropical volume I. Naya Udyog, Calcutta. 5. Gardener, Bradford and Hooker. 1952. Fundamentals of fruit production. Mc Graw Hill Book Co. Inc. London. 6. Singh, S., Krishnamoorthy. S., and Katyal, S. L. 1967. Fruit culture in India. ICAR, New Delhi.
Reference Books	1. Bose, T.K & S. K. Mitra, Nayaprakash. 1990. Fruits: Tropical and subtropical.206 Bidhan Saram, Calcutta – 700 116, India.

	2. Mithra,S. K. T. K. Bose and D.S. Rathore. 1990. Temperate fruits. Horticulture and Allied Publisher. 3. Chattopadhyay, T. K. 1994. A text book of Pomology (Vol 1-3) Kalyani Publishers, New Delhi. 4.Pal, J.S. 1997. Fruit Growing, Kalyani Publishers, New Delhi. 5. Singh, S.P. 1995. Commercial Fruits, Kalyan Publishers, Ludhiyana.
Web resources	1. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php 8 2.https://www.indiacustomercare.com/swayam-online-education-toll-free-number-18001219025 9 3.https://www.britannica.com/science/pomology 10 4.https://www.thefreedictionary.com/pomolog 5. 2 https://swayam.gov.in/NPTEL

MappingwithProgrammeOutcomes:

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

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

ACADEMIC-INDUSTRIAL ACTIVITY

Internship/Industrial Training

Title of the Course	**ACADEMIC-INDUSTRIAL ACTIVITY**						
Paper Number	**Skill Enhancement**						
Category	Elective	**Year**	III	**Credits**	2	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
				-			
Pre-requisite		The summer vacation academic-industrail activity programme will give students the chance to experience real-world organisational situations, learn about processes and rules, and grasp the operations of the industry.					

C1	The main goal of the internship programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen days in an industry/institution over the summer..
C2	To comprehend how theoretical ideas are applied in many sectors and industries.
C3	To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem-solving and management skills.
C4	The internship must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.
C5	Internships provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.	K1
CO2	Compile data and familiarize yourself with techniques for plannir carrying out tests	K2
CO3	Collect data and educate yourself on how to analyze the results of you scientific studies.	K3 & K5

CO4	This in-the-moment industrial exposure helps them become knowledgeble and skilled in the latest technology.	K4
CO5	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur	K5 & K6
UNIT	**CONTENTS**	**No. of Hours**
I	**Guidelines for Internship Programme:** 1. To give students the opportunity to spend at least fifteen days on their own during the II Semester vocation in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures. 2. Individual instruction is provided for the internship. The internship programme must be completed in order to receive a credential. 3. Students are required to indentify a research labs/industry/recognized institution for their Internship Programme Coordinator in consultation with and approval of their faculty guide. The choice of the research labs/industry/recognized institution should be intimated to the Internship coordinator before commencement of the Internship. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship Program. 4. Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or shareholders, the nature of business, organizational structure, reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter. 5. Before leaving the research labs/industry/recognized institution, obtain the Internship Programme completion	

	certificate on the letterhead of a research lab/industry/, or an accredited institution. 6. Maintain Internship Programme record with details on activities and personal learning during their project period. 7. The department head and the coordinator of the internship programme form a committee to ensure that the internship is followed. 8. At least two copies of the report must be prepared by the intern at the conclusion of the internship program—one for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labeled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages. 9. The internship training report should be submitted to the department within a month from the date of commencement of third semester. 10. However, such submission shall not be accepted after the end of third semester Examinations.	
II	**Evaluation of the Internship:** i. The internship program will be assessed by the assigned Internship Programme Coordinator from the host institute. ii. Evaluation will be done by the Internship Programme Coordinator of the host institute and through seminar presentation/viva-voce. iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information. iv. According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the	

	internship coordinator.	
III	**College Guide Manual – Summer Internship Program** 1. The Internship Programme Coordinator should give proper procedures to the intern before and after the Internship. 2. The Internship Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the internship. 3. The weekly report submitted by the student should be reviewed and reported to the Internship Programme coordinator.	
IV	**Internal:** 100 marks Academic Industrial Activity- Programme Completion certificate - 30 marks Internship report - 30 marks Presentation - 20 marks Viva-voce - 20 marks	
V	**CONTENTS OF THE REPORT** Title page Page for supervisory committee Table of Acknowledgement Academic Industrial Activity- Programme Certificate **Executive Summary** Introduction of the Report Overview of the Organization What I have Learned Analyses Summary Recommendations and Conclusion References Appendices	

