



PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 636011

DEGREE OF BACHELOR OF SCIENCE

CHOICE BASED CREDIT SYSTEM

Syllabus for

B.SC. BOTANY

(SEMESTER PATTERN)

(For Candidates admitted in the Colleges affiliated to Periyar University from 2026-27 onwards)

DEFINITION

PROGRAMME

“**Programme**” means the **degree programme** offered in a specific academic discipline.

COURSE

“**Course**” refers to the individual subjects offered under the degree programme, distributed across the entire duration of the programme of study, as detailed below.

Part I – Foundation Language (Tamil / Other Languages): Refers to the Foundation Language course in Tamil or another approved language offered under the programme.

Part II – Foundation Language (English): Refers to the Foundation Language course in English offered under the programme.

Part III consists of **Core Courses (CC)**, **Generic Electives (EC–Allied Courses)**, and **Discipline Specific Electives (EC)** offered under the programme.

Core Courses (CC): Refers to the **core subjects** that are directly related to the **Botany** programme. These are the compulsory courses that form the foundation of the degree and include both theory papers and practical.

Generic Electives (EC–Allied Courses): These are **allied or supporting subjects** offered as Generic Electives. They are interdisciplinary, meaning they come from related fields rather than core Botany.

Discipline Specific Electives (EC): Refers to elective courses offered within the Botany discipline.

Part IV consists of **NME (Non-Major Electives)**, **SEC (Skill Enhancement Courses)**, **Value Education**, **DM (Disaster Management)**, **H.W (Health and Wellness)**, **EVS (Environmental Studies)**, **Extension Activities**, and **Internship**.

NME (Non-Major Elective – Generic): Refers to courses offered as electives for students who do not belong to the concerned programme.

Part IV – SEC (Skill Enhancement Courses – Discipline Centric / Entrepreneurial): Refers to core-specific, skill-based elective courses offered under the programme.

EVS (Environmental Studies): Refers to a course that focuses on the study of the environment

Value Education – Yoga: Refers to activities aimed at the holistic development of students.

Extension Activity: These include participation in **NSS (National Service Scheme)**, **NCC (National Cadet Corps)**, **Sports**, **YRC (Youth Red Cross)**, and other co-curricular and extracurricular activities.

Internship: Refers to a practical training programme to be carried out during the summer vacation for a minimum duration of 40 hours, aimed at providing hands-on experience and exposure to real-world work environments related to the field of study.

Duration of the Course

The duration of the undergraduate Bachelor of Science (B.Sc.) programme is three years. The programme is divided into six semesters, with each academic year comprising two semesters. Each semester consists of 90 working days.

Practical examinations are conducted at the end of each semester. These regulations apply to students pursuing the regular course of study in institutions approved by the University.

Credit

Credit refers to the weightage assigned to each course of study (subject) by the experts of the concerned Board of Studies.

Credit System

The Credit System is a pattern of study in which the prescribed credits are distributed across different semesters during the programme. Students earn credits by successfully completing the courses prescribed for each semester. At the end of the programme, the **Cumulative Grade Point Average (CGPA)** is awarded based on the total credits earned by the student.

The total credits prescribed for the Undergraduate Programme are as follows:

Undergraduate Programme (Three Years): 152 (142 + 10 NM) Credits

AIM AND SCOPE OF THE COURSE

1. To provide students with a comprehensive understanding of various disciplines of Plant Science.
2. To enable students to acquire fundamental knowledge and develop technical skills in Basic Botany and its applied branches through the study of different courses and their respective units.
3. To impart employability-oriented elective papers and skill-based knowledge through courses such as Entrepreneurial opportunities in Botany, Botanical Garden and Landscaping, Herbal Technology, Aquatic Botany, Bio nanotechnology, Forensic Botany, and Environmental Impact Analysis, thereby creating opportunities for employment and research in Government and Private organizations.
4. To promote innovation, entrepreneurship, and experiential learning by incorporating internships as integral components of the curriculum.
5. To develop practical competencies in microscopic techniques, specimen observation, scientific illustration, laboratory instrumentation, and physiological and ecological experimental methods through well-structured practical courses.

ELIGIBILITY FOR ADMISSION

A candidate seeking admission to the first year of the Bachelor of Science (B.Sc.) Degree Programme in Botany shall have passed the Higher Secondary Examination (Academic or Vocational Stream with Botany / Biology and Chemistry under higher secondary board of examination Stream) conducted by the Government of Tamil Nadu or any other examination recognized as equivalent by the Syndicate of the University.

Admission shall be subject to the rules and regulations prescribed by the University. Candidates who satisfy the prescribed eligibility conditions shall be admitted to the B.Sc. Degree Programme in Botany and shall be eligible to appear for the University examinations.

PASSING MINIMUM

A candidate shall be declared to have passed the University examination in a course if he/she secures not less than **40% of the maximum marks** prescribed for that course.

CLASSIFICATION OF SUCCESSFUL CANDIDATES

The classification of successful candidates shall be based on the aggregate marks obtained in the University examinations:

- Candidates securing **60% or more** of the aggregate marks shall be declared to have passed in **First Class**.
- Candidates securing **50% or more but less than 60%** of the aggregate marks shall be declared to have passed in **Second Class**.
- Candidates securing **40% or more but less than 50%** of the aggregate marks shall be declared to have passed in **Third Class**.

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	B.Sc. BOTANY
Programme Code:	
Duration:	3 Years (UG)
Programme Outcomes:	PO1: Disciplinary knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study PO2: Critical thinking: Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. PO3: 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. PO4: Research-related skills: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation 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.

Proramme Specific Outcomes:	On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to: PSO1: Disciplinary Knowledge: Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory. PSO2: Critical Thinking: Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively PSO3: Problem Solving: Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities. PSO4: Analytical & Scientific Reasoning: Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models. PSO5: Research related skills: Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects.
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PO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6
PO1	✓					
PO2		✓				
PO3			✓			
PO4				✓		
PO5					✓	
PO6						✓

Highlights of the Revamped Curriculum:

- The curriculum is student-centric and designed to meet the evolving needs of industry and society. It incorporates industrial components, hands-on training, skill enhancement modules, industrial projects, entrepreneurial skill development, and training for competitive examinations, while maintaining the quality of core courses and integrating application-oriented content wherever appropriate.
- The core courses encompass recent developments in the discipline and scientific advancements. They include practical training, advanced programming packages relevant to the discipline, and the development of statistical models and algorithms to solve industrial and real-world problems. The curriculum also promotes peer learning through advanced topics offered in the final semester, fostering research aptitude among students.
- General Studies and Statistics-based problem-solving skills are offered as mandatory components under the **Training for Competitive Examinations** course in the final semester, enabling students to prepare effectively for various competitive examinations.
- The curriculum is structured to strengthen the Industry–Academia interface by enhancing students' employability through industry-oriented learning experiences.
- The **Statistical Quality Control** course provides exposure to real-life industrial problems and equips students with the skills to develop mathematical and statistical models for quality improvement and industrial decision-making.
- An internship during the vacation of second year provides students with valuable workplace experience, enabling them to apply classroom knowledge in real-world settings, develop professional competencies, and make informed career choices.
- Elective courses incorporate state-of-the-art techniques from multidisciplinary, interdisciplinary, and cross-disciplinary domains. These courses cover both conventional and emerging areas, including Database Management Systems (DBMS), computer software for analytics, and other contemporary technologies relevant to the discipline.

Methods of Evaluation Theory		
Internal Evaluation	Continuous Internal Assessment Test	25 Marks
	Assignments 5 marks	
	Tests 15 marks	
	Attendance and Class Participation 5 marks	
External Evaluation	End Semester Examination	75 Marks
	Total	100 Marks
Methods of Evaluation Practicals		
	Continuous Internal Assessment Test 30 marks	40 Marks
	Attendance and Class Participation 10 marks	
External Evaluation	End Semester Examination	60 Marks
	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	

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

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part-I Language – Tamil	3	6	Part-I Language – Tamil	3	6	Part-I Language – Tamil	3	5	Part-I Language – Tamil	3	5	Part-III Core (Theory)	5	6	Part-III Core (Theory)	5	6
Part-II English	3	6	Part-II English	3	5	Part-II English	3	5	Part-II English	3	5	Part-III Core (Theory)	5	6	Part-III Core (Theory)	5	6
Part-III Core (Theory)	5	5	Part-III Core (Theory)	5	5	Part-III Core (Theory)	5	5	Part-III Core (Theory)	5	5	Part-III Core (Theory)	5	6	Part-III Core (Theory)	5	6
Part-III Core (Practical)		3	Part-III Core (Practical)	5	3	Part-III Core (Practical)		3	Part-III Core (Practical)	5	3	Part-III Core Practical		3	Part-III Core Practical	5	3
Part-III Allied I (Theory)	4	4	Part-III Allied I (Theory)	4	4	Part-III Allied-II (Theory)	4	4	Part-III Allied –II (Theory)	4	4	Part-III Core Practical		3	Part-III Core Practical	5	3
Part-III Allied- I (Practical)		3	Part-III Allied -I (Practical)	3	3	Part-III Allied-II (Practical)		3	Part-III Allied –II (Practical)	3	3	Part-IV Skill Enhancement Course	2	2	Part-III Elective - III	2	3
Part-IV NME-1 offered to other departments	2	2	Part-IV NME-1 offered to other departments	2	2	Part-III Elective -1	3	3	Part-III Elective -II	3	3	Part-IV Summer Internship /Industrial Training	2	-	Part-IV Extension activity	1	1
Part-IV Value Education	1	1	Part-IV Disaster Management	1		Part-IV Skill Enhancement Course	2	2	Part-IV Skill Enhancement Course	2	2	Part-IV E.V.S	2	2	-	-	-
						Part-IV H.W	1										
			NMSDC	2	2	NMSDC	2		NMSDC	2		NMSDC	2	2	NMSDC	2	2
Total Papers	6		8+1			8+1			8+1			6+1			7+1		
Total Credits	18			26+2			21+2			28+2			21+2			28+2	

Total Credits = 152(142 + 10 NM)

[Part-I & II-24]

[Part-III-100 (Core-70, Allied-22, Elective-8)]

[Part-IV-18 (NME-4, SEC-6, Value Education-1, DM-1, H.W-1, EVS-2, Ext-1, Internship-2), NM-10]

CBCS- COURSE PATTERN AND SYLLABUS
UG - BOTANY
(For students who join the programme from 2026-2027 onwards)

First year – semester I							
Part	Language/ Core/ elective	Name of the Course	Hours Per/ Week	Credit	Internal marks	External marks	Total Marks
I	Language	Language Paper I	6	3	25	75	100
II	Language	English Paper I	6	3	25	75	100
III	Core1	Core I- Algae and Bryophytes	5	5	25	75	100
III	Core 3	Major-Practical (including Core I and Core II)	3	Assessment in the academic year end			
III	Allied 1	Allied: Zoology Paper-I	4	4	25	75	100
III	Allied 3	Allied: Zoology Practical I	3	Assessment in the academic year end			
IV	NMEC1	1. Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping	2	2	25	75	100
IV	Value Edu	Yoga	1	1	25	75	100
		Total	30	18			600
First year – semester II							
I	Language	Language Paper II	6	3	25	75	100
II	Language	English Paper II	5	3	25	75	100
III	Core 2	Core II- Fungi, Bacteria, Viruses, and Lichens	5	5	25	75	100
III	Core 3	Core III - Major-Practical including Core I and Core II	3	5	40	60	100
III	Allied 2	Allied Zoology Paper II	4	4	25	75	100
III	Allied 3	Allied Zoology Practical I	3	3	40	60	100
IV	NMEC 2	1. Mushroom cultivation 2. Herbal Medicine 3. Global Climate change	2	2	25	75	100
IV		Disaster management		1	25	75	100
	NMSDC		2	2	25	75	100
		Total	30	28			900
Second year – semester III							
I	Language	Language Paper III	5	3	25	75	100
II	Language	English Paper III	5	3	25	75	100
III	Core 4	Core IV - Pteridophytes, Gymnosperms and Paleobotany	5	5	25	75	100
III	Core 6	Major Practical (including Core IV and Core V)	3	Assessment in the academic year end			
III	Allied 4	Allied Chemistry Paper I	4	4	25	75	100
III	Allied 6	Allied Chemistry Practical I	3	Assessment in the academic year end			
III	Elective course1	1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial Botany	3	3	25	75	100
IV	SEC1	Entrepreneurial Skill Entrepreneurial opportunities in botany	2	2	25	75	100
IV		Health and Wellness		1	25	75	100
	NMSDC			2	25	75	100
		Total	30	23			800

Second year – semester IV							
I	Language	Language Paper IV	5	3	25	75	100
II	Language	English Paper IV	5	3	25	75	100
III	Core5	Core V - Plant Anatomy and Embryology of Angiosperms	5	5	25	75	100
III	Core6	Core VI Major Practical including Core IV and Core V	3	5	40	60	100
III	Allied 5	Allied Chemistry Paper II	4	4	25	75	100
III	Allied 6	Allied Chemistry Practical I	3	3	40	60	100
III	Elective course 2	1. Horticulture 2. Natural Resource Management 3. Forestry	3	3	25	75	100
IV	SEC 2	Herbal Technology	2	2	25	75	100
	NMSDC			2	25	75	100
		Total	30	30			900
Second Year Vacation Internship 40 hours							
Third year semester V							
III	Core 7	Core VII – Plant Morphology, Taxonomy of Angiosperms and Economic Botany	6	5	25	75	100
III	Core 8	Core VIII- Plant Pathology and Plant Protection	6	5	25	75	100
III	Core 9	Core IX – Cell Biology, Genetics and Plant Breeding	6	5	25	75	100
III	Core 10	Core X Major Practical including Core VII Core VIII and Core IX	6	Assessment in the academic year end			
IV	SEC 3	Botanical garden and landscaping	2	2	25	75	100
IV	Internship	Internship viva voce	-	2	-	-	100
IV		Environmental Sciences	2	2	25	75	100
	NMSDC		2	2	25	75	100
		Total	30	23			700
Third year – semester VI							
III	Core 11	Core XI– Plant Ecology and Phytogeography	6	5	25	75	100
III	Core 12	Core XII- Plant Biotechnology and Molecular Biology	6	5	25	75	100
III	Core 13	Core XIII- Plant Physiology and Plant Biochemistry	6	5	25	75	100
III	Core 10	Core X- Major Practical including Core VII, Core VIII and Core IX	-	5	40	60	100
III	Core 14	Core XIV – Major Practical including Core XI, Core XII, and Core XIII	6	5	40	60	100
III	Elective course 3	1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	3	2	25	75	100
V	EA	Extension activity	1	1			
	NMSDC		2	2	25	75	100
		Total	30	30			700
		GRANDTOTAL		152			4700

Practical Exam will be held in the academic year end i.e., II, IV and VI semester

CORE I - ALGAE AND BRYOPHYTES

Title of the Course		ALGAE AND BRYOPHYTES					
Paper Number		CORE I					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		--		5
Pre-requisite		Students should be familiar with the basics of different genera of Algae and Bryophytes.					
Learning Objectives							
C1	To provide a comprehensive knowledge on the biology of algae, evolutionary relationship and economic importance						
C2	To understand the morphological and reproduction of various genera						
C3	To understand the structure, reproduction and life history of different algae						
C4	Enable the students to know an overview of Non-vascular cryptogams and to understand the morphological diversity of Bryophytes.						
C5	To know the evolution and economic importance of Bryophytes						
Course outcomes	On completion of this course, students will be able to: CO						Programme outcomes
CO1	Relate to the structural organization, reproduction and significance of algae.						K1
CO2	understanding the various life cycle patterns and the fundamental concepts in algal growth						K2
CO3	Will know the benefits of various algae on the ecosystem.						K3
CO4	Recognize morphological, anatomical variations and Reproduction of Bryophytes						K4
CO5	Understanding the importance and uses of Bryophytes.						K5

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

CORE I - ALGAE AND BRYOPHYTES

UNIT	CONTENTS
I	ALGAE General Characteristics, Classification (Fritsch), Cell Structure, Pigmentation, Reserve Food Materials, Habit and Habitat- fresh and marine forms, planktophytes, benthophytes, epiphytes, thermophytes, epizoic algae, soil algae, saprophytes, cryptophytes, aerophytes, symbionts, endozoophytes and parasites. Thallus Organization – unicellular, colonial, filamentous, siphonous and pseudoparenchymatous. Reproduction, Life Cycle- haplontic, diplontic, diplohaplontic and diplobiontic. Evolutionary Relationship, Economic Importance - food, feed, fuel, phycoremediation, agriculture, industrial and pharmaceutical.
II	Thallus organization, Reproduction and Life cycle of the following genera: <i>Anabaena</i>, <i>Chlorella</i>, <i>Volvox</i>, <i>Oedogonium</i> and <i>Chara</i>.
III	Thallus organization, Reproduction and Life cycle of the following genera: <i>Caulerpa</i>, <i>Ulva</i>, <i>Pinnularia</i>, <i>Sargassum</i> and <i>Gracilaria</i>.
IV	BRYOPHYTES General characteristics, Occurrence, Distribution, Classification (Watson) and Evolution. Morphological and Anatomical Structure, Reproduction and Life cycle of the following genera: <i>Marchantia</i> and <i>Porella</i>
V	Morphological and Anatomical Structure, Reproduction and Life cycle of the following genera: <i>Anthoceros</i> and <i>Polytrichum</i>. Economic importance of Bryophytes – pollution indicators, prevention of soil erosion, medicinal, horticulture and industrial uses.

