SRI MEENAKSHI GOVERNMENT ARTS COLLEGE FOR WOMEN

(An Autonomous Institution Affiliated to Madurai Kamaraj University)

Re-Accredited with B^{++} Grade by NAAC (4^{th} Cycle)

Madurai-625002.

SYLLABUS

Programme:	Undergraduate
Programme Code:	**UBOE 1**
Name of the Programme:	**B.Sc. BOTANY**
Duration of the Programme:	3 Years (6 Semesters)
Year:	**2024-2027**
Eligibility for Admission:	As per DCE norms (i) Pass in +2 or equivalent exam (Biology / Botany & Zoology) (ii) Should have studied Chemistry

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Core Courses

Discipline Elective (Allied) Courses

Discipline Specific Elective Courses

Skill Enhancement Courses

Foundation Course

Professional Competency Course

DEPARTMENT OF BOTANY

Study of plants has always been a fascination of the human kind for all life will have to essentially depend on floral elements for both nutritional and survival needs. From such a fundamental understanding of life and life' s processes, to reach to an aesthetic appreciation of nature and its constituent biotic elements interacting with the abiotic material world, one needs a systemic approach and a critical study of the plant world. The idea of development and conservation will have to be pragmatically addressed for a comprehensive understanding and an active engagement at different levels. The Department of Botany dedicating its efforts, grit and the single-minded focus on this exciting mission, functions as a humble but active constituent of the noble institution Sri Meenakshi Government Arts College for Women that has envisioned and committed itself to the cause of emancipation of the womanhood in this part of our nation. The crew in Botany dedicates dearly for the noble endeavor by finding viable and practical solutions, infusing interest and imparting relevant skills in every possible way that a holistic education is made available in its portal.

The credibility and trust that the college and the department have earned over the years make the women folk of this region to come into its fold for pursuing professional training for career prospects. The need for updated knowledge in Botany to deal with the issues of this predominantly agrarian backdrop and the modest household from where the students hail, but the immense energy and potential that they hone could suffice to find relevance in these students to go after their personal and professional dreams and aspirations. The programs, courses and the training offered in the department by its committed faculty help learners to equip with vocational skills and leadership traits that the two academic programs, offered at the bachelors' and masters' level to promptly meet the task cut out (Specific Vission, Mission statements) with appropriate outcomes (listed course-wise), embed effective exposure and ensure training on plant based knowledge and resources for self actualization and upholding common good.

Programs offered by the Department:

1. B.Sc. Botany since 2008-09
2. M.Sc. Botany since 2013-14

Scope of the Department:

To explore nature and the plant world and translate the experience in organic terms for empowering self and womanhood

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

PROGRAMME OUTCOMES OF B.Sc. BOTANY – TANSCHE

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme:	**B.Sc. BOTANY**
Programme Code:	**UBOE 1**
Duration:	**3 Years (UG)**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one' s views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one' s learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an

	open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability to embrace moral/ethical values in conducting one' s life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstrating the ability to identify ethical issues related to ones work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work. **PO 14: Leadership readiness/qualities:** Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way. **PO 15: Lifelong learning:** Ability to acquire knowledge and skills, including, learning how to learn", that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

PROGRAMME SPECIFIC OUTCOMES OF B.Sc. BOTANY – TANSCHE

Programme Specific Outcomes:	On successful completion of Bachelor of Botany programme, the student should be able to: **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to Botany. Also, exhibit proficiency in performing experiments in the laboratory. **PSO2: Critical Thinking:** Analyze complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities. **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models. **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects. **PSO6: Self-directed & Lifelong Learning:** Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.

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

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.
The S, M, L is based on the Course outcomes. The mapping is based on the revised Bloom' s Taxonomy Verbs used to describe your Course outcomes.