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme outcomes**
1. For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.	K1

2. Compile data and familiarize yourself with techniques for planning and carrying out tests.	K2
3. Collect data and educate yourself on how to analyze the results of your scientific studies.	K3 & K5
4. This in-the-moment industrial exposure helps them become more knowl and skilled in the latest technology.	K4
5. Improving communication skills and coming up with creative ideas are components of training that help someone become an entrepreneur.	K5 & K6

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis Course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

RecommendedText:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

MappingwithProgrammeOutcomes:

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

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

CORE XIV –PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**						
Paper Number	**CORE XIV**						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**		**LabPractice**	**Total**
		4		2		-	6
Pre-requisite		Understanding the environmental factors impacting biodiversity is crucial after taking this course.					

Learning Objectives	
C1	To know about plant water relationships
C2	To understand the mechanism of transpiration and translocation
C3	To conceptualize the processes of photosynthesis and respiration
C4	To know importance , functions and applications of growth hormones
C5	To familiarize with the structure and function of various biomolecules

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Relate to the significance of water in plant growth and development.	K1
CO2	Summarize the physiological events during transpiration and translocation	K2
CO3	Analyse the importance of photosynthesis and respirationK3	
CO4	Recaptulate the important growth factors and role of growth hormonesK4	
CO5	. Comprehend the structure , function and importance of various biomolecules. K5	

Unit	**CONTENTS**
I	**PHYSIOLOGY** **WATER RELATIONS:** Water relations—imbibition, diffusion, osmosis and plasmolysis; mechanism of water absorption – active and passive, Ascent of sap – path, Mechanism – Transpiration pull and cohesion theory.
II	Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories. Translocation of solutes – path, mechanism - Munch mass mass flow hypothesis
	PHOTOSYNTHESIS:

III	Photo systems.Light reaction: Electron transport system - Cyclic and non cyclic. Dark reaction - C3 cycle, C4 cycle, **RESPIRATION** Types, Glycolysis, Krebs Cycle, Oxidative phosphorylation, respiratory quotient
IV	**GROWTH:** Growth – Growth curve, plant growth regulators - auxins, gibberellins and cytokinins, - Practical applications. Photoperiodism and Vernalization.
V	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.Structure and function of DNA and RNA.Classification and importance of vitamins
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquired fromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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-PP5. 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)

MappingwithProgrammeOutcomes:

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

CO5	3	3	2	3	1	2	3	1	1	2

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

CORE XV GENETICS AND PLANT ECOLOGY

Title of the Course	**GENETICS AND PLANT ECOLOGY**						
Paper Number	**CORE XV**						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		4	2		-	6	
Pre-requisite	Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.						

Learning Objectives	
C1	To relate Mendelian genetics and laws of inheritance
C2	To know phenomenon of gene interaction
C3	To familiarize with the structure of chromosome and aberration types
C4	To know about concepts of ecology
C5	To understand the organization of ecosystem and flow of energy

Course outcomes: CO	**Programme On completion of this course, the students will be able to:**	**Outcomes**
CO1	Relate concepts of mendelian geneticsK1	
CO2	Explain the phenomenon and factors associated with gene interactionK2	
CO3	Elucidate structure, function and aberration of chromosomes.	K3
CO4	Analyze the importance of vegetation and adaptation of plants in environment. K4	
CO5	Interpret the types of ecosystems and energy flow at various trophic levels	K5

UNIT	**CONTENTS**
I	**GENETICS** .1.Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross – Back cross and Test cross. Incomplete dominance - Mirabilis jalapa. Lethal gene action in Maize
II	Interaction of factors – Complementary genes, Supplementary genes, Epistasis (dominant and recessive), duplicate genes. Extra nuclear inheritance and its significance - Male sterility in corn , Maternal inheritance – Plastid Inheritance in Mirabilis jalapa.