Recommended Texts	
1	Dehradun. Edwardlee, R. 2018. Phycology, 5 th Ed., Cambridge University Press, London.
2	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
3	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4	Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
5	Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
6	Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
7	Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
8	Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
References Books:	
1	Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
2	Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera.
3	Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
4	Round, FE. 1984. The Ecology of Algae. Cambridge University Press.
5	Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York.
6	Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
7	Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.

Mapping with Programme Outcomes

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

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

MAJOR PRACTICAL-I (Including Core I +II)
CORE-III ALGAE AND BRYOPHYTES

Title of the Course		ALGAE AND BRYOPHYTES Practical I (Assessed in semester II)						
Paper Number		CORE III (Assessed in II semester)						
Category	Core	Year	I	Credits	Assessed in II semester	Course Code		
		Semester	I					
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total	
		1	-		2		3	
Pre-requisite		Students should be familiar with the basics of algae.						
Learning Objectives								
C1		To develop skills to identify algae and Bryophytes 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 and Bryophytes						
C4		To study the economic importance of Algae and Bryophytes.						
C5		To understand various techniques in algal cultures						

Course outcomes	On completion of this course, the students will be able to: CO	Programme outcomes
CO1	Recall and identify algae using key identification characters.	K1
CO2	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	K2
CO3	Describe the internal structure of algae prescribed in the syllabus. Decipher the algal diversity in fresh/marine water and their economic significance.	K3
CO4	To enable students gain expertise in hand sectioning technique. To study diversity of Bryophytes. To understand the anatomical structure of the Bryophytes	K4
CO5	To Interpret the significance of reproductive structures in Bryophytes	K5

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

ALGAE AND BRYOPHYTES - Practical I

EXPERIMENTS
1. Micro-preparation of Algae, the types prescribed in the syllabus. 2. Identifying the micro slides relevant to the syllabus. 3. Identifying types of algal mixture. 4. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus. 5. Economic importance Bryophytes 6. Field visit for two to three days to study fresh water /marine water algal habitats and forest area for study the Bryophytes. 7. Field visit: 2 days visit to nearby sea shore area for algal observation and industry actively engaged in algal technology.

Recommended Texts	
1.	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2.	Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany- 1 (10 th ed). Rastogi Publications, Meerut.
3.	Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
4.	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books	
1.	Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algal identification a field guide, Ottawa Agriculture and Agri food Canada publisher.
2.	Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London.
3.	Gangulee Hand Book of Bryophytes
Web resources	
1.	https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492
2.	https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae- (PDF-21P).html
3.	https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE II - FUNGI, BACTERIA, VIRUSES AND LICHENS

Title of the Course		FUNGI, BACTERIA, VIRUSES AND LICHENS						
Paper Number		CORE II						
Category	Core	Year	I	Credits	5	Course Code		
		Semester	II					
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total	
		4	1		--		5	
Pre-requisite		Students should be familiar with the basics of fungi, bacteria, viruses, and lichens.						
Learning Objectives								
C1	To describe the common characteristics of fungi as heterotrophic, unicellular, or multicellular organisms.							
C2	To understand and discuss the economic importance of fungi.							
C3	To describe the common characteristics of bacteria and viruses and understand and discuss their importance.							
C4	To identify the major groups of fungi, bacteria, mycoplasma, viruses, and lichens.							
C5	To understand the structure, function, and identification of lichens.							
Course outcomes	On completion of this course, the students will be able to: CO						Programme outcomes	
CO1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.						K1	
CO2	Develop an understanding of microbes, fungi and lichens.						K2	
CO3	Identify and classify the major groups of fungi, bacteria, viruses, mycoplasma, and lichens.						K3	
CO4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.						K4	
CO5	Evaluate the beneficial and harmful roles of microorganisms and lichens.						K5	

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

FUNGI, BACTERIA, VIRUSES AND LICHENS

UNIT	CONTENTS
I	FUNGI General account and classification of fungi (Alexopoulos and Mims, 1979); cell structure and cell wall composition; thallus organization; modes of nutrition; reproduction - parasexuality and heterothallism. Study of true fungi, their ecological significance, and life cycles of Zygomycotina - <i>Pilobolus</i> , Ascomycotina - <i>Penicillium</i> , Basidiomycotina - <i>Puccinia</i> and Deuteromycotina - <i>Cercospora</i> .
II	Economic Importance of Fungi: Cultivation of edible mushrooms (<i>Pleurotus</i>). Agricultural applications of fungi, including biofertilizers (VAM) and biopesticides. Industrial and pharmaceutical importance of fungi, production of ethanol, citric acid, protease, vitamins (Vitamin B-complex and Vitamin B12), and antibiotics (Penicillin). Harmful effects of fungi, with special reference to mycotoxins.
III	BACTERIA General characteristics and classification of bacteria (Bergey's Manual, 1994); Archaeobacteria and Eubacteria; morphology and ultrastructure of bacterial cells. Modes of nutrition: Heterotrophic - parasitic, saprophytic, and symbiotic. Autotrophic - photosynthetic and chemosynthetic. Reproduction in bacteria. Economic Importance of Bacteria: Agriculture - biofertilizers (<i>Rhizobium</i>). Industry - production of butter, cheese, vinegar, alcohol, tobacco and tea curing. Tanning - retting and sewage treatment. Medicine - production of antibiotics. MYCOPLASMA: Wall-less forms of bacteria (Mycoplasma) and spheroplasts: general characteristics and cell structure.
IV	VIRUSES Discovery, general characteristics, and classification of viruses (Baltimore classification). Structure and replication of viruses, with special reference to viroids and prions. Plant Viruses: Tobacco Mosaic Virus (TMV), Rice Dwarf Virus, Geminiviruses. Vaccine production and the role of viruses in medical research. Bacteriophages Structure and reproduction, including the lytic and lysogenic cycles.
V	LICHENS Classification of lichens (Hale, 1969); habitat; structure; nature of mycobionts and phycobionts; types of lichens (crustose, foliose, and fruticose); distribution; thallus organization; reproduction; and ecological significance, with special reference to <i>Usnea</i> . Economic Importance of Lichens: Uses of lichens in Food and fodder, Flavouring, Tanning and dyeing, Cosmetics and perfumes, Brewing and distillation, Mineral weathering, Natural products, Traditional medicine (Ayurveda and Siddha), Pharmaceutical products, Biodegradation, Air pollution monitoring and biomonitoring, Soil formation, Nitrogen fixation and Harmful aspects of lichens.

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	Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
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	Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology, Tata MaGraw Hill Publishing House, New Delhi.
Web Resources	
1	https://www.amazon.in/Fungi-Sarah-C-Watkinson- ebook/dp/B0199YFDDE
2	http://www.freebookcentre.net/biology-books-download/A-text-book-of- mycology-and-plant-pathology.html
3	http://www.freebookcentre.net/Biology/Mycology-Books.html
4	https://www.kobo.com/us/en/ebook/introduction-to-fungi
5	http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
6	http://www.freebookcentre.net/biology-books-download/Fungi-(PDF- 15P).html

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	2
CO 2	3	3	2	2	3	3	2	1	2	1
CO 3	2	2	3	3	1	2	1	3	1	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	3
S-Strong (3)		M-Medium (2)		L-Low(1)						

MAJOR PRACTICAL-I (Including Core I +II)
CORE-III- FUNGI, BACTERIA, VIRUSES AND LICHENS

Title of the Course		FUNGI, BACTERIA, VIRUSES AND LICHENS					
Paper Number		CORE III					
Category	Core	Year	I	Credits	5	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		1	-		2		3
Pre-requisite		Students should be familiar with the basics of bacteria, viruses, fungi and lichens.					
Learning Objectives							
C1	To enable students to identify microscopic and macroscopic fungi.						
C2	To prepare microslides of fungi and lichens.						
C3	To identify the fungi, bacteria, viruses and lichens based on the morphology, and micro slides.						
C4	To identify the fungi and lichens based on the morphology, and microslides.						
C5	To know the economic importance of the microbes studied.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Identify microbes, fungi and lichens using key identifying characters					K1	
CO2	Develop practical skills for culturing and cultivation of fungi.					K2	
CO3	Identify and select suitable control measures for the common plant diseases.					K3	
CO4	Analyze the characteristics of microbes, fungi and plant pathogens					K4	
CO5	Access the useful role of fungi in agriculture and pharmaceutical industry.					K5	

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

FUNGI, BACTERIA, VIRUSES AND LICHENS EXPERIMENTS

FUNGI

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides.
2. Protocol for mushroom cultivation.
3. Inoculation techniques for fungal culture (Demonstration only).
4. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
5. VAM - Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
6. Visit to fungal biotechnology laboratories.

BACTERIA

1. Ultra structure of bacteria.
2. Simple and Gram staining of Bacteria

VIRUSES

1. Structure of TMV, Rice Dwarf Virus , Gemini Virus and Bactriophage.

LICHENS

1. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
2. Identifying the permanent micro slides relevant to the syllabus.
3. Study of thallus and reproductive structures (apothecium) through permanent slides.
4. Economic importance of Lichens - Dye and perfume.

Recommended Texts

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

Reference Books	
1	Alexopoulos, J and Mims, W. 1985. Introductory Mycology, Wiley Eastern Limited NewDelhi.
2	Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1(10 th ed). Rastogi Publications, Meerut.
3	Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4	Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5	Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
Web Resources	
1	https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4
2	https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_esc=y
3	https://www.flipkart.com/colour-handbook-practical-plantpathology/p/itmefsn6dyhfhs9b
4	https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y
5	https://www.kobo.com/us/en/ebook/introduction-to-fungi

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE-IV – PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Title of the Course		PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY					
Paper Number		CORE IV					
Category	Core	Year	II	Credits	5	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		-		5
Pre-requisite		Students should be familiar with the basics of Pteridophytes, Gymnosperms and Paleobotany.					
Learning Objectives							
C1	To provide students with an overview of vascular cryptogams.						
C2	Understand the structural diversity of pteridophytes and gymnosperms.						
C3	To understand the evolution of pteridophytes and the affinities of gymnosperms with pteridophytes.						
C4	To know the economic importance of pteridophytes and gymnosperms.						
C5	To enable students to understand paleobotany and the process of fossilization.						
Course outcomes	On completion of this course, the students will be able to: CO						Programme Outcome
CO1	Describe the general characteristics, classification, morphology, anatomy, reproduction, and life cycles of pteridophytes.						K1
CO2	Explain the evolutionary trends in pteridophytes, and evaluate the affinities between pteridophytes and gymnosperms.						K2
CO3	Describe the general characteristics, classification, morphology, anatomy, reproduction, and life cycles of gymnosperms.						K3
CO4	Analyze the structural diversity, ecological adaptations, and economic importance of pteridophytes and gymnosperms.						K4
CO5	Explain the principles of paleobotany, geological time scale, fossilization processes, fossil fuels.						K5

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

PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

UNIT	CONTENTS
I	Pteridophytes General characters and salient features of pteridophytes. Classification of pteridophytes (Reimer, 1954) and criteria for classification. Morphology, anatomy, reproduction, and life cycles of representative taxa: Psilotopsida – <i>Psilotu</i> , Lycopsida – <i>Selaginella</i> , Sphenopsida – <i>Equisetum</i> , Pteropsida – <i>Marsilea</i> .
II	Heterospory and the origin of the seed habit. Origin and evolution of pteridophytes: Anthocerotean Theory, Protocorm Theory, Telome Theory, Enation Theory, Stelar Evolution, Apogamy and apospory. Ecological and economic importance of pteridophytes.
III	Gymnosperms General characters and distinguishing features of gymnosperms. Affinities of gymnosperms with pteridophytes. Classification of gymnosperms (Sporne). Morphology, anatomy, reproduction, and life cycles of: <i>Cycas</i> and <i>Pinus</i> .
IV	Structure, reproduction, and life histories of: <i>Ginkgo</i> , <i>Ephedra</i> and <i>Gnetum</i> . Ecological and economic importance of gymnosperms.
V	Paleobotany Introduction to paleobotany and the geological time scale. Fossilization: processes, types of fossils, and significance. Fossil fuels and their origin. Morphology, anatomy, and affinities of fossil pteridophytes: <i>Lepidodendron</i> and fossil gymnosperms: <i>Heterangium</i> or <i>Lyginopteris</i> (select any one).

Recommended Texts	
1	Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2	Sharma, O.P. 2012. Pteridophyta. Tata McGraw-Hill Education, Delhi.
3	Biswas, C. and Johrc, B.M. 1977. The Gymnosperms. Narosa publishing House, New Delhi.
4	Vashishta, P.C. 1991. Gymnosperms. S. Chand & Company Ltd., Ram Nagar, New Delhi.
5	Singh, Pandey and Jain (2017). Archegoniate, Rastogi Publication, Meerut.
6	Karl, J.N. 1981. Paleobotany, Paleoecology & Evolution. Praeger Publishing, New Delhi.
	Shripad, N.A. 1998. Paleobotany, Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.

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 Pteridophyta,
3	Central book depot, Allahabad.
	Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4	Sporne, K.L. 1976. Morphology of Pteridophytes, 4 th edition, B.I. Publication. Chennai.
5	Bower, F.O. 1908. The origin of Land Flora. Macmillan Press, London.
6	Eames, A.J. 1936. Morphology of Vascular Plants. Lower groups, New York.
7	Arnold, C.A. 1947. An Introduction to Paleobotany. Academic Press, New York.
Web Resources	
1	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
2	http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_23432.aspx

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

MAJOR PRACTICAL – II (Including Core IV and V)
CORE VI - PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Title of the Course		PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY - PRACTICAL-II (Assessed in IV semester)					
Paper Number		CORE VI					
Category	Core	Year	II	Credits	Assessed in IV semester	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		1	-		2		3
Pre-requisite		Students should be familiar with the fundamentals of Pteridophytes, Gymnosperms, Paleobotany.					
Learning Objectives							
C1	To enable students observe and record the morphological features of Pteridophytes and Gymnosperm.						
C2	To study diversity of Pteridophytes and Gymnosperm						
C3	To understand the anatomical structure of selected species of Pteridophytes and Gymnosperms.						
C4	Develop comprehensive skills in sectioning and micro preparation.						
C5	To enable students to gain insights into the basics of paleobotany and methods of fossilization.						
Course outcomes	On successful completion of this course the student will be able to: CO					Programme Outcomes	
CO1	Recognize the major groups of Pteridophytes and Gymnosperms.					K1	
CO2	Describe the structure of Pteridophytes and Gymnosperms forms prescribed in the syllabus.					K2	
CO3	Identify and illustrate the morphological and anatomical features of Pteridophytes and Gymnosperms.					K3	
CO4	Interpret the significance of reproductive structures in Pteridophytes and Gymnosperms.					K4	
CO5	To understand the anatomy of the fossil plants through microscopy.					K5	

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

PRACTICAL II- PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY EXPERIMENTS	
1.	Vegetative and reproductive structures of Pteridophyte: <i>Psilotum</i> , <i>Selaginella</i> , <i>Equisetum</i> , <i>Marsilea</i> .
2.	Vegetative and reproductive structures of Gymnosperms: <i>Cycas</i> , <i>Pinus</i> , <i>Ephedra</i> and <i>Gnetum</i>
3.	Paleobotany: Fossil slides or photograph representation from Pteridophytes and Gymnosperms
4.	Botanical field trip (3–5 days) to a forest area to study the diversity of pteridophytes and gymnosperms in their natural habitats.