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

CBCS - COURSE PATTERN AND SYLLABUS
UG - BOTANY

SEMESTER I	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part I	Part -I - Language – Tamil Paper I	6	3
Part II	Part - II - English– Paper I	6	3
Part III Core I	Part - III - Core – Plant Diversity I – Algae	5	5
Core II	Plant Diversity I Algae - Practical-I	5	5
Elective Course EC 1 Discipline Specific/Generic	Part -III - Allied: Zoology Paper – I	4	3
Skill Enhancement Courses SEC1 Part - IV - NME-I	1. Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping	2	2
Foundation Course FC		2	2
Total		**30**	**23**
SEMESTER II	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial)**	**CREDIT**
Part I	Part -I - Language – Tamil Paper I	6	3
Part II	Part - II - English– Paper II	6	3
Part III Core III	Part - III - Core - Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	5	5
Core IV	Plant Diversity II - Fungi, Bacteria, Viruses, pathology and Lichens – Practical II	5	5
Elective Course EC 2 Discipline Specific/Generic	Part -III - Allied: Zoology Paper – II	4	3
Skill Enhancement Courses SEC 2 Part - IV - NME-II	1. Mushroom cultivation 2. Herbal Medicine 3. Global Climate change	2	2
Skill Enhancement Courses SEC 3	Botanical garden and landscaping	2	2
	Total	**30**	**23**

I Year Vacation Academic-Industry Activity Academia-Industry-Academic interface training-**30 hours**		-	2
SEMESTER III	**NAME OF THE COURSE**	**Hours Per / Week (Lecture/Tutorial)**	**CREDIT**
Part I	Part – I – Language – Tamil – Paper III	6	3
Part II	Part – II – English– Paper III	6	3
Core V	Part – III – Core – Plant Diversity III - Bryophytes and Pteridophytes	5	5
Core VI	Part – III – Core – Plant Diversity III Bryophytes and Pteridophytes – Practical-III	5	5
Elective Course EC 3	Part -III - Allied: Chemistry Paper – III	4	3
Skill Enhancement Courses SEC 4	Herbal Technology	1	1
Skill Enhancement Courses SEC 5	*Entrepreneurial Skill Entrepreneurial opportunities in botany	2	2
Part IV	Environmental studies	1	-
Total		**30**	**22**

SEMESTER IV	**NAME OF THE COURSE**	**Hours Per / Week (Lecture/Tutorial)**	**CREDIT**
Part I	Language – Tamil – Paper IV	6	3
Part II	English– Paper IV	6	3
Part - III Core VII	Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	5	5
Part III Core VIII	Part - III - Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV	5	5
Elective – Industry Module 4	Elective Course EC 4 Cultivation of Algae	3	3
Skill Enhancement Courses SEC 6	Fermentation technology	2	2
Skill Enhancement Courses SEC 7	Environmental impact analysis	2	2
Part IV	Environmental Studies	1	2
Total		**30**	**25**

***Road map for SE5:** Workshop on Entrepreneurship with hands-on training special lectures by experts/industrialists on entrepreneurial schemes and funding available from Central/State Government

Second Year Vacation – **Internship -** 40 hours	**2 credit**

SEMESTER V	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial)	CREDIT
Part III V Core IX	Part - III - Core - Plant Morphology, Taxonomy and Economic Botany	5 (4+1)	4
Core X	Part - III - Core -Plant Morphology, Taxonomy And Economic Botany - Practical- V	5 (4+1)	4
Core XI	Part - III - Core - Plant Anatomy and Embryology	5 (4+1)	4
Elective course 5	EC5 1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial Botany	4	3
Elective Course 6	EC6	4	3
Project	Project with Viva-voce	5	4
Part IV	Value Education	2	2
Part V	Extension activity	-	2
Total		**30**	**26**

SEMESTER VI	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial)	CREDIT
VI Core XIV	Part - III - Core – Plant Ecology and Phytogeography	6	4
Core XV	Part - III - Core - Plant Biotechnology and Molecular Biology	6	4
Core XVI	Part - III - Core -Plant Physiology and Plant Biochemistry	6	4
Elective Course	**EC 7** 1. Horticulture 2. Natural Resource Management 3. Forestry	5	3
Elective Course	**EC 8** 1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	5	3
Skill Enhancement Courses Professional Competency Enhancement	**SEC 8** Training for Competitive examinations 1.Botany for Competitive examination(2hours) • General Studies for Competitive examinations (2 hours) Botany for Advanced Studies (4 hours)	2	2
Part IV	Value Education		1
Total		**30**	**21**
	TOTAL CREDITS	**----**	**140**

Assessment Criteria for B.Sc. Botany - TANSCHE

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

EVALUATION PATTERN FOR EXTERNAL EXAMINATION INCLUSIVE OF INTERNSHIP AND EXTENTION ACTIVITY

(GIVEN BY CURRICULUM DEVELOPMENT COMMITTEE)

- Summer Internship / Industrial Training-As recommended by TANSCHE, Undergraduate students will undergo a **Summer Internship / Industrial Training** during II Year Summer Vacation and its Evaluation will be done in **Semester V with 2 credits**.