III	Chromosome theory of linkage, crossing over, recombinations. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation
IV	**ECOLOGY** Vegetation – Units of Vegetation – Formation, Association, Consociation, , Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical adaptations in plants.
V	Ecosystem - Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

CO3	2	2	3	3	1	2	1	3	1	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	3

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

CORE XVI- PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY PRACTICAL

Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRYPRACTICAL**						
Paper Number	CORE XVI						
Category	Core	**Year**	III	**Credits**	2	**CourseCode**	
		Semester	VI				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
		-	3	3

Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants.
Learning Objectives	
C1	To study plant water relations and membrane permeability
C2	To demonstrate rate of photosynthesis and respiration
C3	To carryout experiments related with separation of compounds
C4	To carry out estimation of important biomolecules
C5	To learn about structure of nucleic acids and enzyme action through models and charts

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate the importance of plant water relationships	K1
2. Demonstrate Experiments on rate of photosynthesis and respiration.	K2
3. Elucidate the basic principles involvedin separation of biological	K3

compounds	
4. Quantify important biomolecules in plant samples.	K4
5. Appreciate the structure of DNA and RNA mechanism of enzyme action by using models and charts	K5

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PRACTICALS

PHYSIOLOGY EXPERIMENTS

1. Determination of water potential by plasmolytic method.
2. Effect of temperature on membrane permeability.
3. Study of rate of photosynthesis under different wavelengths (red, green & blue) of light.
4. Determination of rate of respiration of different respiratory substrates.

Demonstration

1. Tissue tension
2. Suction due to transpiration
3. Ganong's potometer
4. Fermentation – Kuhn's Tube experiment

BIOCHEMISTRY

1. Estimation of Sugar Anthrone method

2. Separation of plant pigments by paper chromatography

3. Estimation of Starch - I_2 – KI Method

4. Estimation of Protein – Lowry method

Models for enzyme action – Lock and key, Induced fit

Models / photographs for structure of DNA and RNA

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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.AnintroductiontoPracticalBiochemistry,TataMcGraw–HillPublishing CompanyLtd.,New Delhi. 5 Palanivelu,P.2004.LaboratoryManualforanalyticalbiochemistryandseparationtechniques,SchoolofBiotechnology,MaduraiKamarajUniversity,Madurai. 6. Jayaraman.J.1981.Laboratory Manual in Biochemistry.Whiley Eastern Limited,NewDelhi. 7. Bendre,A.M.andAshokKumar,2009.AtextbookofpracticalBotany.Vol.I&II .RastogiPublication.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,KandJ.Walker(Eds).1994.PrinciplesandTechniquesofPracticalBiochemistry(4th Edition)CambridgeUniversityPress,Cambridge. 6. Bendre,A.MandAshokKumar.2009.AtextbookofpracticalBotany.Vol.I&II. RastogiPublication.Meerut.9th Edition.

	7. ManjuBala,SunitaGupta,Gupta,N.K.2012.PracticalsinPlantPhysiologyand Biochemistry.ScientificPublisher.
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

MappingwithProgrammeOutcomes:

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

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

CORE XVII–GENETICS AND PLANT ECOLOGY - PRACTICAL

Title of the Course	**GENETICS AND PLANT ECOLOGY - PRACTICAL**						
Paper Number	CORE XVII						
Category	Core	**Year**	III	**Credits**	2	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
				-	3	3	
Pre-requisite		Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants.					

Learning Objectives	
C1	To solve problems in Mendelian ratios
C2	To demonstrate mechanism of crossing over, mutations and male sterility
C3	To familiarize with the methods of studying vegetation
C4	To study morphological adaptation of plants in different habitats
C5	To identify internal adaptive characters of plants in different habitats

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1Relate to the Important concepts in mendelian genetics	K1
2.Demonstrate Skills in studying the mechanism of crossing over and mutations.	K2
3.Elucidate the basic principles practices involved in studying plant vegetation.	K3
4.Identify the morphological features of plants in different habitats	K4

.	
5.Analyse the internal adaptations of plant organs with reference to the habitat.	K5

PRACTICALS

GENETICS

Genetic problems – test cross, back cross, incomplete dominance and interaction of genes.