Recommended Texts	
1	Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
2	Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition.
3	Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4	Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
Reference books	
1	Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.
2	James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
3	Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4	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=HzYUAQAIAAJ
4	https://trove.nla.gov.au/work/11471742?q&versionId=46695996
5	http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html .

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	1	2	2	2	3
CO 2	3	3	2	2	3	3	2	3	2	2
CO 3	2	2	3	3	1	2	1	3	3	3
CO 4	3	3	3	3	3	2	2	3	3	3
CO 5	3	3	2	2	3	3	2	3	2	2
S-Strong (3)		M-Medium (2)		L-Low(1)						

CORE V - PLANT ANATOMY AND EMBRYOLOGY

Title of the Course		PLANT ANATOMY AND EMBRYOLOGY					
Paper Number		CORE V					
Category	Core	Year	II	Credits	5	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	1		-		5
Pre-requisite		To acquire knowledge of the anatomical structure and reproductive phases of angiosperms..					
Learning Objectives							
C1	To understand the fundamental concepts of plant anatomy and embryology.						
C2	To study the internal tissue organization of various plant organs.						
C3	To differentiate between normal and abnormal secondary growth.						
C4	To comprehend the structural organization of flowers with reference to pollination and fertilization processes.						
C5	To understand the principles of plant embryology.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Explain the fundamental concepts of plant anatomy.					K1	
CO2	Describe the primary and secondary structures of roots, stems, and leaves of dicot and monocot plants, and differentiate normal and anomalous secondary growth.					K2	
CO3	Identify and interpret various tissue systems, vascular bundle arrangements, nodal anatomy, and specialized anatomical features of plants.					K3	
CO4	Understand the structural organization and developmental processes of reproductive structures, including anther, ovule, male and female gametophytes, and embryo sac.					K4	
CO5	Explain the processes of pollination, fertilization, double fertilization, endosperm formation, polyembryony, apomixis, and seed development in angiosperms.					K5	

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

PLANT ANATOMY AND EMBRYOLOGY

UNIT	CONTENTS
I	Tissues: Simple tissue systems - parenchyma, collenchyma, and sclerenchyma (fibres and sclereids). Complex tissue systems - xylem and phloem. Meristems and Classification: Apical meristem, intercalary meristem, and lateral meristem. Theories of Meristem Organization: Apical cell theory, Histogen theory, and Tunica-Corpus theory. Root Apex: Histogen theory and Korper-Kappe theory.
II	Primary Structure of Root and Stem: Primary structure of dicot and monocot roots and stems. Epidermal tissue system: epidermis, cuticle, trichomes, bulliform cells, periderm, and silica cells. Ground Tissue System: Cortex, endodermis, pericycle, and pith. Vascular Tissue System: Types of vascular bundles - conjoint (collateral and bicollateral) and concentric (amphicribal and amphivasal) - and their arrangement in roots and stems. Nodal Anatomy: Leaf trace, leaf gap, and types of nodal anatomy - unilacunar, trilacunar, and multilacunar nodes.
III	Secondary Growth: Secondary thickening in dicot and monocot roots and stems. Wood structure: annual rings, tyloses, sapwood, and heartwood. Anomalous Secondary Growth: Anomalous secondary growth in stems of <i>Boerhaavia</i>, <i>Nyctanthes</i>, and <i>Dracaena</i>. Leaf Anatomy: Anatomy of dicot and monocot leaves; types of stomata. Periderm: Structure and development of periderm—phellem, phellogen, phelloderm, rhytidome, and lenticels.
IV	Embryology Anther Development: Structure and development of anther (T.S. of anther) and development of the male gametophyte. Ovule and Female Gametophyte: Structure and types of ovules—orthotropous, anatropous, hemianatropous, campylotropous, amphitropous, and circinotropous. Development of female gametophyte (monosporic, bisporic, and tetrasporic types), with special reference to the <i>Polygonum</i> type. Embryo Sac: Organization and ultrastructure of the mature embryo sac.
V	Fertilization: Double fertilization and triple fusion. Endosperm: Types of endosperm—free nuclear, cellular, helobial, and endosperm haustoria. Polyembryony and Related Phenomena: Types of polyembryony, apomixis, parthenogenesis, and parthenocarpy. Seed: Structure and importance of seeds.

Recommended Texts	
1	Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2	Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4 th revised and enlarged edition). Vikas Publishing House, New Delhi.
3	Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4	Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
5	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.
Web Resources	
1	https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2
2	https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy
3	https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4	https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG
5	https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

MAJOR PRACTICAL-II (Including Core IV +V)
CORE VI - PLANT ANATOMY AND EMBRYOLOGY

Title of the Course		PLANT ANATOMY AND EMBRYOLOGY					
Paper Number		CORE VI					
Category	Core	Year	II	Credits	5	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		1	-		2		3
Pre-requisite		To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					
Learning Objectives							
C1	To understand the anatomical organization of plant tissues and organs.						
C2	To identify simple and complex tissues.						
C3	To examine anomalous secondary growth in selected plant species.						
C4	To study stomatal types, ovule types, endosperm types, and pollinia.						
C5	To study the embryological structures, anthers, ovules, endosperm, and embryos.						
Course outcomes	On successful completion of this course the student will be able to: CO					Programme Outcomes	
CO1	Understand the anatomical organization of plant tissues and organs through microscopic observation and sectioning techniques.					K1	
CO2	Identify simple and complex tissues and distinguish the anatomical features of dicot and monocot stems, roots, and leaves.					K2	
CO3	Examine normal and anomalous secondary growth in selected plant species.					K3	
CO4	Recognize different stomatal types, ovule types, endosperm types, and pollinia based on their structural characteristics.					K4	
CO5	Develop practical skills in the preparation, observation, dissection, and identification of embryological structures, including anthers, ovules, endosperm, and embryos.					K5	

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

PRACTICAL II
PLANT ANATOMY AND EMBRYOLOGY
EXPERIMENTS

ANATOMY

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

EMBRYOLOGY

1. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
2. Observation of pollinia –Calotropis.
3. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides).
4. Types of Endosperm - Nuclear, cellular and helobial (Permanent slides).
5. Dissection and display of any two stages of embryo in *Tridax*

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.
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.

Web Resources	
1	https://www.amazon.in/Practical-Anatomy-Adrian-19011973Foster/dp/1341784509
2	https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&redir_esc=y

Mapping with Programme Outcomes:

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

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

CORE VII - PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course		PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY					
Paper Number		CORE VII					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	2		-		6
Pre-requisite		Students should acquire knowledge of the morphological and anatomical characteristics and uses of plants. .					
Learning Objectives							
C1	Students will acquire a comprehensive understanding of the morphology of flowering plants, including vegetative and floral structures.						
C2	Students will understand the basic concepts and principles of plant classification.						
C3	Students will understand the major evolutionary trends in angiosperms.						
C4	Students will identify the characteristic features of selected plant families.						
C5	Students will understand the economic importance of plants.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Describe the morphology of flowering plants, including the structure and modifications of plant parts.					K1	
CO2	Explain the principles of plant taxonomy, botanical nomenclature, herbarium techniques, and plant classification.					K2	
CO3	Identify and classify selected angiosperm families based on their diagnostic morphological characters, floral formulae, floral diagrams.					K3	
CO4	Differentiate major angiosperm families using taxonomic characters and evaluate their significance in plant systematics.					K4	
CO5	Discuss the source, cultivation, processing, and economic importance of major crop plants.					K5	

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

PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

UNIT	CONTENTS
I	Morphology of Flowering Plants Morphology of the root system: types and modifications. Morphology of the shoot system: aerial, sub-aerial, and underground modifications. Leaf: types, simple and compound leaves, phyllotaxy, and modifications (phyllodes, pitchers, tendrils, and stipules). Flower: structure, parts, symmetry, aestivation, and placentation. Floral formula and floral diagram. Inflorescence: definition and types—racemose, cymose, mixed, and special types. Fruits and seeds: morphology and mechanisms of dispersal.
II	Plant Taxonomy and Botanical Nomenclature History of angiosperm classification: artificial system (Linnaeus) and natural system (Bentham and Hooker). Outline of the Bentham and Hooker system of classification. Overview of the APG IV system of classification. Herbarium techniques: collection, pressing, drying, mounting, and preservation of plant specimens. E-herbaria and biodiversity databases. Botanical Survey of India and the role of botanical gardens in plant taxonomy and conservation. Botanical nomenclature: principles, rules, typification, and author citation. Introduction to molecular taxonomy and DNA barcoding.
III	Systematic Study of Selected Plant Families – I Systematic study of the following families based on the natural system of classification, with special reference to diagnostic characters, floral formula, floral diagram, and economic importance: Annonaceae, Nymphaeaceae, Brassicaceae, Rutaceae, Leguminosae (Fabaceae, Caesalpinioideae, and Mimosoideae), Malvaceae, Cucurbitaceae, Asteraceae, and Apocynaceae.
IV	Systematic Study of Selected Plant Families – II Systematic study of the following families based on the natural system of classification, with special reference to diagnostic characters, floral formula, floral diagram, and economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Verbenaceae, Amaranthaceae, Euphorbiaceae, Asparagaceae, Orchidaceae, Poaceae, and Cyperaceae.
V	Economic Botany Study of the source, brief cultivation practices, processing, and economic importance of the following plant products: cereal (rice), pulse (black gram), sugar crop (sugarcane), beverage crops (coffee and tea), oilseed crop (groundnut), spice (cardamom), essential oil plant (rose), medicinal plant (ashwagandha), natural rubber (<i>Hevea brasiliensis</i>), timber plant (teak), and fibre crop (cotton).

Recommended Texts	
1	Singh, G. (2019). Plant Systematics: Theory and Practice (4th Ed.). Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2	Sharma, O.P. (2017). Plant Taxonomy (3rd Ed.). McGraw Hill Education (India) Pvt. Ltd., New Delhi.
3	Simpson, M.G. (2019). Plant Systematics (3rd Ed.). Academic Press, Elsevier, USA.
4	Stuessy, T.F. (2009). Plant Taxonomy: The Systematic Evaluation of Comparative Data (2nd Ed.). Columbia University Press, New York.
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-Hill Book Co., New York.
Web sources	
1	https://www.worldfloraonline.org/
2	https://powo.science.kew.org/
3	https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y
4	https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
5	https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	2
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	3	2	1
CO 4	3	3	3	3	3	2	3	2	2	3
CO 5	3	3	2	3	2	3	3	3	3	3
S-Strong (3)		M-Medium (2)		L-Low(1)						

CORE-VIII- PLANT PATHOLOGY AND PLANT PROTECTION

Title of the Course		PLANT PATHOLOGY AND PLANT PROTECTION					
Paper Number							
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		4	2		--		6
Pre-requisite		Students should be familiar with the basics of Plant pathology and plant protection.					
Learning Objectives							
C1	To study List the major pests and pathogens, including insects, nematodes, rodents, fungi, bacteria, and viruses, that cause damage to Indian crops.						
C2	To understand the symptoms and management practices for the bacterial diseases						
C3	To understand the symptoms and control measures for the viral diseases.						
C4	To study the scope and importance of plant protection						
C5	To know the principles of plant protection, including cultural, chemical, biological, and legal methods, for integrated pest and disease management.						
Course outcomes	On completion of this course, students will;						Programme outcomes
CO1	Identify the major pests and pathogens that damage Indian crops.						K1
CO2	Describe the characteristic symptoms and recommend appropriate management practices for major bacterial diseases.						K2
CO3	Recognize the symptoms of important viral diseases and suggest suitable control measures.						K3
CO4	Explain the scope and importance of plant protection and demonstrate the operation of plant protection equipment. Apply the principles of seed treatment, soil sterilization, and integrated plant protection.						K4
CO5	Design an integrated pest and disease management (IPM/IDM) schedule by combining cultural, biological, chemical and legal methods for a given crop						K5

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved. (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

PLANT PATHOLOGY AND PLANT PROTECTION

UNIT	CONTENTS
I	PLANT PATHOLOGY Damage caused to Indian crops by insects, nematodes, rodents, fungi, bacteria, and viruses. General symptoms of plant diseases and their control measures. Geographical distribution of plant diseases: Endemic, Epidemic, Sporadic, and Pandemic. Fungal diseases with special reference to their causal organism, characteristic symptoms, and control measures: Damping-off of seedlings, Bud rot of coconut, Black rust of wheat, Blast of paddy (rice), Smut of maize and Tikka disease of groundnut
II	Bacterial Diseases: General characteristics of plant pathogenic bacteria. Survival of bacterial pathogens. Modes of transmission (seed-borne, soil-borne, water-borne, insect vectors, and mechanical transmission). Favourable environmental conditions for disease development. Bacterial diseases with special reference to their causal organism, characteristic symptoms, and control measures: Soft rot of vegetables, Bacterial blight of rice, Citrus canker and Ring rot of potato.
III	Viral and Phytoplasma Diseases Plant Viruses- Nature and characteristics of plant viruses, Modes of transmission of plant viruses. Viral diseases with special reference to their causal organism, symptoms, and control measures - Tobacco Mosaic, Banana Bunchy Top, Mosaic disease of Lady's Finger (Okra) and Cassava Mosaic Disease (Tapioca) Phytoplasma Diseases- General account of phytoplasmas. Study of the following phytoplasma diseases: Little Leaf of Brinjal and Papaya Leaf Curl
IV	PLANT PROTECTION Scope and Importance, Equipment's used in plant protection -Sprayers - dusters - soil injector - seed dressing drum; Seed treatment: traditional and modern methods of seed treatment. Soil sterilization: traditional and modern methods of soil sterilization. Role of soil sterilization in polyhouse farming.
V	Methods of Plant Protection Cultural Methods - Tillage, Time of sowing and planting, Crop hygiene and field sanitation, Crop rotation, Trap crops, Use of resistant varieties and Irrigation and drainage management Mechanical Methods - Collection and destruction of diseased plant debris, Netting and bagging, Physical barriers, Sticky bands and grease bands, Tin bands, Light traps and Pheromone traps Physical Methods - Heat treatment and Soil solarisation, Chemical Methods - Safe handling, and uses of Bactericides, Fungicides, Insecticides, Nematicides, Acaricides, Molluscicides, Rodenticides and Herbicides. Biological Methods - Biological control of insect pests using predators, parasitoids, and microbial agents. Legal Method - Plant quarantine: concept and objectives. International and domestic plant quarantine. Need and importance of plant quarantine.