Evaluation pattern for Internship shall be as follows:

Attendance (mandatory)	- 40 marks
Field work and performance	- 40 marks
Report writing	- 20 marks

- Evaluation pattern for Extension Activity shall be as follows:

Attendance	- 50 marks
Participation	- 25 marks
Report	- 25 marks

Code:

Sri Meenakshi Government Arts College for Women (A), Madurai-2

B.Sc. Degree Examination- 2024

TITLE OF THE PAPER:

(For those who joined in June 2024)

Duration: 3 hours Maximum Marks: 75

Section-A (5x2=10 Marks)

Answer all Questions (Each answer not exceeding half a page)

(Q.No:1-5)

Section-B (5x5=25Marks)

Answer all Questions **Choosing either A or B** (Each answer not exceeding Two pages)

(Q.No:6-10)

Section-C (5x8=40Marks)

Answer all Questions **Choosing either A or B** (Each answer not exceeding Three pages)

(Q.No:11-15)

Blueprint

Section / Unit	I	II	III	IV	V
A	1	1	1	1	1
B	2	2	2	2	2
C	2	2	2	2	2

TEMPLATE FOR B.Sc. BOTANY
SEMESTER- I

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
I	U231A1 / U231H1	LC	Tamil/Hindi	6	3	3	25	75	100
II	U232A1	ELC	English	6	3	3	25	75	100
III	U23CB1	CC1 (T)	Plant Diversity I – Algae & Bryophytes	5	5	3	25	75	100
III	U23CB2P	CC2 (P)	Plant Diversity I – Algae & Bryophytes Practical I	3	3	3	25	75	100
III	U23GZ25	GEC 1(T)	Allied Zoology I	4	4	3	25	75	100
III	U23GZ26P	GEC 2(P)	Allied Zoology Practical - I	2	-	-	-	-	-
IV	U23SEB1	SEC1/ NM	Organic farming	2	2	3	25	75	100
IV	U23FB1	FC	Basics of Botany	2	2	3	25	75	100
	Total			30	22				700

SEMESTER- II

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
I	U231A2 / U231H2	LC	Tamil/Hindi	6	3	3	25	75	100
II	U232A2	ELC	English	6	3	3	25	75	100
III	U23CB3	CC3 (T)	Plant Diversity II – Fungi, Bacteria, Viruses, Plant Pathology and Lichens	5	5	3	25	75	100
III	U23CB4P	CC4 (P)	Plant Diversity II - Fungi, Bacteria, Viruses, Plant Pathology and Lichens – Practical II	3	3	3	25	75	100
III	U23GZ27	GEC 3(T)	Allied Zoology II	4	4	3	25	75	100
III	U23GZ26P	GEC 2(P)	Allied Zoology Practical - I	2	2	3	25	75	100
IV	U23SEB2	SEC2	Mushroom Cultivation	2	2	3	25	75	100
	U23SEB3	SEC3/ NM	Botanical garden and Landscaping	2	2	3	25	75	100
	Total			30	24				800

SEMESTER- III

Part	Course Code	Corse Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
I	U231A3 / U231H3	LC	Tamil/Hindi	6	3	3	25	75	100
II	U232A3	ELC	English	6	3	3	25	75	100
III	U23CB5	CC5 (T)	Plant Diversity III – Pteridophytes, Gymnosperms & Paleobotany	5	4	3	25	75	100
III	U23CB6P	CC6 (P)	Plant Diversity III Pteridophytes, Gymnosperms & Paleobotany – Practical-III	3	3	3	25	75	100
III	U23GC23	GEC 4(T)	Allied Chemistry	4	4	3	25	75	100
III	U23GC21P	GEC 5(P)	Allied Chemistry - Practical	2	-	-	-	-	-
IV	U23SEB4	SEC4	Entrepreneurial Opportunities in Botany	1	1	3	25	75	100
IV	U23SEB5	SEC5/NM	Herbal Technology	2	2	3	25	75	100
IV	U23EVS1	E.V.S.	Environmental Studies	1	--	--	--	--	--
	Total			30	20				700