Photographs / Charts

1. Male sterility in Corn -

2.Maternal Inheritance

3.Crossing over- single and double crossing over

4.Mutation- Addition, Deletion, Duplication

Ecology

1. Analysis of herbaceous vegetation by using Quadrat and line transect method
2. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes..

Hydrophytes : *Nymphaea, Hydrilla*

Xerophytes : *Nerium, Casuarina*

Mesophytes : *Mangifera, Ficus*

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	8. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut. 9. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. 10. 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. 11. Plummer,D.1988.AnintroductiontoPracticalBiochemistry,TataMcGraw–HillPublishing CompanyLtd.,New Delhi. 12. Palanivelu,P.2004.LaboratoryManualforanalyticalbiochemistryandseparationtechniques,SchoolofBiotechnology,MaduraiKamarajUniversity,Madurai. 13. Jayaraman.J.1981.Laboratory Manual in Biochemistry.Whiley Eastern Limited,NewDelhi. 14. Bendre,A.M.andAshokKumar,2009.AtextbookofpracticalBotany.Vol.I&II.Rastogi Publication.Meerut.9th Edition.
Reference Books	8. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell. 9. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual. 10. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida. 11. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India). 12. Wilson,KandJ.Walker(Eds).1994.PrinciplesandTechniquesofPracticalBiochemistry(4th Edition)CambridgeUniversityPress,Cambridge. 13. Bendre,A.MandAshokKumar.2009.AtextbookofpracticalBotany.Vol.I&II.Rastogi Publication.Meerut.9th Edition. 14. ManjuBala,SunitaGupta,Gupta,N.K.2012.PracticalsinPlantPhysiologyandBiochemistry.ScientificPublisher.
Web resources	6. https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK 7. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009 8. https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9 9. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9386102633 10. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318

MappingwithProgrammeOutcomes:

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

CO3	2	2	3	3	1	2	1	2	2	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	2

ELECTIVE COURSE - VII

1. HORTICULTURE AND PLANT BREEDING

Title of the Course	**HORTICULTURE**						
Paper Number	Elective-VII						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek	**Lecture**		**Tutorial**		**LabPractice**	**Total**	
	3		2		-	5	
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 plant propagation methods						
C3	To know about the components of a garden						
C4	To provide an over view of plant breeding						
C5	To impart knowledge on importance of plant breeding						
Course outcomes: CO	**On completion of this course, the students will be able to Programme Outcomes**						
CO1	Enumerate the concepts in horticulture and nursery management.						K1
CO2	Demonstrate a working knowledge on propagation methods						K2
CO3	Appraise the importance of various components of a garden.						K3
CO4	Analyze different methods of Plant breeding techniqueK4						

CO5	Validate the role of plant breeding in producing disease resistant cropsK5
UNIT	**CONTENTS**
I	Scope, importance and divisions of horticulture. Gardening: Definition and objectives ;different types of gardening – Formal, informal and kitchen garden.
II	Propagation methods: Cutting – root, stem and leaf; Layering – ground and air layering, grafting– tongue and approach grafting; Budding – T budding and Patch budding; Vegetative propagules - bulb, sucker, corm. Seed Propagation: Preparation of Nursery beds,Transplantation – steps and Methods.
III	Garden components: Lawn, Hedges, Edges, Rockery, Topiary, water garden, Bonsai and Hanging basket.
IV	Nature, Scope and Objectives of Plant Breeding; Plant introduction-selection methods (pureline and mass), Hybridization techniques, Heterosis breeding, Interspecific and intergeneric hybridization.
V	Mutation Breeding: Procedure and practices, Mutagens, Polyploidy breeding and its applications. Breeding for disease resistance.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE - VII

2. NATURAL RESOURCE MANAGEMENT

Title of the Course	**NATURAL RESOURCE MANAGEMENT**						
Paper Number	Elective-VII						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**		**LabPractice**	**Total**
		3		2		-	5
Pre-requisite	To understand the concept of different natural resources and their utilization.						