Recommended Texts	
1	Agros, GN (1997) Plant Pathology (4th ed.) Academic Press.
2	Vikas Publishing House Private Limited, New Delhi.
3	Pandey, B.P. (2001). Plant Pathology. S. Chand & Company Limited, New Delhi.
4	Dubey, RC (2005). Text book of Biotechnology S.Chand& Co, New Delhi.
5	Bap Reddy, D. and Joshi, N.C. (1991). Plant Protection in India (Second Edition). Allied Publishers Ltd., New Delhi.
References Books	
1	Bilgrami, K.S. and Dubey, R.C. (1985). Text book of Modern Plant Pathology.
2	Mehrotra, R.S. (2003). Plant Pathology (Second edition). Tata McGraw-Hill Education, New Delhi
3	Rangasami, G. and Mahadevan, A. (1998). Diseases of Crop Plants in India. Prentice Hall of India Ltd. New Delhi.
4	Chaudhury and Majid, (1954).Hand Book of plant protection. Department of Agriculture,Government press, Shillong, Assam.
Web resources	
1	https://www.classcentral.com/course/swayam-plant .
2	https://www.classcentral.com/report/swayam-moocs-course-list
3	https://bsppjournals.onlinelibrary.wiley.com/journal/13653059
4	https://onlinefreecourse.com/a-complete-list-of..
5	https://www.acsedu.com/Courses/plant-pathology-481.aspx
6	https://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses .
7	https://epp-online.cals.ncsu.edu/plant-pathology
8	https://apniphysics.com/information/swayam-students-learning-portal
9	https://nptel.ac.in/courses/102/103/102103016

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE IX CELL BIOLOGY, GENETICS AND PLANT BREEDING

Title of the Course	CELL BIOLOGY, GENETICS AND PLANT BREEDING						
Paper Number	CORE IX						
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V				
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total
	4		2		-		6
Pre-requisite		To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.					
Learning Objectives							
C1	To enable students to gain insights into cell wall organization and its functions.						
C2	To familiarize with various cell organelles and their functions.						
C3	To gain knowledge in classical genetics.						
C4	To know about sex linked inheritance.						
C5	To have knowledge about plant breeding techniques for crop improvement.						

Course outcomes	On completion of this course, the students will be able to:	Programme Outcomes
CO1	Enumerate the structure and functions of cells, cellular structures, and organelles.	K1
CO2	Explain the cell cycle, cell division, and the laws of inheritance with suitable examples.	K2
CO3	Elucidate the concepts of sex determination and sex-linked inheritance.	K3
CO4	Analyze the importance of gene interactions at the population and evolutionary levels.	K4
CO5	Develop a conceptual understanding of plant genetic resources, plant breeding, gene banks, and gene pools.	K5

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

CELL BIOLOGY, GENETICS AND PLANT BREEDING

UNIT	CONTENT
I	Cell Biology Introduction to cell biology - scope and significance, cell organization, ultrastructure of prokaryotic and eukaryotic cells, structure and functions of the plant cell. Cell boundaries - cell wall - primary wall, and secondary wall, structure, chemical composition, and functions of the cell wall, simple and bordered pits, plasmodesmata. Plasma membrane - occurrence, structure (Fluid Mosaic Model), chemical composition, functions, and origin. Properties of the plasma membrane. Membrane transport - passive transport, facilitated diffusion, active transport, endocytosis, and exocytosis.
II	Cell Organelles and Cell Division Occurrence, structure, functions, and origin of the endoplasmic reticulum, Golgi apparatus, lysosomes, ribosomes, mitochondria, and chloroplasts. Semi-autonomous nature of mitochondria and chloroplasts. Ultrastructure and functions of the nucleus and chromosomes. Molecular organization of chromatin: euchromatin and heterochromatin. Polytene and lampbrush chromosomes. Types and functions of centromeres. Cell inclusions. Cell cycle and cell division: mitosis and meiosis, with their significance.
III	Principles of Genetics Mendelian genetics: monohybrid and dihybrid crosses. Mendel's laws of inheritance - reciprocal, back, and test crosses. Non-Mendelian inheritance: incomplete dominance (<i>Mirabilis jalapa</i>), gene interactions, including complementary, supplementary, inhibitory, duplicate, and epistatic (dominant and recessive) genes, multiple alleles and the ABO blood group system in humans.
IV	Advanced Genetics Chromosome theory of linkage; crossing over, genetic recombination, and gene mapping. Sex determination in plants. Sex-linked inheritance: haemophilia and colour blindness. Polyploidy - origin, types, and significance. Mutations: types and significance. Chromosomal aberrations: deletion, duplication, inversion, translocation, and addition. Extranuclear inheritance and its significance: cytoplasmic male sterility in maize; plastid inheritance in <i>Mirabilis jalapa</i> ; genetics of <i>Neurospora</i> ; and population genetics based on the Hardy-Weinberg principle.
V	Plant Breeding Principles of plant breeding. Plant introduction and acclimatization. Methods of crop improvement: mass, pure-line, and clonal selection; hybridization techniques; and heterosis, including interspecific and intergeneric hybridization, with their causes and effects. Role of mutation breeding and polyploidy in crop improvement and their applications. Breeding methods for crop improvement in paddy and sugarcane. Biotechnological approaches to crop improvement, including the scope and limitations of transgenic crops, with special reference to Bt cotton.

Recommended Texts	
1	Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55.
2	Sinnott, E.W., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
3	Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.
4	Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
References Books:	
1	De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2	Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3	Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
4	Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5	Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
6	Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.
7	Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
Web resources	
1	http://www.freebookcentre.net/Biology/Cell-Biology-Books.html
2	https://www.us.elsevierhealth.com/medicine/cell-biology
3	https://www.amazon.in/Cell-Biology-Thomas-D-Pollard- ebook/dp/B01M7YAL2A
4	https://www.us.elsevierhealth.com/medicine/genetics
5	https://libguides.uthsc.edu/genetics/ebooks
6	https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding
7	http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE X - PRACTICAL COVERING – CORE VII, VIII AND IX
PRACTICAL-III

Title of the Course		MAJOR PRACTICAL-III (including Core VII, VIII & IX) to be Assessed in VI Semester.					
Paper Number		CORE X					
Category	Core	Year	III	Credits	5	Course Code	
		Semester	V		Assessed in VI Semester		
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		1 +1	-		2 + 2		6
Pre-requisite		Students should possess a theoretical understanding of cell biology, genetics, and plant breeding, plant pathology and Plant protection, plant taxonomy and basic laboratory skills relevant to the core course.					
Learning Objectives							
C1	Students will study the morphological characteristics and to describe plants using standard botanical terminology and floral characteristics and also to collect, preserve, and prepare herbarium specimens.						
C2	To study List the major pests and pathogens, including insects, nematodes, rodents, fungi, bacteria, and viruses, that cause damage to Indian crops.						
C3	To develop knowledge of cell structures, cell organelles, chromosomes, and stages of cell division through microscopic observations and photomicrograph studies.						
C4	Genetic principles through problem-solving involving Mendelian inheritance, allelic interactions, multiple alleles, and chromosome mapping.						
C5	To familiarize with plant breeding techniques, including emasculation, seed viability testing, and the evaluation of heterosis.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Develop comprehensive skills in field identification, specimen collection, technical description, botanical illustration, and herbarium preparation.					K1	
CO2	Explain the scope and importance of plant protection and the operation of plant protection equipment. Apply the principles of seed treatment, soil sterilization, and integrated plant protection.					K2	
CO3	Identify the structure of plant cells, cell organelles, and different stages of mitosis and meiosis using prepared slides and microscopic observations.					K3	
CO4	Analyze genetic data by performing monohybrid and dihybrid crosses, test crosses, and problems involving gene interactions, linkage, and genetic mapping.					K4	
CO5	Demonstrate plant breeding techniques such as emasculation, bagging, controlled pollination, and pollen viability testing.					K5	

PRACTICAL-III CORE X - PRACTICAL COVERING CORE VII, VIII AND IX	
EXPERIMENTS	
PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY 1. Study the Morphology of root, stem and leaf modification, types of inflorescence and fruits. 2. Identify plants of local flora included under theory syllabus and family identification and derivation based on reasoning (Bentham and Hooker Classification). 3. Dissect, identify, observe, and draw the floral parts of representative plants belonging to the families prescribed in the syllabus. 4. Describe the floral parts, prepare a longitudinal section (L.S.) of the flower, draw the floral diagram, and write the floral formula for at least one representative species from each prescribed family. 5. Collect, preserve, and submit twenty (20) properly prepared herbarium sheets, along with a field notebook and a duly certified practical record. 6. Study the economically important plant products prescribed in the Economic Botany syllabus, with special reference to their morphology, botanical names, and families. 7. Students should undertake botanical field visits (4–5 days) under the guidance of faculty members for the observation, study, identification, and collection of plant specimens prescribed in the syllabus.	
PLANT PATHOLOGY AND PLANT PROTECTION 1. Collection and study of diseased plant materials. 2. Study of fungal, bacterial and viral diseases mentioned in the syllabus. 3. Handling of plant protection appliances (Dusters, sprayers, and other appliances.) 4. Preparation of 5 herbarium sheets of Pathology – specimens studied	
Cell biology 1. Study of the photomicrographs of cell organelles. 2. Ergastic substances - starch grains, aleurone grains, cystolith & raphide (permanent Slides). 3. Study the polytene and lamp brush chromosome. 4. Identification of different stages of mitosis and meiosis by using squash and smear techniques – Onion root tip and flower buds.	
Genetics 1. Genetic problems – test cross, back cross and allelic interaction. 2. Construction of chromosome map – three point test cross 3. Multiple alleles problems.	
Plant Breeding 1. Emasculation technique. 2. To test the viability of seeds using Tetrazolium chloride. 3. Genetic models of heterosis. 4. Phenotype of heterosis (Maize).	

Recommended Texts	
1	Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2	Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.
3	Pandely, B.P. 1987. Taxonomy of Angiosperms.
4	Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
5	Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
6	Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.
Reference Books	
1	Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne.1994. Natural Products. Longman Scientific and Technical Essex.
2	Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
3	Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
4	Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
5	Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.
6	Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertonni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
7	Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
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

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE XI - PLANT ECOLOGY, BIODIVERSITY AND PHYTOGEOGRAPHY

Title of the Course	PLANT ECOLOGY, BIODIVERSITY AND PHYTOGEOGRAPHY						
Paper Number	CORE XI						
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		2		-	6
Pre-requisite		Understanding the environmental factors that influence biodiversity is essential after completing this course.					
Learning Objectives							
C1	Understand the significance of biotic and abiotic components of ecosystems and their interactions.						
C2	Explain the flow of energy and nutrient cycling within ecosystems.						
C3	Develop conceptual knowledge of biodiversity, its importance, and conservation strategies.						
C4	Analyze the impacts of pollution and other environmental factors on ecosystems.						
C5	Gain knowledge of phytogeographical concepts and the distribution patterns of plants.						

Course outcomes	On completion of this course, the students will be able to:	Programme Outcomes
CO1	Develop an understanding of the principles of ecology, including the interactions between biotic and abiotic components and their influence on vegetation patterns.	K1
CO2	Familiarize students with vegetation dynamics, ecological adaptations, plant succession, and organization of ecosystems, including energy flow, trophic relationships, ecological pyramids, and biogeochemical cycles.	K2
CO3	Create awareness about plant biodiversity, its importance, threats to biodiversity, and various conservation strategies, including in situ and ex situ approaches.	K3
CO4	Provide knowledge of environmental pollution, its causes, impacts, and management strategies for sustainable environmental protection.	K4
CO5	Introduce the concepts of phytogeography and biogeography, including plant distribution patterns, vegetation regions of India, speciation, and factors influencing plant diversification.	K5

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

PLANT ECOLOGY, BIODIVERSITY AND PHYTOGEOGRAPHY

UNIT	CONTENT
I	Ecology and Vegetation Studies Biotic and abiotic factors and their influence on vegetation, Autecology and synecology, Development of vegetation - Migration, ecesis and colonization. Methods of vegetation study - quadrat and transect methods. Plant succession - hydrosere and xerosere, Ecological classification of plants - morphological and anatomical adaptations of plants.
II	Ecosystem Ecology Structure and trophic organization of ecosystems; food chains and food webs - energy flow in ecosystems. Types of ecosystems: pond, forest, and grassland ecosystems. Ecological pyramids and biogeochemical cycles of carbon, nitrogen, and phosphorus.
III	Biodiversity and Conservation Plant biodiversity and its importance. Definition and levels of biodiversity - genetic, species, and ecosystem diversity. Biodiversity hotspots - criteria and biodiversity hotspots of India. Loss of biodiversity - causes and conservation strategies (in situ and ex situ methods). Seed banks: conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species. Forest conservation, social forestry, and participatory forest management. Concepts of plant degeneration and regeneration.
IV	Environmental Pollution and Management Pollution: types of pollution (primary and secondary) and their impacts. Air pollution - greenhouse effect, global warming, ozone depletion, and acid rain. Water and soil pollution - causes and consequences. Remedial measures - green buildings and environmental management practices. Disaster management.
V	Phytogeography and Biogeography Phytogeography: definition, introduction, principles, concepts, scope, and significance. Distribution patterns of plants: continuous and discontinuous distribution with reference to endemism, Age–Area hypothesis, and continental drift theory. Phytogeography of India: vegetation regions of India and plant indicators. Diversification of land plants, speciation, changing Earth, and island biogeography.

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	Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4	Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
5	Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
6	Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.
References Books:	
1	De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2	Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
3	Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
4	Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd., 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.
Web resources	
1	https://www.kobo.com/us/en/ebook/plant-ecology-3.
2	https://www.worldcat.org/title/plant-ecology/oclc/613206385
3	https://books.google.co.in/books/about/Plant_Ecology.html?
4	https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP
5	http://www.freebookcentre.net/Biology/Ecology-Books.html
6	https://www.amazon.in/Plant-Ecology-Ernst-Detlef- Schulze/dp/354020833X
7	https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity)

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE XII - BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Title of the Course	BIOTECHNOLOGY AND MOLECULAR BIOLOGY						
Paper Number	CORE XII						
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		2		-	6
Pre-requisite		Basic knowledge of cell biology, genetics, biochemistry, and microbiology, along with an understanding of the structure and function of nucleic acids, proteins, and fundamental laboratory techniques.					
Learning Objectives							
C1	To understand the basic concepts and applications of biotechnology in agriculture, medicine, environment, and industrial sectors.						
C2	To know the plant tissue culture principles, techniques, and applications, including micropropagation and synthetic seed technology.						
C3	To understand the genetic engineering tools, recombinant DNA technology, vectors, restriction enzymes, and gene transfer methods.						
C4	To know about the molecular basis of genetic material, including DNA and RNA structure, replication, repair, and their biological significance.						
C5	To familiarize students the mechanisms of gene expression, protein synthesis, and regulation of gene activity in prokaryotes.						

Course outcomes	On completion of this course, the students will be able to:	Programme Outcomes
CO1	Explain the fundamental concepts, history, scope, and applications of biotechnology in agriculture, medicine, environment, and industry.	K1
CO2	Describe the principles and techniques of plant tissue culture, including totipotency, aseptic methods, media preparation, callus induction, micropropagation, and synthetic seed technology.	K2
CO3	Identify the tools and techniques involved in genetic engineering, including vectors, restriction enzymes, recombinant DNA technology, and gene transfer methods.	K3
CO4	Analyze the structure, function, replication, and repair mechanisms of genetic material, including DNA and RNA.	K4
CO5	Explain the processes of transcription, translation, genetic code, and regulation of gene expression in prokaryotes.	K5

Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

BIOTECHNOLOGY AND MOLECULAR BIOLOGY

UNIT	CONTENT
I	Introduction and Applications of Biotechnology Biotechnology: concept, history, and scope. Applications of plant biotechnology in various fields. Agricultural applications - Biofertilizers and biopesticides. Medical applications - Antibiotics (penicillin), recombinant vaccines, insulin, and interferons. Environmental applications - Bioremediation and biofuel production. Industrial applications - Ethanol production using yeast, citric acid production using <i>Aspergillus niger</i>, and protease production using <i>Bacillus</i> spp.
II	Plant Tissue Culture Plant tissue culture: introduction, scope, and importance. Concept of totipotency. Aseptic techniques in plant tissue culture. Composition and types of culture media - sterilization techniques; explant preparation and inoculation. Callus induction and micropropagation. Applications of plant tissue culture. Synthetic seed technology.
III	Genetic Engineering and Recombinant DNA Technology Vectors: plasmids, pBR322, Ti plasmid, and cosmids. Restriction enzymes - endonucleases, exonucleases, reverse transcriptases, methylases, alkaline phosphatases, and ligases. Recombinant DNA technology. Gene transfer methods - physical (biolistic method and micro injections), chemical (lipofication) and Biological methods (<i>Agrobacterium</i>-mediated gene transfer). Applications of genetic engineering: Golden Rice and Bt cotton.
IV	Molecular Biology of Genetic Material Nature and functions of genetic material. Nucleic acids: base pairing and Chargaff's rule. Structure of DNA; types of DNA; denaturation and renaturation. DNA replication in prokaryotes. Structure and types of RNA. DNA repair mechanisms.
V	Gene Expression and Regulation Transcription: enzymes involved in transcription, RNA polymerase, classes of RNA molecules, and transcription in prokaryotes. Protein synthesis: genetic code, characteristics of the genetic code, codons, and anticodons. Gene regulation in prokaryotes: lac operon and trp operon.