SEMESTER- IV

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
I	U231A4 / U231H4	LC	Tamil/Hindi	6	3	3	25	75	100
II	U232A4	ELC	English	6	3	3	25	75	100
III	U23CB7	CC7 (T)	Cultivation of Algae	4	4	3	25	75	100
III	U23CB8P	CC8(P)	Cultivation of Algae – Practical-IV	3	3	3	25	75	100
III	U23GC24	GEC 6(T)	Allied Chemistry	4	4	3	25	75	100
III	U23GC21P	GEC 5(P)	Allied Chemistry - Practical	2	2	3	25	75	100
IV	U23SEB6	SEC6	Fermentation Technology	2	2	3	25	75	100
IV	U23SEB7	SEC7	Environmental Impact Analysis	2	2	3	25	75	100
IV	U23EVS1	E.V.S.	Environmental Studies	1	2	3	25	75	100
	Total			30	25				900
SUMMERINTERNSHIP/INDUSTRIALTRAINING *Allied Courses are considered as GEC									

SEMESTER- V

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
III	U23CB9	CC9 (T)	Plant Morphology, Taxonomy and Economic Botany	5	5	3	25	75	100
III	U23CB10	CC10 (T)	Plant Anatomy, Embryology & Evolution	5	5	3	25	75	100
III	U23CB11P	CC11 (P)	Plant Morphology, Taxonomy, Economic Botany, Plant Anatomy, Embryology and Evolution - Practical-V	6	3	3	25	75	100
III	U23CB12	CC12	Plant Ecology and Phytogeography	4	4	3	25	75	100
III	U23DB01	DSEC1	Bio-analytical Techniques	4	3	3	25	75	100
III	U23DB04	DSEC2	Forestry	4	3	3	25	75	100
IV	U23SIB1		Summer Internship / Industrial Training	--	2	--	--	--	100
V	U23VE1		Value Education	2	2	3	25	75	100
	Total			**30**	**27**				**800**

SEMESTER- VI

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
III	U23CB13	CC13	Plant Physiology and Plant Biochemistry	6	5	3	25	75	100
III	U23CB14	CC14	Plant Biotechnology and Molecular Biology	6	5	3	25	75	100
III	U23CB15P	CC15(P)	Plant Physiology, Plant Biochemistry, Plant Biotechnology and Molecular Biology - Practical-VI	6	3	3	25	75	100
III	U23DB06	DSEC3	Horticulture	5	3	3	25	75	100
III	U23DB08	DSEC4	Forensic Botany	5	3	3	25	75	100
IV	U23EAB		Extension Activity	--	1	--	--	--	100
IV	U23PCB1		Professional Competency Skill - Botany for Competitive Examinations	2	2	3	25	75	100
	Total			**30**	**22**				**700**

LIST OF GEC COURSES OFFERFED BY THE DEPARTMENT OF BOTANY

UG TEMPLATE – FOR ALLIED BOTANY

OFFERED BY BOTANY DEPARTMENT TO I B.Sc. ZOOLOGY STUDENTS (2023-2026 BATCH)

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
Semester – I									
III	U23GB52	GEC 1(T)	Allied Botany I	4	4	3	25	75	100
III	U23GB53P	GEC 2 (P)	Allied Botany Practical - I	2	2	3	25	75	100
Semester -II									
III	U23GB53P	GEC 2 (P)	Allied Botany Practical - I	2	2	3	25	75	100
III	U23GB54	GEC 3 (T)	Allied Botany II	4	4	3	25	75	100
Total				12	10				300

UG TEMPLATE – FOR ALLIED ENVIRONMENTAL BIOLOGY

OFFERED BY BOTANY DEPARTMENT TO I B.Sc. GEOGRAPHY STUDENTS (2023-2026 BATCH)

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
Semester – I									
III	U23GB55	GEC1 (T)	Introduction to Ecobiology	4	4	3	25	75	100
III	U23GB56P	GEC2 (P)	Allied Environmental Biology Practical – I	2	2	3	25	75	100
Semester – II									
III	U23GB56P	GEC2 (P)	Allied Environmental Biology Practical – I	2	2	3	25	75	100
III	U23GB57	GEC3 (T)	Basic Forest Botany	4	4	3	25	75	100
Total				12	10				300