Learning Objectives	
C1	To develop an appreciation for the natural resources and their ecological and economic impact.
C2	To gain an understanding of various strategies of natural resource management.
C3	To understand the concept of different natural resources and their utilization.
C4	To create the models of natural resource conservation and maintenance.
C5	To study the significance of natural resources pertaining to economy and environment.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Relate to significance of natural resources pertaining to economy and environment.	K1
CO2	Understand the concept of different natural resources and their utilization.	K2
CO3	Evaluate the management strategies of different natural resources.	K3
CO4	Critically analyze the sustainable utilization land, water, forest and energy resources.	K4
CO5	Design new models of natural resource conservation and maintenance.	K5 & K6

UNIT	**CONTENTS**
I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological,

	social and economic dimension of resource management.
II	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.
III	Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, new prospects.
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
ExtendedProfessionalComponent (is a part of internal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi. 2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. 3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 4. United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition 5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House 6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.
Reference Books	1. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303. 2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876. 3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner. 4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House. 5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press. 6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB). 7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science. 8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd. 9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
Web resources	1. https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&redir_esc=y 2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE 4. https://www.kobo.com/us/en/ebooks/natural-resources 5. https://www.igi-global.com/chapter/natural-resources-management/195183 6. 6crLIC&redir_esc=y 7. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 8. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE 9. https://www.kobo.com/us/en/ebooks/natural-resources 10. https://www.igi-global.com/chapter/natural-resources-management/195183

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE – VII

3. FORENSIC BOTANY

Title of the Course	**FORENSIC BOTANY**						
Paper Number	Elective-VII						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**	**LabPractice**	**Total**	
		3		2	-	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: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1
CO2	Summarize the forensic importance of different parts of plants	.K2
CO3	Apply techniques for the collection and preserve of botanical evidences of crime.	K3
CO4	Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
CO5	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.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE VIII

PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Title of the Course	**PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY**					
Paper Number	CORE XIII					
Category	Core	**Year**	III	**Credits**	3	**CourseCode**
		Semester	VI			
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**		
	4	1	-	5		
Pre-requisite	To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.					

Learning Objectives

C1	To know the importance and scope of biotechnology
C2	To familiarize with the tools and techniques in biotechnology
C3	To recognize plant tissue culture technique as important means of invitro propagation
C4	To know about genetic code and protein synthesis
C5	To familiarize with DNA replication and gene regulation.

Course outcomes: CO:	**Programme On the completion of the course the students will be able to**	**Outcomes**
CO1	Recognize the fundamentals concepts of plant biotechnology and genetic engineering.	K1
CO2	Applyvarious tools and techniques in biotechnology	K2
CO3	Elucidate methods used in plant tissue culture	K3
CO4	Explain various steps in protein synthesis	K4
CO5	Describe the mechanism of DNA replication and gene regulation.	K5

UNIT	**CONTENTS**
I	Biotechnology – definition, history and scope. Application of plant biotechnology in Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin.. Environment – Bioremediation and Biofuel.
	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, *Agrobacterium*

II	mediated gene transfer. Direct method – Biolistic method..
III	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 micro-propagation. Synthetic seed technology
IV	Genetic code and its features. Protein synthesis:Transcription. Enzymology – RNA polymerase – classes of RNA molecules and post transcriptional modifications, Translation.
V	Molecular mechanism of DNA replication. DNA damage and repair .Gene regulation in Prokaryotes – *lac* operon and *trp* operon.

ELECTIVE COURSE – VIII

2. FORESTRY

Title of the Course	**FORESTRY**						
Paper Number	Elective-VIII						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		3	2		-	5	
Pre-requisite	Prior knowledge on trees, forests and their importance.						