Recommended Texts	
1	Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.
2	Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.
3	Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
4	Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.
5	Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.
6	Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag
References Books:	
1	Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology- principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2	Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.
3	Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.
4	James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York.
5	Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York.
6	Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.
7	Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York.
8	Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.
Web resources	
1	http://www.freebookcentre.net/Biology/BioTechnology-Books.html
2	https://www.kobo.com/us/en/ebook/plant-biotechnology-1
3	https://www.worldcat.org/title/molecular-biology/oclc/1062496183
4	http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
5	https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE XIII PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Title of the Course	PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY						
Paper Number	CORE XIII						
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice		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 to water relation of plants with respect to various physiological phenomenon.						
C2	To know the pathways of photosynthesis.						
C3	To familiarize with respiration and nitrogen metabolism.						
C4	To know about plant growth regulators.						
C5	To familiarize with plant biochemistry.						

Course outcomes	On completion of this course, the students will be able to:	Programme Outcomes
CO1	Relate to water relation of plants with respect to various physiological phenomenon.	K1
CO2	Explain the process and significance of photosynthesis and respiration.	K2
CO3	Elucidate properties of nutrients and their deficiency symptoms in plants.	K3
CO4	Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	K4
CO5	Decipher the phenomenon of seed dormancy and Germination in plants.	K5

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

PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

UNIT	CONTENTS
I	Water Relations Properties of water, imbibition, diffusion, osmosis and plasmolysis; ascent of sap, mechanism of water absorption – active and passive, apoplast and symplast pathways. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of water including Cohesion-Tension Theory, and solute transport including mass flow hypothesis.
II	Photosynthesis Radiant energy, Photosynthetic unit, photosynthetic pigments and their role, photosystems - Light reaction, electron transport system in the chloroplast (Z-Scheme). Path of carbon in photosynthesis (Dark reaction) - C3 cycle, C4 cycle, CAM pathway, Photorespiration
III	Respiration Aerobic respiration, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient. Nitrogen Metabolism Biological nitrogen fixation, nitrification and denitrification. Nitrate assimilation- Synthesis of amino acids - Reductive amination and transamination. Biogeochemical cycle of nitrogen.
IV	Growth Plant growth; Plant growth regulators - auxins, gibberellins, cytokinins, ethylene and abscisic acid; Photomorphogenesis; practical applications - photoperiodism, vernalization, dormancy, phytochromes. Stress Physiology – Concepts, plant responses to stresses related to water, salt and temperature.
V	Plant Biochemistry Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties, classification, nomenclature, mode of action, factors influencing enzyme action.

Recommended Texts	
1	Kochhar, S.L. and Gujral, S.K. 2020. Plant physiology: theory and applications. Cambridge University Press, 2 nd Edition.
2	Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi.
3	Pandey, N.S and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.
4	Bhatla, S.C., Lal, M.A. 2018. Plant Physiology, Development and Metabolism. Springer Singapore.
5	Taiz, I., Zeiger, E., Møller, I.M. and Murphy, A. 2018. Plant Physiology and Development. Sinauer, 7 th Edition.
6	Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
7	Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
8	Jain, J.L. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.
9	Nelson, D.L. and Cox, M.M. 2021. Lehninger Principles of Biochemistry. Macmillan publishers, 8th Edition.
10	Conn, E and Stumpf, P.K. 1979. Outline of Biochemistry Wiley Eastern Ltd., New Delhi.
11	Verma, V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.
Reference Books	
1	Raven, P. Johnson, G., Mason, K., Losos, J. and Duncan, T. 2020. Biology, Mc Graw Hill, 12 th Edition.
2	Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
3	Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
4	Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
5	Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
6	Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
7	Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA.
8	Nobel, P. S. 2020. Physiochemical and Environmental Plant Physiology. Academic Press, San Diego, 5 th Edition.
9	Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
10	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.
11	Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

Web Resources	
1	https://onlinecourses.swayam2.ac.in/cec19_bt09/preview
2	https://onlinecourses.swayam2.ac.in/cec21_bt20/preview
3	https://onlinecourses.swayam2.ac.in/cec22_bt13/preview
4	https://www.youtube.com/watch?v=RT-w2xHV1_E
5	https://swayam.gov.in/nd2_cec20_bt01/preview
6	https://learn.careers360.com/biology/plant-physiology-chapter/
7	https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
8	https://basicbiology.net/plants/physiology
9	https://www.biologydiscussion.com/plants/plant-physiology/top-6-processes-of-plantphysiology/24154.

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE XIV PRACTICAL COVERING – CORE XI, XII AND XIII
MAJOR PRACTICAL – IV

Title of the Course	PRACTICAL - IV (including core XI+XII+XIII)						
Paper Number	CORE XIV						
Category	Core	Year	III	Credits	5	Course Code	
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total
	1+1		-		2+2		6
Pre-requisite		Practical pertaining to above subjects is important to get knowledge on various physiological functions of plants.					
Learning Objectives							
C1	To study morphological and anatomical adaptations of plants of various habitats.						
C2	To demonstrate techniques of plant tissue culture.						
C3	To familiarize with the structure of DNA, RNA.						
C4	To carryout experiments related with plant physiology.						
C5	To perform biochemistry experiments.						
Course outcomes	On completion of this course, the students will be able to:						Programme Outcomes
CO1	Relate to the distribution and adaptations of plants pertaining to their habitat						K1
CO2	Demonstrate skills in green planning and callus culture.						K2
CO3	Elucidate the basic principles involved in the plant physiology and biochemistry experiments.						K3
CO4	Appreciate the structure and functions of DNA and RNA.						K4
CO5	Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.						K5

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

MAJOR PRACTICAL - IV
Core XIV - (Including core XI+XII+XIII)

EXPERIMENTS	
Plant Ecology and Phytogeography 1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats. Hydrophytes - <i>Nymphaea</i> , <i>Hydrilla</i> and <i>Eichhornia</i> , Xerophyte - <i>Nerium</i> , <i>Casuarina</i> and <i>Aloe vera</i> . Mesophytes - <i>Tridax</i> , <i>Vernonia</i> ., Halophytes - <i>Avicennia</i> , <i>Rhizophora</i> (only permanent slides), Epiphytes - <i>Vanda</i> (only permanent slides) 2. Map of the phytogeographical regions of India. 3. Quadrature study and line transect. 4. Plan for a green building 5. Field trip to scrub jungle or wetland for vegetation study.	
Plant Biotechnology – Demonstration 1. Sterilization techniques in plant tissue culture. 2. MS - Media preparation. 3. Explant sterilization, Callus induction, Plantlet, hardening.	
Molecular Biology – Photographs DNA Structure; tRNA; DNA – Replication; DNA – Repair; Genetic code	
Plant Physiology and Plant Biochemistry 1. Determination of water potential by plasmolytic method. 2. Effect of chemicals on plasma membrane permeability. 3. Effect of environmental factors on rate of transpiration by Ganong’s photometer 4. Separation of plant pigments by paper chromatography. 5. Study the rate of photosynthesis under different light intensities using Willmott’s bubble counter. 6. Study the rate of photosynthesis under different wavelengths (red & blue) of light. 7. Comparison of rate of respiration of different plant parts (flower bud and germinating seeds). 8. Measurement of pH of extracted cell sap (lemon, tomato) and different soils using pH meter. 9. Enzyme activity – catalase. 10. Biochemical test for carbohydrates, proteins and lipids-Priliminary qualitative tests.	
Demonstration – Experiments 1. Study the rate of transpiration by using gravimetric method. 2. Demonstration of stomatal movement (opening and closing). 3. Induction of roots in leaves by auxins. 4. Potato osmoscope. 5. Anaerobic respiration (Khune’s method).	

Recommended Texts	
1	Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2	Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3	Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
4	Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi.
5	Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
6	Jayaraman.J.1981. Laboratory Manual in Biochemistry. Wiley Eastern Limited, New Delhi.
7	Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II Rastogi Publication. Meerut. 9 th Edition.
Reference Books	
1	Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.
2	Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
3	Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
4	Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
5	Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4 th Edition) Cambridge University Press, Cambridge.
6	Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
Web resources	
1	https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK
2	https://www.amazon.in/Practical-Biotechnology-Plant-Tissue- Culture/dp/8121932009
3	https://www.elsevier.com/books/molecular-biology- techniques/carson/978-0-12-815774-9
4	https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita- Sangha/dp/9386102633
5	https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale- Onslow/dp/1107634318

Mapping with Programme Outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	1
CO 2	3	3	2	2	3	3	2	3	3	2
CO 3	2	2	3	3	1	2	1	2	2	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	3	2
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE - ALLIED BOTANY-I

Title of the Course		ALLIED BOTANY- I					
Paper Number		Core-Allied-I					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	1		-		4
Pre-requisite		To study basics of botany.					
Learning Objectives							
C1	To study morphological and anatomical adaptations of plants of various habitats.						
C2	To demonstrate techniques of plant tissue culture.						
C3	To familiarize with the structure of DNA, RNA.						
C4	To carryout experiments related with plant physiology.						
C5	To perform biochemistry experiments.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
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 cells and explain the development of cells.					K4	
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.					K5	

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

ALLIED BOTANY- I

UNIT	CONTENT
I	Algae and Bryophytes General characters of algae - Structure, reproduction and life cycle of the following genera - <i>Anabaena</i> and <i>Sargassum</i> and economic importance of algae. General characters of Bryophytes, Structure, Reproduction and life cycle of <i>Funaria</i> .
II	Fungi, Lichens, Bacteria and Virus General characters of fungi, structure, reproduction and life cycle of the following genera - <i>Penicillium</i> and <i>Agaricus</i> and economic importance of fungi. A brief account of Lichens Bacteria - general characters, structure and reproduction of <i>Escherichia coli</i> and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.
III	Pteridophytes and Gymnosperms General characters of Pteridophytes, Structure, Reproduction and life cycle of <i>Lycopodium</i> . General characters of Gymnosperms, Structure, Reproduction and life cycle of <i>Cycas</i> .
IV	Cell Biology Prokaryotic and Eukaryotic cell- ultra structure and organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
V	Genetics and Plant Biotechnology Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - <i>In vitro</i> culture methods. Plant tissue culture and its application in biotechnology.

Recommended Texts	
1	Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2	Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3	Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4	Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.

Reference books	
1	Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes – Surjeet Publications, Delhi.
2	Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3	Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4	Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5	Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6	Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
7	Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.
Web Resources	
1	https://www.kobo.com/us/en/ebook/the-algae-world
2	http://www.freebookcentre.net/biology-books-download/Fungi-(PDF- 15P).html
3	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4	https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5	https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6	https://www.us.elsevierhealth.com/medicine/cell-biology
7	https://www.us.elsevierhealth.com/medicine/genetics
8	https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	3	3
CO 4	3	3	2	3	3	3	2	3	2	3
CO 5	3	2	2	2	2	2	2	1	2	1
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE - ALLIED BOTANY-II

Title of the Course		ALLIED BOTANY- II					
Paper Number		Core-Allied-II					
Category	Core	Year	I	Credits	4	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	1		-		4
Pre-requisite		To study basics of botany.					
Learning Objectives							
C1	To be familiar with the basic concepts and principles of plant systematics.						
C2	Learn the importance of plant anatomy in plant production systems.						
C3	Understand the mechanism underling the shift from vegetative to reproductive phase.						
C4	To learn about the physiological processes that underlie plant metabolism.						
C5	To know the energy production and its utilization in plants.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Understand the fundamental concept s of plant anatomy and embryology					K1	
CO2	Analyze and recognize the different organs of plants and secondary growth					K2	
CO3	Understand water relation of plants with respect to various physiological processes					K3	
CO4	Classify aerobic and anaerobic respiration					K4	
CO5	Classify plant systematics and recognize the importance of herbarium and virtual herbarium					K5	

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

ALLIED BOTANY-II

UNIT	CONTENTS
I	MORPHOLOGY OF FLOWERING PLANTS: Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf type: simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special type. Terminology with reference to flower description.
II	TAXONOMY: Study of the range of characters and plants of economic importance in the following families: Leguminosae (3 sub families included), Asclepiadaceae, Acanthaceae, Euphorbiaceae and Poaceae
III	ANATOMY Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot of monocot roots. Anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.
IV	EMBRYOLOGY Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination and double fertilization, structure of dicotyledonous and monocotyledonous seeds.
V	PLANT PHYSIOLOGY Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration – Glycolysis- Krebs cycle- electron transport system. Transpiration. Growth hormones - auxins and cytokinins and their application

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. Rajni
5	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=Roi0lwSXFuUC&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

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE ALLIED BOTANY PRACTICAL I

Title of the Course		ALLIED BOTANY PRACTICAL I					
Paper Number		Core-Allied Practical					
Category	Core	Year	I	Credits	3	Course Code	
		Semester	I & II		Assessed in II Semester		
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		1	-		2	3	
Pre-requisite		Practicals pertaining to above subjects is important to get knowledge various aspects of plants.					
Learning Objectives							
C1	To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure microorganisms, algae, and fungi.						
C2	To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.						
C3	To be familiar with the basic concepts and principles of plant systematics.						
C4	Understanding of laws of inheritance, genetic basis of loci and alleles.						
C5	To learn about the physiological processes that underlie plant metabolism.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	To study the internal organization of algae and fungi.					K1	
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms					K2	
CO3	To study the classical taxonomy with reference to different parameters.					K3	
CO4	Understand the fundamental concepts of plant anatomy and embryology.					K4	
CO5	To study the effect of various physical factors on photosynthesis.					K5	

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

ALLIED BOTANY PRACTICAL I EXPERIMENTS

1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
2. Micro photographs of the cell organelles ultra structure.
3. Simple genetic problems.
4. To describe in technical terms, plants belonging to any of the family prescribes and to identify the family.
5. To dissect a flower, construct floral diagram and write floral formula.
6. Economic importance of Families studied
7. Demonstration experiments
 - Ganong's Light screen
 - Ganong's respiroscope
 - Ganong's Potometer
8. To make suitable micro preparations of anatomy materials prescribed in the syllabus.
9. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy, Embryology, Cell biology and Biotechnology.

Recommended Texts

- | | |
|---|---|
| 1 | Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. |
| 2 | Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. |
| 3 | Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. |
| 4 | Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman Company, New York, England. |
| 5 | Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice H 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 Agri food Canada publisher. |
| 3 | Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. |
| 4 | Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wil Publications. |
| 5 | Steward, F.C. 2012. Plant Physiology Academic Press, US |

Web Resources	
1	https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2	https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=&gbpv=1&dq=gy mnosperms&printsec=frontcover
3	https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ
4	https://medlineplus.gov/genetocs/understanding/basics/cell/
5	https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6	http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7	https://www.amazon.in/Manual-Practical-Bryophyta-Suresh- Kumar/dp/B0072GNFX4

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

NON-MAJOR ELECTIVE-I

1. ORGANIC FARMING

Title of the Course		ORGANIC FARMING					
Paper Number		Non-Major Elective-I					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		-		2
Pre-requisite		To understand the various applications of Organic farming					
Learning Objectives							
C1	To enable students to gain knowledge on the scope of organic farming and its significance.						
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.						
C3	To understand the physical and chemical properties of soil.						
C4	To study sustainable agriculture.						
C5	To know about the importance of biofertilizers.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Recognize the different forms of biofertilizers and their uses.					K1	
CO2	Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.					K2	
CO3	.Apply techniques for synthesizing green manure and develop strategies to increase crop yield.					K3	
CO4	Analyze and decipher the significance of biofertilizers in soil fertility.					K4	
CO5	Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.					K5	

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

1. ORGANIC FARMING

UNIT	CONTENT
I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.
II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost-methods, production and utilization.
IV	Biofertilizers–classification, nitrogen fixers– <i>Rhizobium</i> , <i>Cyanobacteria</i> , <i>Azolla</i> and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes- biocompost making methods.