DISCIPLINE SPECIFIC ELECTIVE PAPERS OFFERED BY DEPARTMENT OF BOTANY

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Duration of Exam	Marks		
							Int	Ext	Total
III	U23DB01	DSEC 1	a) Bio-analytical Techniques	4	3	3	25	75	100
	U23DB02		b) Aquatic Botany						
	U23DB03		c) Entrepreneurial Botany						
III	U23DB04	DSEC 2	a) Forestry	4	3	3	25	75	100
	U23DB05		b) Computer Applications in Botany						
III	U23DB06	DSEC 3	a) Horticulture	4	3	3	25	75	100
	U23DB07		b) Natural Resource Management						
III	U23DB08	DSEC 4	a) Forensic Botany	4	3	3	25	75	100
	U23DB09		b) Bionanotechnology						

COURSE STRUCTURE ABSTRACT FOR B.Sc. BOTANY PROGRAMMES

Part	Course	Total No. of	Hours	Credit	Marks
I	Tamil	4	24	12	400
II	English	4	24	12	400
III	Core Course -Major(CCM)	15	69	60	1500
III	GEC- Elective Course (Allied)	6	24	20	600
III	DSEC – Elective Course	4	18	12	400
IV	Internship	1	--	2	100
IV	Skill Enhancement Course (SEC-6 & NM)	7	13	13	700
IV	Foundation Course	1	2	2	100
IV	E.V.S.	1	2	2	100
V	Value Education	1	2	2	100
IV	Extension Activity/NSS/NCC/SPORTS	1	-	1	100
IV	Professional Competency Skill	1	2	2	100
Total		**46**	**180**	**140**	**4600**

CORE-I PLANT DIVERSITY I ALGAE AND BRYOPHYTES

Programme: B.Sc. BOTANY							
Title of the Course		**PLANT DIVERSITY I ALGAE AND BRYOPHYTES**					
Paper Number		**CORE I**					
Category	Core	**Year**	I	**Credits**	5	**Course Code**	**U23CB1**
		Semester	I				
Instructional Hours per week: 5		**Lecture**		**Tutorial**	**Lab Practice**		**Total Hours**
		3		2	--		75 hrs/Semester
Pre-requisite		Students should be familiar with the basics of different classes of algae and Bryophytes.					

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To provide a comprehensive knowledge on the biology of algae.
C2	To understand the role of algae in ecosystems as primary producers of nutrition.
C3	To understand importance of algae to animals and humans.
C4	To understand the morphological diversity of Bryophytes.
C5	To know the evolution of Bryophytes.
UNIT	**CONTENTS**
I	**ALGAE** Classification (Fritsch-1935-1945), criteria for classification, algal distribution. Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum, Gracilaria*).
II	Reproduction-Vegetative, asexual, sexual reproduction and life cycle of haplontic-*Oedogonium*, diplontic-*Diatoms*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*.
III	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae. Algae as food and feed: Agar-agar, Alginic acid, Carrageenan and Diatomite. Application of algae as fuel, agriculture and pharmaceutical – Phycoremediation - Algae as indicator of water pollution.
IV	**BRYOPHYTES** General characters of Bryophytes, classification (Rothmaler,1951). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
V	Structure, reproduction and life cycle of the following classes: Hepaticopsida (*Riccia*) Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*).

Extended Professional Component (is a part of internal component only, Not to be included in the External Examinationquestion 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

Course outcomes	On completion of this course, students will;
CO1	Relate to the structural organization, reproduction and significance of algae.
CO2	Compare and contrast the thallus organization and modes of reproduction in algae.
CO3	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.
CO4	Explain the anatomy and reproduction of Bryophytes.
CO5	Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes.

Recommended Texts:

1. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
2.Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4.Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.
6. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
7. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.

References Books:

1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi.
3. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera.
4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
5. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
6. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
7. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
8. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
9. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.

Web Resources:

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

Biotechnology/Pereira-Neto/p/book/9781466581678
5. https://www.wileyindia.com/a-textbook-of-algae.html
6. https://www.kobo.com/in/en/ebook/algae-biotechnology
7. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	1	1	2
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	1	2	2	2	1
CO 2	3	2	`1	3	3
CO 3	2	1	3	2	2
CO 4	2	3	3	3	2
CO 5	3	3	3	2	3

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

CORE-II PLANT DIVERSITY I ALGAE AND BRYOPHYTES - PRACTICAL-I

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT DIVERSITY – I: ALGAE AND BRYOPHYTES PRACTICAL I**						
Paper Number	CORE II						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	**U23CB2P**
		Semester	I				

Instructional Hours per week: 3	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
		-	3	45 hrs/Semester

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

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.
C2	To identify microalgae in a mixture.
C3	To study the economic importance of few species.
C4	To enable students gain expertise in hand sectioning technique.
C5	To understand the anatomical structure of the Bryophytes.