Learning Objectives	
C1	To study the distribution pattern, composition and diversity of forest ecosystem
C2	To understand the method of forest management principles and conservation.
C3	To enable them to meaningfully contribute in the forest conservation.
C4	To raise student awareness of the need to create a sustainable way of living and the current global issues with forestry caused by human interference.
C5	To provide a platform to appreciate biodiversity and the importance.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	K1
CO2	Understand complex interactions of humans and forest ecosystems in a global contex.	K2
CO3	Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
CO4	Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation.	K4
CO5	Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	K5

	UNIT

I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes,plants, animals, soil, wind, light, temperature, rainfall, and fire. Nutrient cycling in forests (Carbon, Nitrogen, oxygen, phosphorus and sulphur).
II	**SILVICULTURE**: Forests - definition. Forest types of India and Tamil Nadu - revised classification – pure and mixed stands - even and uneven aged stands. Role of forests - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.
III	Forest Resources and Utilization: Non-Timber Forest Products (NTFPs): gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac. Timber identification - general principles. Pulp, paper and rayon.
IV	Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation. Biodiversity - Definition, origin, types – factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book.
V	Conservation of forests: Importance of forests in Carbon sequestration, the social,cultural and economic value of forests and ecosystem services, Indian Forest Policy (1990), National Forest Policy (1988), People's involvement in protecting forests, Joint Forest Management, Involvement of women in forest conservation
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros. 2. Roger Sands. 2013. Forestry in a global context, CAB international. 3. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun. 4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi. 5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi. 6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat. 7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun. 8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun. 9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi. 10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
ReferenceBooks	1. Donald L. Grebner.Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press 2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland. 3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York. 4. Agarwala,V.P.1990.ForestsinIndia,EnvironmentalandProtectionFrontiers.OxfordIBHPublishingCo.,New Delhi. 5. Belcher,B.M. 1998.Aproduction-to-consumptionsystemsapproach:LessonsfromthebambooandrattansectorsinAsia.In:Wollenberg,EandA.Ingles(Eds.).Incomesfrom theforest:methodsforthedevelopmentandconservationofforestproductsforlocalcommunities.CenterforInternationalForestryResearch(CIFOR),Bogor,Indonesia. 6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. WertzKanounnikoff.2007.Incentivesandconstraintsshapeforestoutcomes.In:Atloggerheads?Agricultural expansion, poverty reduction and environment in tropical forests. The WorldBank,Washington,DC. 7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
Web resources	1. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf.

	2. https://www.britannica.com/science/forestry 3. https://en.wikipedia.org/wiki/Forestry. 4. https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119 5. https://academic.oop.com 6. https://www.cbd.int>development>doc. 7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

MappingwithProgrammeOutcomes:

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

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

ELECTIVE COURSE - VIII

3. COMPUTER APPLICATIONS IN BOTANY

Title of the Course	**COMPUTER APPLICATIONS IN BOTANY**						
Paper Number	Elective-VIII						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**		**LabPractice**	**Total**
		3		2		-	5
Pre-requisite	To equip students with computational skills for drug design.						
Learning Objectives							
C1	To familiarize the student with the fundamentals concepts of bioinformatics.						
C2	To equip students with computational skills for drug design.						
C3	Tolearnaboutthebioinformaticsdatabase,dataformatanddataretrievalfr omonlinesources.						
C4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.						
C5	Studentisawarewith the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.						
Course outcomes: CO	**On completion of this course, the students will be able to:** **Programme Outcomes**						
CO1	Recognize advanced resources for accessing scholarly literature from the internet.						K1
CO2	Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.						K2
CO3	Apply various software resources with advanced functions to carry out analysis of data procured through research.						K3
CO4	Decipher the effective utilization of bibliography management software while typing and downloading citations.						K4
CO5	Determine how the knowledge gained can be used for designing experiments and data interpretation.						K5 & K6
UNIT	**CONTENTS**						

I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media
II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines-yahoo, Google, etc. telnet, ftp.
III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.
V	**Applications:** Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS.Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

theExternalExamination questionpaper)	
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi Publications, 7th Reprint (1st Edition. 2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press. 3. Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc. 4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House. 5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons. 6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell. 7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.
Reference Books	1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US. 2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US. 3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun. 4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press. 5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg. 6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition. 7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Molecular Biologists. Volume III 2nd Edn. Horizontal Scientific Press, Norwich, UK.
Web Resources:	1. http://www.agrimoon.com/introduction-to-computer-applications-pdf-book/ 2. https://www.ebooks.com/en-us/subjects/computers/ 3. https://it.careers360.com/download/ebooks 4. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformatics2

	2.23-4-2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20Amira.pdf 5. http://www.freebookcentre.net/Biology/BioInformatics-Books.html 6. https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf

MappingwithProgrammeOutcomes:

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

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

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SEMESTER–II

FOODANDNUTRITION

Objectives

Preamble:Facilitatesunderstandingoftheprinciplesoffoodandnutrition.It providesthestudenttounderstandthenutritivevalues,importance, factorsaffectingstorageandmethodsofpreservationoffoodwhichmakethestudent sawareofapplicationof differentplantsinvariousindustries.