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	
5	Vayas, S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
6	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 II nd Edition, CBS Publishers, New Delhi

Web Resources	
1	https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY
2	https://www.e-booksdirectory.com/listing.php?category=323
3	http://www.freebookcentre.net/Biology/Agriculture-Books.html
4	https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf
5	https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbm=bb&hvdev=c&hvqmt=b&tag=msndeskstdin21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	2
CO 2	3	3	2	1	2	3	2	3	2	3
CO 3	2	2	3	3	1	2	2	3	2	3
CO 4	3	2	1	1	2	3	2	3	2	3
CO 5	3	3	2	3	1	2	3	3	3	3
S-Strong (3)			M-Medium (2)		L-Low(1)					

NON-MAJOR ELECTIVE-I

2. ENVIRONMENTAL BIOTECHNOLOGY

Title of the Course		ENVIRONMENTAL BIOTECHNOLOGY					
Paper Number		Non-Major Elective-I					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		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	On completion of this course, the students will be able to: CO					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	

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

2. ENVIRONMENTAL BIOTECHNOLOGY

UNIT	CONTENT
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, <i>ex situ</i> and <i>in situ</i> bioremediation.
V	Biometallurgy and related topics: Biomining – bioleaching - Biofilms and biocorrosion.

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	
6	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

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

NON-MAJOR ELECTIVE-I
3. NURSERY AND LANDSCAPING

Title of the Course		NURSERY AND LANDSCAPING					
Paper Number		Non-Major Elective-I					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	I				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		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 and practice the knowledge gained by developing kitchen garden and ornamental garden.						
C2	To be able to design gardens and become entrepreneur in Horticulture.						
C3	To study the methods of propagation.						
C4	To know about nursery structure.						
C5	To learn about gardening.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Explain the principles, scope, and management practices of nurseries and landscaping.					K1	
CO2	Demonstrate various methods of plant propagation and cultivation of important ornamental crops.					K2	
CO3	Design and maintain different types of gardens and landscapes.					K3	
CO4	Apply protected cultivation techniques and specialty horticultural practices such as bonsai and topiary.					K4	
CO5	Prepare organic manures and compost, manage nursery operations sustainably, and identify entrepreneurial opportunities in the nursery and landscaping sector.					K5	

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

3. NURSERY AND LANDSCAPING

UNIT	CONTENT
I	Introduction to Nursery and Landscaping Concepts, importance, scope, and career opportunities in nursery and landscaping; types of nurseries; site selection; nursery establishment and management; tools and equipment used in nurseries.
II	Plant Propagation and Floriculture Methods of plant propagation: seed propagation, cuttings, layering, grafting, budding, and micropropagation (overview); cultivation practices of major ornamental flowers—Rose, Chrysanthemum, and Jasmine; nursery management for ornamental plants.
III	Gardening and Landscape Design Types of gardens: formal, informal, kitchen/vegetable, rock and terrace gardens; principles and elements of landscape design; planning and layout of gardens; lawn establishment and maintenance; selection and use of ornamental plants, shrubs, hedges, climbers, and ground covers.
IV	Protected Cultivation and Specialty Horticulture Nursery structures: greenhouse, shade house, mist chamber, polyhouse (overview); protected nursery practices; indoor gardening; topiary, bonsai, hanging baskets, vertical gardening, and roof gardening.
V	Organic Inputs and Nursery Management Organic manures and fertilizers; composting and vermicomposting; potting media preparation; irrigation and nutrient management; common pests and diseases in nurseries and their eco-friendly management; marketing and entrepreneurship opportunities in nursery and landscaping.

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).
4	Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
5	Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
6	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. (3 rd 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=1637077031
4	https://in.pinterest.com/pin/496733033900458021/?lp=true
5	https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

NON-MAJOR ELECTIVE-II
1. MUSHROOM CULTIVATION

Title of the Course		MUSHROOM CULTIVATION					
Paper Number		Non-Major Elective-II					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		-		2
Pre-requisite		Basic knowledge on structure and function of various groups of mushrooms.					
Learning Objectives							
C1	To learn and develop skills in mushroom cultivation.						
C2	To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.						
C3	To cultivate mushroom cultivation in small scale industry.						
C4	To learn about diseases and post harvest technology.						
C5	To study new methods and strategies to contribute to mushroom production.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Recall various types and categories of mushroom.					K1	
CO2	Explain about various types of food technologies associated with mushroom industry.					K2	
CO3	Apply techniques studied for Cultivation of various types of mushroom.					K3	
CO4	Analyze and decipher the environmental factor and Economic value associated with mushroom cultivation					K4	
CO5	Develop new methods and strategies to contribute to mushroom production.					K5	

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

1. MUSHROOM CULTIVATION

UNIT	CONTENT
I	Introduction to Mushrooms Introduction, importance and scope of mushroom cultivation; morphology and classification of mushrooms; edible and poisonous mushrooms; nutritional and medicinal value; life cycle of common edible mushrooms.
II	Commercial Mushroom Cultivation Cultivation techniques of major edible mushrooms: Oyster mushroom (<i>Pleurotus</i> spp.) and Button mushroom (<i>Agaricus bisporus</i>), substrate preparation, sterilization/pasteurization, environmental requirements, crop management, and harvesting; scope of mushroom cultivation as a small-scale enterprise.
III	Spawn Production and Crop Management Spawn production techniques; mother culture and spawn preparation; preparation of growth media/substrates; spawning methods; spawn running; environmental control; crop management; harvesting and yield improvement.
IV	Post-Harvest Management and Value Addition Harvesting, grading, packaging, storage, transportation, and marketing of fresh mushrooms; processing and value-added mushroom products; quality standards; entrepreneurship opportunities and economics of mushroom cultivation.
V	Pest and Disease Management Identification and management of major diseases and pests of mushrooms; fungal competitors, bacterial and viral diseases; insect pests, mites, and nematodes; sanitation and hygiene; integrated pest and disease management (IPDM) practices.

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, strain improvement with their marketing. Daya Publishing House.
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 4 th 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

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	2
CO 2	3	3	2	1	2	3	2	3	2	1
CO 3	2	2	3	3	1	2	2	3	2	1
CO 4	3	2	1	1	2	3	2	1	2	1
CO 5	3	3	2	3	1	2	3	3	1	1
S-Strong (3)			M-Medium (2)			L-Low(1)				

NON-MAJOR ELECTIVE-II

2. HERBAL MEDICINE

Title of the Course		HERBAL MEDICINE					
Paper Number		Non-Major Elective-II					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		-		2
Pre-requisite		To understand the importance of herbal medicine.					
Learning Objectives							
C1	To understand the nuances of medicinal 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	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Define and describe the principle of cultivation of herbal products.					K1	
CO2	Explain phytochemistry economically 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	

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

2. HERBAL MEDICINE

UNIT	CONTENT
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 – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons, some poisonous plants; their toxicity and action.
III	Adulteration of crude drugs and its detection – methods of adulteration; types of adulteration. Medicinal plants of export values; rejuvenating herbs; Medicinal uses of Non-flowering plants.
IV	Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).
V	Botanical description and active principles of leaves; Flowers; Fruits seed and entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).

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 Henry, 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. <i>Motilal Banarsidass, Fourth edition.</i>
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

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	2	1	2	1	3	2	1
CO 2	3	3	2	1	1	2	2	2	2	2
CO 3	2	2	1	3	1	2	1	3	2	1
CO 4	3	2	1	2	1	2	3	3	2	3
CO 5	3	3	2	2	1	1	3	3	1	3
S-Strong (3)		M-Medium (2)			L-Low(1)					

NON-MAJOR ELECTIVE-II
3. GLOBAL CLIMATE CHANGE

Title of the Course		GLOBAL CLIMATE CHANGE					
Paper Number		Non-Major Elective-II					
Category	Elective	Year	I	Credits	2	Course Code	
		Semester	II				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		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	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Relate to the anthropogenic pressure on the environment and carbon footprint.					K1	
CO2	Explain about the physical basis of natural green gas house effect on man and materials.					K2	
CO3	Evaluate human influenced driver of our climate system and its applications					K3	
CO4	Analyze the causes and Effects of depletion of the stratospheric ozone layer.					K4	
CO5	Develop new strategies to mitigate issues of global environmental change.					K5	

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

3. GLOBAL CLIMATE CHANGE

UNIT	CONTENT
I	Global Environmental Change Concept and dimensions of global environmental change; drivers of environmental change; climate system and Earth's energy balance; sustainable development and environmental challenges; international environmental agreements and organizations - UNFCCC, IPCC, Kyoto Protocol, Paris Agreement, Clean Development Mechanism (CDM), carbon footprint, ecological footprint, and carbon credits.
II	Stratospheric Ozone Layer and Ozone Depletion Formation and evolution of the stratospheric ozone layer; causes of ozone depletion; ozone-depleting substances (ODS); impacts of enhanced UV-B radiation on plants, microorganisms, animals, human health, and materials; global initiatives for ozone protection, including the Montreal Protocol and its achievements.
III	Climate Change and Its Impacts Greenhouse effect; greenhouse gases and their sources; evidence and causes of climate change; impacts on weather, water resources, oceans, agriculture, biodiversity, forests, ecosystems, and human health; climate change adaptation and mitigation strategies; climate-resilient agriculture.
IV	Atmospheric Pollution and Ecosystem Responses Atmospheric deposition of nutrients and trace elements; causes, trends, and environmental consequences; eutrophication; acid rain—formation, causes, impacts on soil, water, plants, animals, microorganisms, and ecosystems; prevention and control measures.
V	Climate Action and Environmental Sustainability Climate policies and governance; renewable energy and low-carbon technologies; carbon sequestration and nature-based solutions; disaster risk reduction; climate-smart agriculture; environmental monitoring; public awareness, environmental ethics, and the Sustainable Development Goals (SDGs).

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.
4	Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5	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

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO 2	3	2	1	2	3	3	2	3	1	2
CO 3	2	2	3	1	1	2	3	2	3	1
CO 4	3	3	3	2	1	1	3	2	3	2
CO 5	3	2	2	3	2	3	1	2	2	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE COURSE-I
1. BIO-ANALYTICAL TECHNIQUES

Title of the Course		BIO-ANALYTICAL TECHNIQUES					
Paper Number		Elective-I					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To impart expertise about analysis and research.					
Learning Objectives							
C1	To understand the principle, operation and maintenance of various tools/equipment in the laboratory.						
C2	Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.						
C3	To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.						
C4	To give an exposure to various forms of field research and data analysis techniques.						
C5	To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.						
Course outcomes	On completion of this course, the students will be able to: CO						Programme Outcomes
CO1	Relate to the various biological techniques and its importance.						K1
CO2	Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy						K2
CO3	Apply suitable strategies in data collections and disseminating research findings.						K3
CO4	Compare and contrast the significance of different types of chromatography techniques.						K4
CO5	Develop methodologies for extraction and analysis of biochemical compounds.						K5

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

1. BIO-ANALYTICAL TECHNIQUES

UNIT	CONTENT
I	CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
II	ELECTROPHORESIS AND PH METER Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
III	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.
IV	BIOSTATISTICS Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram– measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.
V	CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).

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, Lond
7	Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. L
8	Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Ta McGraw
9	Hill Publishing Company Ltd. New Delhi.
	Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England C New Jersey.
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-Khandp

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE COURSE-I
2. AQUATIC BOTANY

Title of the Course		AQUATIC BOTANY					
Paper Number		Elective-I					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To understand ecological functions and economic uses of aquatic plants.					
Learning Objectives							
C1	To give an overview of the distribution of lower plants forms and its ecological significance.						
C2	To enable students to understand the ecological functions and economic uses of aquatic plants.						
C3	To equip students to collect, analyze and identify the planktons.						
C4	To give an exposure to various forms seaweeds.						
C5	To know about the values and uses of aquatic plants.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
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	

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

2. AQUATIC BOTANY

UNIT	CONTENT
I	MARINE AND LIMNETIC MACRO ALGAE Common seaweeds of Indian subcontinent: <i>Ulva</i>, <i>Caulerpa</i>, <i>Sargassum</i>, <i>Gracilaria</i>, etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: <i>Anabaena</i>, <i>Chlorella</i>, <i>Scenedesmus</i>.
II	MANGROVES Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including <i>Avicennia</i>, <i>Rhizophora</i>, <i>Acanthus</i> and <i>Aegiceras</i>. 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.

Recommended Texts	
1	Lee, R.E. 2008. Phycology. 4 th edition. Cambridge University Press, Cambridge.
2	Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International.
3	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
4	Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.
5	Daubenmire, R.F.1973. Plant and Environment. John Willey.
6	Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi.
7	Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 ISSN: 0971-8044.
Reference books	
1	Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.
2	Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands.
3	Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp.
4	Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp.
5	Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp.
6	Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	
1	http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf
2	http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf
3	https://www.springer.com/gp/book/9788132221777
4	http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf
5	https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	2	1	1	2	3	2	3	2	3
CO 3	2	2	3	1	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	1	2	3	2
CO 5	3	2	1	1	2	3	3	3	2	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE COURSE-I
3. ENTREPRENEURIAL BOTANY

Title of the Course		ENTREPRENEURIAL BOTANY					
Paper Number		Elective-I					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To develop innovative ideas to exploit the economically useful plant products 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	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Recognize the significance of government agencies for entrepreneurship development.					K1	
CO2	Explain about entrepreneuria l values, risk assessment and solutions.					K2	
CO3	Make use of entrepreneurial opportunities.					K3	
CO4	Analyze and decipher the significance of bioventure and value added products.					K4	
CO5	Devise innovative methods for making value added products.					K5	

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

3. ENTREPRENEURIAL BOTANY

UNIT	CONTENT
I	INTRODUCTION Need - definition and concept - Types and characterization – entrepreneurial values- motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
II	BIOVENTURE Industry - overview of <i>Spirulina</i> , <i>Pleurotus</i> , 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	VALUE ADDED 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 and jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.
IV	ORGANIZATIONS AND AGENCIES TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurship – various government schemes.
V	ENTREPRENEURIAL OPPORTUNITIES Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, 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.

Recommended Texts	
1	Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New venture creation, Galgeha publication company, New Delhi.ISSN: 2321-8916.
2	Desai,V.,2015. Entrepreneurship development, First edition.Himalaya publication house, Mumbai. ISBN:9789350973837.
3	Khanna,S.S. 2016. Entrepreneurial development. S.Chand company limited, New Delhi.ISBN:9788121918015.
4	Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10th ed). Rastogi Publications, Meerut.
5	Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
Reference books	
1	Manohar,D.1989. Entrepreneurship of small scale industries,vol.III.Deepanddeep publication, New Delhi. ISSN: 09735925.
2	Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservation of fruits and vegetables. Indian Council of Agricultural Research (ICAR). ISSN:0101- 2061.
3	Ranganna,S.,2001.Handbook of analysis and quality control of fruits and Vegetable products, Second edition, Tata Mc Graw hill, New Delhi.ISBN: 780074518519.
4	Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut.
5	Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co.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

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	1	2
CO 2	3	1	3	2	1	3	1	3	3	1
CO 3	2	2	3	3	1	1	2	3	1	2
CO 4	3	3	2	2	3	2	3	3	2	3
CO 5	3	3	2	3	1	2	3	3	2	3
S-Strong (3)		M-Medium (2)		L-Low(1)						

ELECTIVE COURSE-II

1. HORTICULTURE

Title of the Course		HORTICULTURE					
Paper Number		Elective-II					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To impart expertise knowledge on horticulture applications.					
Learning Objectives							
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.						
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.						
C3	To know about hydroponic culture.						
C4	To develop the various horticultural crop protection.						
C5	To impart the knowledge on market preparation.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Enumerate the concepts in horticulture and nursery management.					K1	
CO2	Demonstrate aworking knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.					K2	
CO3	Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.					K3	
CO4	Analyze different methods of weed control in horticultural crops.					K4	
CO5	Develop their competency on pre and post- harvest technology in horticultural crops.					K5	

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

1. HORTICULTURE

UNIT	CONTENT
I	Importance and scope of horticulture. Classification of horticultural crops – fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (greenhouses), environment controls.
II	Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.
III	Horticultural crop protection; physical control - pruning. Chemical control-pesticides, fungicides. Plant propagation - cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
IV	A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.
V	Technology of horticultural crops - market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and canning, drying and chemical preservation.

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. Perpetual 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.
Web Resources	
1	https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK
2	https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/
3	http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/
4	https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648
5	https://cbseportal.com/ebook/vocational-books-horticulture
6	http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	2	1	2	2	2	1
CO 2	3	3	2	1	1	3	1	3	1	3
CO 3	2	2	3	3	1	2	2	3	1	2
CO 4	3	3	2	2	3	2	3	1	3	2
CO 5	3	3	2	3	1	3	2	3	1	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE COURSE-II
2. NATURAL RESOURCE MANAGEMENT

Title of the Course		NATURAL RESOURCE MANAGEMENT					
Paper Number		Elective-II					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To understand the concept of different natural resources and their utilization.					
Learning Objectives							
C1	To develop an appreciation of natural resources and their ecological and economic importance.						
C2	To gain an understanding of various strategies for the management and sustainable use of natural resources.						
C3	To understand the different types of natural resources and their effective utilization.						
C4	To design and develop models for the conservation and sustainable management of natural resources.						
C5	To examine the significance of natural resources in relation to economic development and environmental sustainability.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Explain the significance of natural resources in relation to the economy and the environment.					K1	
CO2	Understand the different types of natural resources and their utilization.					K2	
CO3	Evaluate various management strategies for different natural resources.					K3	
CO4	Critically analyze the sustainable utilization of land, water, forest, and energy resources.					K4	
CO5	Design innovative models for the conservation and sustainable management of natural resources.					K5	

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

2. NATURAL RESOURCE MANAGEMENT

UNIT	CONTENT
I	Introduction to Natural Resource Bases Concept and classification of natural resources. Factors influencing resource availability, distribution, and utilization. Interrelationships among different types of natural resources. Productivity issues in natural resource utilization. Ecological, social, and economic dimensions of natural resource management.
II	Forest and Land Resources Forest vegetation: status, distribution, major forest types, and characteristics. Use and over-exploitation of forests; deforestation and case studies. Timber extraction, mining, dams, and their impacts on forests and tribal communities. Forest management strategies in developing and developed countries. Land as a natural resource; land use classification. Land degradation, man-induced landslides, soil erosion, and desertification. Landscape impact analysis, wetland ecology, and wetland management.
III	Water, Energy, Food, and Marine Resources Water resources: utilization and over-exploitation of surface and groundwater. Floods, droughts, water conflicts, dams: benefits and challenges. Water ecology and water resource management. Energy resources: renewable and non-renewable sources, growing energy needs, and alternative energy resources. Food resources: global food issues, impacts of modern agriculture, overgrazing, fertilizer and pesticide problems, waterlogging, salinity, and case studies. Fish and marine resources: production, utilization, unsustainable harvesting, challenges, and future prospects.
IV	Mineral Resources and Resource Management Mineral resources: utilization, exploitation, and environmental impacts. Evolution and history of resource management paradigms. Resource conflicts: extraction, access, and control systems. Approaches to resource management: ecological, economic, ethnological, and integrated resource management. Poverty and natural resource management in developing countries: causes, resource scarcity, and implications.
V	Management of Common International Resources and Case Studies Management of common international resources: oceans, climate, international fisheries, and management commissions. Antarctica and the evolution of international resource management regimes. Case studies: Resource management in mountain ecosystems. Dryland ecosystem management. Marine and coastal resource management. Shifting cultivation and its management. Mangrove ecosystem management.

Recommended Texts	
1	Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2	Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.
3	United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition

Reference books	
1	Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with
2	Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
3	Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.
4	Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
5	Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.
6	Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
7	Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB). 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=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-WATERebook/dp/B00OPTWHOE
4	https://www.kobo.com/us/en/ebooks/natural-resources
5	https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&redir_esc=y
6	https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y

Mapping with Programme Outcomes

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

S-Strong (3)

M-Medium (2)

L-Low (1)

ELECTIVE COURSE-II

3. FORESTRY

Title of the Course		FORESTRY					
Paper Number		Elective-II					
Category	Elective	Year	II	Credits	3	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To understand the knowledge on trees, forests and their importance.					
Learning Objectives							
C1	To study the distribution, composition, structure, and diversity of forest ecosystems.						
C2	To understand the principles, methods, and practices of forest management and conservation.						
C3	To develop the knowledge and skills required to contribute effectively to forest conservation and sustainable management.						
C4	To create awareness of sustainable forest resource utilization and contemporary global issues affecting forests due to human activities.						
C5	To foster an appreciation of forest biodiversity and recognize its ecological, environmental, and socio-economic importance.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Explain the basic concepts of forest distribution, degradation, protection, management, and sustainable resource utilization.					K1	
CO2	Analyze the complex interactions between humans and forest ecosystems in a global context.					K2	
CO3	Demonstrate skills in ecological measurements, data interpretation, and the application of forest ecology and management principles.					K3	
CO4	Examine the factors influencing forest vegetation and degradation, and evaluate methods of wood preservation and forest protection.					K4	
CO5	Develop innovative strategies and apply the acquired knowledge to analyze and solve problems related to the conservation and sustainable management of forest ecosystems.					K5	

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

3. FORESTRY

UNIT	CONTENT
I	Silviculture Objectives, scope, and principles of silviculture. Natural and artificial regeneration of forests. Nursery techniques, containerized seedling production. Vegetative propagation, clonal propagation, macropropagation, and micropropagation techniques.
II	Forest Mensuration, and Utilization Forest mensuration: definition, objectives, and scope. Forest inventory: sampling techniques, sample plots, and crop measurement Forest products: timber, fuelwood, pulp, paper, rayon, and match industries. Wood composites: plywood, particle board, fibreboard, MDF, hardboard, and insulation boards. Non-Timber Forest Products (NTFPs): collection, processing, storage, and utilization of fibres, bamboos, canes, gums, resins, essential oils, medicinal plants, lac, shellac, tassar silk, and the role of tribal cooperative societies.
III	Forest Biology and Biodiversity Environmental issues: global warming, greenhouse effect, ozone layer depletion, acid rain, and the role of forests in environmental conservation. Biodiversity: definition, origin, types, significance, threats, biodiversity hotspots, endemism, and the Red Data Book. Biodiversity assessment: principles and methods.
IV	Forest Botany, Genetics, and Tree Improvement Forest genetics and tree breeding, Tree improvement: variation, selection, Progeny Evaluation Test (PET), Candidate Trees, Plus Trees, and Elite Trees. Provenance and seed source selection. Heritability, genetic gain, hybrids, and heterosis. Seed Production Areas (SPA) and seed orchards: types and establishment. In situ and ex situ gene conservation. Role of exotic forest tree species in India.
V	Agroforestry, Social Forestry, and Urban Forestry Agroforestry: definition, concepts, objectives, and classification of agroforestry systems. Agroforestry practices for different agro-climatic zones of Tamil Nadu. Agroforestry for wasteland reclamation. Social forestry: objectives, scope, necessity, components, and implementation at local and national levels. Community participation and social attitudes towards forestry. Joint Forest Management (JFM): principles, objectives, methodology, and species selection. Urban forestry: definition, scope, benefits, species selection, planting techniques, and management.

Recommended Texts	
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. Forests in India, Environmental and Protection Frontiers. Oxford IBH Publishing Co., New Delhi.
Reference books	
1	Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia.
2	Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. Wertz Kanounnikoff. 2007. Incentives and constraints shape forest outcomes. In: At loggerheads? Agricultural expansion, poverty reduction and environment in tropical forests. The World Bank, Washington, DC.
3	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://www.wds.worldbank.org/external/default/WDSPContentServer/WDSP/IB/2006/10/19/000112742_20061019150049/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 .

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	3	3	2	3	3	2
CO 2	3	3	3	3	2	3	1	1	3	1
CO 3	3	3	3	2	3	3	3	3	3	3
CO 4	3	2	3	1	2	3	1	2	3	1
CO 5	3	2	1	3	1	1	2	3	1	2
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE COURSE-III
1. BIO-NANOTECHNOLOGY

Title of the Course		BIO-NANOTECHNOLOGY					
Paper Number		Elective-I					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To provide an insight into the principles of nanotechnolgoy in biological and medical research.					
Learning Objectives							
C1	To provide students with comprehensive knowledge of basics in nanotechnology.						
C2	To enable the students understand and appreciate the various applications of nanoparticles.						
C3	To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.						
C4	To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.						
C5	To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.						
Course outcomes	On completion of this course, the students will be able to: CO					Programme Outcomes	
CO1	Relate to the essential features of biology and nanotechnology that are converging to create the new era of bionanotechnology					K1	
CO2	Explain the synthesis of nanomaterials and their applications.					K2	
CO3	Apply the knowledge gained to develop nanomaterials					K3	
CO4	Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.					K4	
CO5	Construct various types of nanomaterial for application and evaluate the impact on environment.					K5	

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

1. BIONANOTECHNOLOGY

UNIT	CONTENT
I	INTRODUCTION TO NANOTECHNOLOGY History, Concepts, Prospects and Challenges. Scope of nanotechnology in Indian and global perspectives. Definition - Nanoscience, Nanotechnology. Classification based on the dimensionality- basic understanding of 1D, 2D and 3D nanostructures. Overview of nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biotemplates – DNA to build nanocubes and hinges – smart glue, DNA as wire template.
II	SYNTHESIS OF NANOPARTICLES Synthesis of nanoparticles - Top down and bottom up approach. Methods of synthesis: Physical, Chemical reduction – reducing agents, capping agents, stabilizing of nanoparticles and Biological – Novel synthetic methods using plant extracts, bacteria and fungi.
III	FOREST UTILIZATION AND WOOD TECHNOLOGY Properties & Characterization of Nanoparticles: Nano size effects - optical, electrical, mechanical, magnetic and catalytic activity. Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, Atomic force microscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography and Photoluminescence.
IV	NANOCARRIERS Introduction. Nanocarriers for drug delivery (DDS) – Polymeric nanotubes and solid lipid nanoparticles (SLN) as carriers, controlled release, site specific targeting. Magnetic nanoparticles as drug carriers and its applications.
V	APPLICATIONS OF NANOPARTICLES Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, wound healing and dressing; Environment - green manufacturing. Agriculture - nanofertilizers and nanopesticides. Smart biosensors - Components and its application.

Recommended Texts	
1	Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction to Nanotechnology, A John Wiley & Sons, INC., Publication.
2	George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. CRC Press.
3	Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscience and
4	Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Practices. Capital
5	Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers.
6	Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylor Francis Group. Sharma P.K. 2008. Understanding Nanotechnology. Vista International Publishing House, Delhi.
7	Viswanathan B. 2009. Nano Materials. Narosa Publishing House, New Delhi.
Reference books	
1	Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd,
2	Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience.
3	Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.
4	European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.
5	Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland.
Web Resources	
1	https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453
2	https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4
3	https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
4	https://phys.org/news/2014-10-endless-possibilities-bionanotechnology.html
5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/
6	https://phys.org/news/2014-10-endless-possibilities-bionanotechnology.html
7	http://www.particle-works.com/applications/controlled-drug-release/Applications

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE COURSE-III

2. COMPUTER APPLICATIONS IN BOTANY

Title of the Course		COMPUTER APPLICATIONS IN BOTANY					
Paper Number		Elective-I					
Category	Elective	Year	III	Credits	3	Course Code	
		Semester	VI				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	-		-		3
Pre-requisite		To equip students with computational skills in botany.					
Learning Objectives							
C1	To familiarize the student with the fundamental concepts						
C2	To equip students with computational skills for drug design.						
C3	To learn about the bioinformatics database, data format and data retrieval from online sources.						
C4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.						
C5	Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.						
Course outcomes	On completion of this course, the students will be able to: CO					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	

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

2. COMPUTER APPLICATIONS IN BOTANY

UNIT	CONTENT
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, 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).

Recommended Texts	
1	Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
2	Baxeavanis, 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.
3	Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
4	Andreas, D., Baxeavanis, 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.
5	Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
Reference books	
1	David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
2	Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun.
3	Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press.
4	Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.
5	Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition.
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.freebookcentre.net/Biology/BioInformatics-Books.html

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	1	3	3	3	3
CO 2	3	3	3	2	1	3	3	2	2	3
CO 3	3	3	3	1	2	1	3	2	2	3
CO 4	3	3	3	1	2	1	3	2	2	3
CO 5	3	3	3	1	2	1	3	2	2	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

ELECTIVE COURSE-III

3. FORENSIC BOTANY

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

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

3. FORENSIC BOTANY

UNIT	CONTENT
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: <i>Abrus precatorius</i> , <i>Aconitum napellus</i> , <i>Anacardium occidentale</i> , <i>Argemone mexicana</i> , <i>Cannabis sativa</i> , <i>Claviceps purpuria</i> , <i>Croton tiglium</i> , <i>Atropa belladonna</i> , <i>Gloriosa superba</i> , <i>Jatropha curcas</i> , <i>Lathyrus sativus</i> , <i>Nerium indicum</i> , <i>Nicotiana tabacum</i> , <i>Strychnos nuxvomica</i> , <i>Thevetia nerifolia</i> . Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, <i>Psilocybin</i> 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.

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. Elsevier.
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.crcpress.com/Forensic-Botany-Principles-and-Applications- to-Criminal-Casework/Miller-Coyle/p/book/9780849315299
4	http://docshare02.docshare.tips/files/25818/258183613.pdf

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	1
CO 2	3	3	2	1	1	3	2	3	1	3
CO 3	2	1	2	3	1	2	1	3	1	2
CO 4	3	3	3	3	2	1	3	3	2	1
CO 5	3	3	2	3	2	3	1	2	2	3
S-Strong (3)		M-Medium (2)		L-Low(1)						

SKILL ENHANCEMENT COURSES SEC 1
ENTREPRENEURIAL SKILL
ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course		ENTREPRENEURIAL OPPORTUNITIES IN BOTANY					
Paper Number		Skill Enhancement-1					
Category	SEC	Year	II	Credits	2	Course Code	
		Semester	III				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		-		2
Pre-requisite		To understand the concept of Entrepreneurial Opportunities in Botany.					
Learning Objectives							
C1	To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.						
C2	To create a mindset among students to start their own companies for income generation.						
C3	The students may understand about various fields of botany.						
C4	To develop the concept of Entrepreneurial Opportunities in Botany.						
C5	Describe the new strategies to describe marketing and business management strategy.						
Course outcomes	On completion of this course, the students will be able to					Programme Outcomes	
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach.					K1	
CO2	Explain the concept of Entrepreneurial Opportunities in Botany.					K2	
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations					K3	
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.					K4	
CO5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.					K5	

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

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

UNIT	CONTENT
I	INTRODUCTION TO ENTREPRENEURSHIP Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.
II	TOOLS AND TECHNIQUES Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.
III	NEW VENTURE CREATION Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
IV	PRODUCT DEVELOPMENT AND COMMERCIALIZATION Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
V	BIO-BUSINESS PLANS, IPR AND BIOETHICS Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.

Recommended Texts	
1	Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India.
2	Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India.
3	Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA.
4	Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.
5	Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.