UNIT –I

Food: Major Classes of Food – Carbohydrates, Proteins, Fats and Oils, Vitamins, Minerals – Energy value of food. Balanced Diet.

UNIT– II

PlantsasSourceofFood:NutritiveValueofCerealsandMillets(Rice,Wheat,Maize, Ragi); Pulses (Black gram, Green gram, and Peas); Nuts and Oilseeds (Ground nuts, Sesame, Coconut,); Fruits and Vegetables (Mango,Banana,Guava, Cucumber,Ladiesfinger, carrot)

UNIT–III

FoodPreservation:ImportanceofPreservation,UsesofOilandSpices,UseofSaltandSugar.Preparati onofJelly,PicklesandSquashes.

UNIT– IV

FoodAdditives:DefinitionandTypes;FoodPoisoning-Botulism;FoodAdulteration-HarmfulEffects.

UNIT –V

FermentationsandBeverages:FermentationTypes,andUses.

REFERENCES:

1. BasicsofFood&NutritionMrs.Neetabaijal,Dr.LalitaSharmaStarpublications.
2. Hand book of Food and Nutrition Dr. M. S. Swaminathan

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SEMESTER- III
GARDENING AND GARDEN MANAGEMENT

Objectives:

- Enablethestudentstogainknowledgeaboutcropproduction,plant propagation, plant breeding,geneticengineering,preparationofsoilbiochemistryandsimultaneouslycanworkin various fields includingfloral design,gardencenters,teaching,fruit andvegetable production, arboriculture and landscape construction.

Unit – I

Garden:Types– Formal&InformalGarden–EnglishGarden,MogulGarden,Principlesof Ornamental Gardening.

Unit – II

PropagationTechniques:SoftWoodCutting–stem, leafandroot,SimpleandAirLayering. Implements–Pruningshears,GardenRake.

Unit – III

ComponentsofOrnamentalGardens:Hedges,Edges,FlowerBeds,Arches,Rockery,Lawnand Topiary.

Unit – IV

KitchenGarden:CompostPits,Layout,Preparationof Vermicompost and Panchakaviyas.

Unit – V

IndoorGardening:PrinciplesandMaintenance,Hangingbaskets,TerrariumandBonsai

REFERENCES:

1. FundamentalsofHorticultureandPlantBreeding.V.Kumaresan&N.Arumugam,Saras Publication, Nagercoil.
2. Horticulturalupdates;KrispaShankar,MohdTalhaAnsariMd.Ramjan,Thejangulie AngamiVikashkumar,B.NHazarika,NewVishal Publications.

SEMESTER–IV
PRESERVATION OF FRUITS AND VEGETABLES

Objectives:

- Inspireregarding theprinciplesofpreservationoffruitsandvegetables.
- Knowthenutritivevalues,importanceandfactorsaffectingstorage.
- Understand,methodsofpreservationoffruitsandvegetablesandpreservationrecipes.

UNIT –I

Nutritivevaluesoffruitsandvegetables; spoilage-microbial,enzymaticand insects.

UNIT– II

ImportanceandMethodsofPreservation-
Refrigeration,Freezing,Canning,DryingandDehydration,Preservatives– NaturalandChemical.

UNIT–III

Methods of preparation of Fruit Juice- Orange, Squashes- Pine apple; Jam - Mixed Fruit, Jellies-Guava.

UNIT– IV

Preparation of Chutney- Mango, Sauce –Tomato, Pickles- Mango,Drying of fruits:Grapes and Fig.

UNIT –V

CanningofMango,Cherry,Carrot,Bean andMushrooms.