Reference books	
1	Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.
2	Peter F. Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.
3	Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides).
4	Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
5	Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
6	Webster, J and Weber, R. 2007. Introduction to Fungi, 3 rd Ed. Cambridge University Press, Cambridge
Web sources	
1	https://www.brainkart.com/article/Entrepreneurial-Botany_38321/
2	https://www.youtube.com/watch?v=hnBla1FfcLo
3	https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation
4	http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301
5	https://www.ebooks.com/en-us/subjects/gardening/
6	https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	1	2	1	2	2	1	2
CO 2	3	3	2	2	3	1	2	3	1	2
CO 3	2	2	3	1	2	2	1	3	2	1
CO 4	3	3	1	2	3	2	3	3	2	3
CO 5	3	3	2	3	1	3	3	3	3	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

SKILL ENHANCEMENT COURSES SEC 2
HERBAL TECHNOLOGY

Title of the Course		HERBAL TECHNOLOGY					
Paper Number		Skill Enhancement-2					
Category	SEC	Year	II	Credits	2	Course Code	
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		2	-		-		2
Pre-requisite		To understand the importance of herbal technology.					
Learning Objectives							
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.						
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.						
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.						
C4	To apply the knowledge to cultivate medical plants.						
C5	To know the pharmacological importance of medicinal plants.						
Course outcomes	On completion of this course, the students will be able to: CO						Programme Outcomes
CO1	Define and describe the principle of cultivation of herbal products						K1
CO2	List the major herbs, their botanical name and chemical constituents.						K2
CO3	Apply techniques for monitoring drug adulteration through the biological testing.						K3
CO4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.						K4
CO 5	Develop the skills for cultivation of plants and their value added processing / storage						K5

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

HERBAL TECHNOLOGY

UNIT	CONTENT
I	History and Scope of Herbal Medicines, Scope of Herbal Technology, Traditional Systems of Medicine, Overview of AYUSH (Ayurveda, Yoga & Naturopathy, Unani, Siddha, and Homoeopathy), Cultivation, Harvesting techniques, Processing and Storage of herbs and herbal products
II	Value-Added Plant Products- Concept and significance, Herbs and herbal products recognized in India. Major herbs used as: Herbal medicines, Nutraceuticals, Cosmeceuticals, Biopesticides. Study of major herbs with reference to: Botanical name, Plant parts used, Major chemical constituents.
III	Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, <i>Catharanthus roseus</i> , <i>Withania somnifera</i> , <i>Centella asiatica</i> , <i>Achyranthes aspera</i> , Kalmegh, Giloe (<i>Tinospora</i>), Saravar. Herbal foods, future of pharmacognosy.
IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (<i>Withania somnifera</i> , neem and tulsi),

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 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	Arber, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3	Varzakas, T., Zakyntinos, 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, pp218.
Web resources	
1	https://www.kopykitab.com/Herbal-Science
2	https://kadampa.org/books/free-ebook-downloadhowtotyl?gclid=CjwKCAiA6vXwBRBK EiwAYE7iS5t8yenur CIUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnU QAv D_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=131000493 2&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
5	https://www.dattanibookagency.com/books-herbs-science.html
6	https://www.springer.com/gp/book/9783540791157

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	3	3	2	3	2
CO 2	3	3	3	3	3	3	3	1	3	1
CO 3	3	3	3	3	3	3	3	2	3	2
CO 4	3	3	3	3	3	3	3	1	3	1
CO 5	3	3	3	3	3	3	3	1	3	1
S-Strong (3)			M-Medium (2)			L-Low(1)				

SKILL ENHANCEMENT COURSES SEC 3
BOTANICAL GARDEN AND LANDSCAPING

Title of the Course		BOTANICAL GARDEN AND LANDSCAPING						
Paper Number		Skill Enhancement 3						
Category	SEC	Year	III	Credits	2	Course Code		
		Semester	V					
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total	
		2	-		-		2	
Pre-requisite		Students should know about the fundamental concepts of gardening and landscaping						
Learning Objectives								
C1	Provide a comprehensive understanding of the principles, concepts, and scope of botanical gardening and landscape design.							
C2	Develop knowledge and practical skills in the selection, propagation, cultivation, and maintenance of ornamental plants used in gardens and landscapes.							
C3	Familiarize students with the planning, design, establishment, and management of various types of gardens.							
C4	Equip students with knowledge of floriculture, flower arrangement, post-harvest management.							
C5	Landscape construction, and the application of Computer-Aided Design (CAD) tools for modern landscape planning and visualization.							
Course outcomes	On completion of this course, the students will be able to						Programme Outcomes	
CO1	Explain the principles, scope, and importance of gardening and landscaping, and identify the components and styles of gardens.						K1	
CO2	Select, propagate, establish, and maintain ornamental plants.						K2	
CO3	Design and develop aesthetically pleasing and functional landscapes.						K3	
CO4	Apply the principles of bio-aesthetic planning and landscape design for residential, institutional, commercial, industrial, urban, and public spaces while incorporating sustainable landscaping practices.						K4	
CO5	Demonstrate knowledge of floriculture, flower arrangement, post-harvest management, and the use of Computer-Aided Design (CAD) tools.						K5	

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

BOTANICAL GARDEN AND LANDSCAPING

UNIT	CONTENT
I	Fundamentals of Gardening Principles, scope, and importance of gardening and landscaping. Garden components and ornamental features. Lawn establishment and maintenance. Design and construction of rock gardens, water gardens, and other landscape elements. Greenhouses: types, structures, and applications in ornamental horticulture.
II	Ornamental Plants and Garden Design Classification, selection, propagation, planting, and maintenance of ornamental plants. Landscape use and design value of trees, shrubs, herbaceous perennials, climbers, creepers, palms, ferns, grasses, cacti, and succulents. Styles of gardens: formal, informal, and free-style gardens. Special gardens, including Japanese gardens, butterfly gardens, sensory gardens, herbal gardens, and botanical gardens.
III	Floriculture and Bio-aesthetic Planning Principles and importance of flower arrangement. Production techniques and cultural practices for ornamental flowering plants. Post-harvest handling and value addition of cut flowers. Bio-aesthetic planning: concepts, objectives, and applications. Landscape planning for schools, villages, urban areas, parks, railway stations, riverbanks, dam sites, hydroelectric projects, residential colonies, and playgrounds.
IV	Landscape Design and Urban Landscaping Principles and elements of landscape design. Landscaping for residential, institutional, industrial, commercial, healthcare, corporate, and IT campuses. Landscaping of roadsides, traffic islands, parks, public gardens, and ecotourism sites. Establishment and maintenance of landscaped areas. Vertical gardens, roof gardens, indoor gardens, therapeutic gardens, and theme parks. Bonsai: principles, techniques, training, and maintenance.
V	Sustainable Landscaping and Digital Tools Sustainable landscaping practices. Water-efficient landscaping (xeriscaping), waterscaping, and hardscaping. Selection and use of non-plant landscape components. Eco-friendly landscape management and conservation of urban green spaces. Introduction to Computer-Aided Design (CAD) for landscape planning and design. Applications of CAD and digital tools in outdoor landscaping and interior plantscaping.

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

Mapping with Programme Outcomes

COS	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	1	2	3	1
CO 2	3	3	2	2	1	3	2	3	3	2
CO 3	2	2	3	2	1	2	1	3	2	3
CO 4	3	3	2	3	1	2	3	3	3	2
CO 5	3	3	2	3	2	3	1	3	3	2
S-Strong (3)			M-Medium (2)			L-Low(1)				

MODEL QUESTION PAPER

B. Sc., Botany Degree Examination

((For Students Admitted from the Academic Year 2026 – 2027 onwards under CBCS Pattern)

CORE COURSE – III. MAJOR PRACTICAL I

(Covering the core courses I &II)

(ALGAE, BRYOPHYTES, FUNGI, BACTERIA, VIRUSES AND LICHENS)

Time : 3 hrs.

Maximum : 60 Marks
Practical : 50 Marks
Record : 10 Marks

1. Cut transverse section of A, B and C. Stain and mount in glycerin. Identify giving reason.
Draw diagrams. Leave the slides for valuation. (7X3=21)
2. Stain the material D and interfere its Gram stain. (4X1=4)
3. Draw diagrams and write notes of interest on E, F, G and H. (4X3=12)
4. Name the genus, group and morphology of given part of I, J and K. (3X3=9)
5. Identify and write notes on economic importance of L, and M. (2X2=4)

Key

A - Algae

B - Bryophytes

C- Fungi

(Preperation-2, Identification -1, Diagram -2, Reason -2) (7X3=21)

D - Bacteria

(Procedure-2, Identification with reason-1, preparation-1) (4X1=4)

E - Algae

F - Bryophytes,

G - Fungi:

H - Lichens- fruit body or Bacteria/viruses-micrograph photograph (any four)

(Identification -1, Diagram -1 , Reason -2) (4X3=12)

I - Algae

J - Bryophytes

K - Fungi

(Genus 1, Group 1, Morphology 1) (3X3=9)

L -Algae/Fungi

M -Bacteria/Viruses

(identification 1, importance 1) (2X2=4)

MODEL QUESTION PAPER

B. Sc., Botany Degree Examination

((For Students Admitted from the Academic Year 2026 – 2027 onwards under CBCS Pattern))

CORE COURSE – VI. MAJOR PRACTICAL II

(Covering the core courses IV and V)

(PTERIDOPHYTES, GYMNOSPERMS, PALEOBOTANY, PLANT ANATOMY AND EMBRYOLOGY)

Time : 3 hrs.

Maximum : 60 Marks

Practical : 50 Marks

Record : 10 Marks

1. Cut transverse section of A, B and C. Stain and mount in glycerin. Identify giving reason. Draw diagrams. Leave the slides for valuation. (3X6=24)
2. Make suitable micro-preparation of D and E. Identify giving reason. Draw diagrams. Leave the slides for valuation. (2X3=6)
3. Dissect and mount any one of the stages of the given material F. (1X4=4)
4. Name the genus, group and morphology of given part of G and H. (2X3=6)
5. Identify and write notes on I, J, K, L and M. (5X2=10)

Key

A - Pteridophyte

B - Gymnosperm

C- Dicot / Monocot – root, stem or leaf (any one)

(Preparation-2, Identification -1, Diagram -1, Reason -2) (3X6=24)

D and E – Reproductive part of Pteridophyte and Gymnosperm

(Procedure-1, Identification with reason-1, preparation-1) (2X3=6)

F - Embryo- Dicot- Tridax (Slide and Identification) (1X4=4)

G - Pteridophyte

H – Gymnosperm

(Genus 1, Group 1, Morphology 1) (2X3=6)

I, J, K, L and M - Anatomy, Embryology, Pteridophyte, Gymnosperm and Fossil Slide

(Identification - 1 and Reason -1) (5X2=10)

MODEL QUESTION PAPER

B. Sc., Botany Degree Examination

((For Students Admitted from the Academic Year 2026 – 2027 onwards under CBCS Pattern))

CORE COURSE – X MAJOR PRACTICAL III

(Covering the core courses VII, VIII & IX)

(MORPHOLOGY, TAXONOMY & ECONOMIC BOTANY; PLANT PATHOLOGY & PLANT PROTECTION; CELL BIOLOGY, GENETICS & PLANT BREEDING)

Time : 3 hrs.

Maximum : 60 Marks

Practical : 50 Marks

Record : 10 Marks

1. Refer A and B, to their respective families. Point out the characters on which the identification is based at each level. (Diagrams not necessary) (2X6=12)
2. Describe C in Technical terms. Draw diagrams of the floral parts only. Construct the floral Diagram. Give the floral formula (1X4=4)
3. Make acetocarmine preparation of D (Squash) any one stage. Draw diagram. (1X6=6)
4. Solve the given genetic problem E and F. (2X4=8)
5. Construct the chromosome map with the data provided G. (1X4=4)
6. Identify the casual organism of the diseases material H, Draw diagram, describe the symptoms and list the control measures (1X 7= 7)
7. Seed viability test I (1X3=3)
8. Spot at sight J, K and L (3X2=6)

Key

- A & B - Family from polypetalae / gamopetalae / monochlamydae / monocots (any 2)
(identification 1, steps for Bentham and Hooker key 3) (2X6=12)
- C- (Any one above mentioned group other than given in A &B)
(Technical description 2, floral diagram 1, floral formula 1) (1X4=4)
- D- Onion root tip (Mitosis) / Onion flower bud (Meiosis)
(Preparation 1, Slide 1, Identification 1, diagram 1, reason 2 marks) (1X4=4)
- E & F - Genetic problems (2X4=8)
- G - Chromosome map-three point test cross (1X4=4)
- H – Any disease in the syllabus (1X7=7)
(Name of the disease 1, Casual organism 1, Symptoms 2, Control measures 2, diagram 1)
- I – Seed Viability test using Tetrazolium Chloride
(Procedure 1, Reasons 2) (1X3=3)
- J, K & L - Cell Organelles (any two), Plant protection (equipment) (any one)
(Diagram and notes=2) (3X2=6)

MODEL QUESTION PAPER

B. Sc., Botany Degree Examination

((For Students Admitted from the Academic Year 2026 – 2027 onwards under CBCS Pattern))

CORE COURSE - XIV MAJOR PRACTICAL IV

(Covering the core courses XI, XII & XIII)

(PLANT ECOLOGY & PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY & MOLECULAR BIOLOGY, PLANT PHYSIOLOGY & BIOCHEMISTRY)

Time : 3 hrs.

Maximum : 60 Marks

Practical : 50 Marks

Record : 10 Marks

1. Based on morphological and anatomical characters, assign, A and B to their respective probable habitats. Draw suitable diagrams. Submit slides for valuation. (2X8=16)
2. Outline the procedure, apparatus and materials required for investigating the physiological Problem C assigned. Set up the experiment. Tabulate the data obtained and report the results. Leave the set up for valuation. (1X16=16)
3. Identify the biochemical entities present in material D. (1X6=6)
4. Spot at sight-E, F, G & H (4x3=12)

Key

A & B- Ecology material –
(Preparation 2, identification 1, diagram 2, reason 3 marks) (2X8=16)

C- Experiment selected by student from the lot- Physiology –
(Materials 2, Procedure 4, Setup 4, Observation 2, Result 4marks) (1X16=16)

D- biochemical test for carbohydrate, proteins and lipids
(Procedure-4, Result-2 marks) (1X6=6)

E.F.G.H-Phytogeography maps / Biotechnology / Molecular Biology / Physiology(Demonstration)
(4x3=12)

MODEL QUESTION PAPER

((For Students Admitted from the Academic Year 2026 – 2027 onwards under CBCS Pattern))

B.Sc., BOTANY ALLIED PRACTICAL

(Covering the core courses XI, XII & XIII)

(PLANT ECOLOGY & PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY & MOLECULAR BIOLOGY, PLANT PHYSIOLOGY & BIOCHEMISTRY)

Time : 3 hrs.

Maximum : 60 Marks
Practical : 50 Marks
Record : 10 Marks

1. Refer A & B to their families giving reasons (Diagrams not necessary) (2X5=10)
2. Identify the plant, family and morphology of the parts used for C, D and E (3X3=9)
3. Cut transverse section of F, G, H, I & J Stain and mount in Glycerin. Identify giving reasons. Draw diagrams. Submit the slides for valuation. (5X3=15)
4. Write critical notes on K, L, M, N, O & P Draw diagrams. (2X6=12)
5. Physiology Experiment Q (1X4=3)

Key

- A and B - Any 2 plants prescribed in the syllabus.
Reasons 3, Identification -2 (2 x 5=10)
- C, D and E - plants prescribed in the syllabus (3X3=9)
- F, G, H & I – Algae, Bryophyte, Pteridophyte and Gymnosperm
J- Dicot / Monocot – root, stem or leaf (any one)
(Slide 1, Identification 1, Reasons 2) (5 x 3=15)
- K, L, M, N, O & P – Spotters prescribed in the syllabus (6 x2=12)
Q - Physiology Experiment (1X3= 4)