REFERENCES:

1. Alex.VandRamani.2009.FoodChemistry,MPJPublishers,Chennai.
2. CruessW.V.1948. CommercialFruitsandVegetablesProducts,McGrawHillBookCompanyInc, NewYork.
3. GirdhariLal,G.S.SiddappaandG.L.Tandon,1986,PreservationofFruitsandVegetables,Indian Councilof AgriculturalResearch,NewDelhi.
4. Kumar,N.1997.IntroductiontoHorticulture,RajalakshmiPublication,Nagercoil.
5. Kumaresan,V.2009.Horticulture,SarasPublication,Nagercoil.
6. UshaRani,C.K.andR.MaryChristi.2010.PreservationofFruits andVegetables,SheenGrafix,Nagercoil.

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SEMESTER–V

FLORICULTURE

Objectives:

- Thecourseprovidesthoroughknowledgeaboutthecommercialcultivation offlowersanddifferentvalueaddedproductspreparedfromit.
- Ithighlightsthepotentialofthesestudiestobecome anentrepreneur.

UNIT –I

Floricultureanditsimportance,cultivationofJasmine and Rose.

UNIT– II

CommercialproductionandcultivationtechniquesofMarigoldandGerbera.

UNIT–III

Cultivationtechniquesof***Anthurium***and***Heliconia***,cutflowerproduction,importanceof cutflower production, package&export.

UNIT– IV

Importanceofflowersinperfumery,ExtractionofJasmineoilandRoseoil.

UNIT –V

Introduction,GeneralPrinciplesofflowerarrangement,WesternandJapaneseflowerarrangement.

REFERENCES:

1. Kumar,N.1997.IntroductiontoHorticulture,RajalakshmiPublication,Nagarcoil.
2. Kumaresan,V.2009.Horticulture,SarasPublication,Nagarcoil.
3. Randhawa,G.S.1973.OrnamentalHorticultureinIndia.TodayandTomorrowPrintersandPublishers,NewDelhi.
4. VishnuSwarap,1997.Gardenflowers,NationalBookTrust,India.

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SEMESTER–VI

BOTANY FOR COMPETITIVE EXAMINATION

Objectives:

The basic Principles of Botany to the students which are vital role for facing competitive examinations.

UNIT – I

Basics of the Plant Kingdom; Diagnostic features of Algae, Fungi, Bryophyta, Pteridophyta, Gymnosperms - Economic importance of these groups.

UNIT – II

Basics of Angiosperm Taxonomy: A brief account of Natural systems of classification (Bentham and Hooker's system) and Phylogenetic system of classification (Engler and Prantl's system) Binomial Nomenclature. A Brief account of the following Families and their Economic Importance – Fabaceae, Cucurbitaceae, Poaceae.

UNIT – III

Medicinal Importance: ***Zingiber officinale, Ocimum sanctum, Azadirachta indica, Phyllanthus niruri, Andrographis paniculata*** and ***Acalypha indica.***

UNIT – IV

Basics of Plant physiology: Basics of Absorption of Water, Transpiration, Photosynthesis, Respiration.

Ecosystem: Concept, processes and component: Types of ecosystems – Aquatic and Forest.

UNIT – V

An Introduction to Genetics - Mendelism, Monohybrid cross and Dihybrid Cross. Biofertilizers - Importance of biofertilizers: ***Azolla*** - Importance, mass production and application. Panchagavya - Importance, preparation and application of Panchagavya.

REFERENCES

1. Bhattacharya, Hait, Ghosh. 2014. A Text Book of Botany-(Volume:2), New Central Book Agency (P) Ltd, Kolkata.

2. Pandey S.N, Misra, S.P, Trivedi, P.S- 2012. A Text Book of Botany – Vikas Publishing House Pvt Ltd, Noida

3. Soni, N.K and Vandana soni-2010 Fundamentals of Botany (Volume 1,2,3) Tata Mc Graw Hill Education Private Limited, New Delhi

4. Yoganarasimhan.2000 Medicinal Plants of India Cyber media, Bangalore.

5. Miller, C.E. and Turk, L.M., 2002, Fundamentals of soil Science, Biotech Books, Delhi.