EXPERIMENTS

Algae

1. Micro-preparation of the types prescribed in the syllabus.
2. Economic importance of Algae as: (i) Biofertilizers (ii) Agar Agar (iii) Alginate.
3. Field visit to study fresh water/marine water algal habitats.
4. Visit to nearby industry actively engaged in algal technology.

Bryophytes

1. Micro preparation of the following Bryophytes. Hepaticopsida – *Riccia*, Anthocerotopsida – *Anthoceros*, and Bryopsida – *Funaria*.

Extended ProfessionalComponent (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 competitiveexaminations 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
Course outcomes:	On completion of this course, the students will be able to CO
CO1	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.
CO2	Decipher the algal diversity in fresh/marine water and their economic significance.
CO3	Evaluate the various techniques used to culture algae for commercial purposes
CO4	Describe the structure of Bryophytes.
CO5	Identify and illustrate the morphological and anatomical features of bryophytes.

Recommended Texts

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Bendre, M.Ashok and AshokKumar, A. 2020.Text Book of Practical Botany-1 (10th ed). Rastogi Publications, Meerut.
3. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
4. Aziz, F and Rashe ed, R. 2019.A Course Book of Algae. Publisher: University of Sulaimani:978-9922-20-391-1.
5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.

Reference Books:

1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.
2. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London.
3. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
4. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
5. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi.

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/
4. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	2	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	3	2	1
CO 2	3	2	3	3	3
CO 3	2	1	3	1	2
CO 4	2	3	3	3	2
CO 5	3	3	3	2	3

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

SEC 1 - ORGANIC FARMING

Programme: B.Sc. BOTANY							
Title of the Course	**ORGANIC FARMING**						
Paper Number	I						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	**U23SEB1**
		Semester	I				
Instructional Hours per week: 2		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		2		-	-	30 hrs/Semester	
Pre-requisite		Students to gain knowledge on the scope of organic farming and its significance.					

elevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented	✓	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.
UNIT	**CONTENTS**
I	Soil – physical, chemical properties. Soil Pollution, Oil, chemicals – fertilizers, pesticide and herbicide, non-degradable solids, 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, Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure– cow dung, Vermicompost-methods, production and utilization.
IV	Biofertilizers– classification, nitrogen fixers– *Rhizobium*, Cyanobacteria, *Azolla* and

	Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes:	On completion of this course, the students will be able to:
CO1	Recognize the different forms of biofertilizers and their uses.
CO2	Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.
CO3	Apply techniques for synthesizing green manure and develop strategies to increase crop yield.
CO4	Analyze and decipher the significance of biofertilizers in soil fertility.
CO5	Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.

Recommended Texts

1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.
3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech.
4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.

Reference Books

1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers.
3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi.
4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh

5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi

Web Resources

1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY
2. https://www.e-booksdirectory.com/listing.php?category=323
3. http://www.freebookcentre.net/Biology/Agriculture-Books.html

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	3	2	1	2
CO 3	2	2	3	3	1
CO 4	3	2	1	1	2
CO 5	3	3	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO 2	3	2	3	2	3
CO 3	2	2	3	2	3
CO 4	3	2	3	2	3
CO 5	2	3	3	3	3

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

FOUNDATION COURSE FOR BOTANY - BASICS OF BOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**BASICS OF BOTANY**						
Paper Number	Foundation Course						
U2Category		**Year**	I	**Credits**	2	**Course Code**	**U23FB1**
		Semester	I				
Instructional Hours per week:2	**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**		
	2		-	-	30 hrs/Semester		
Pre-requisite	To recall the students about the basic aspects of botany.						

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

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

UNIT	CONTENTS
I	**BIODIVERSITY** Systematics : Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.

II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane Plastids, Ribosomes.
III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
IV	**GENETICS** Concept of Heredity and Variation - Mendel' s Laws of Inheritance.
V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper) Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes	On completion of this course, the students will be able to:
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
CO4	Compare the structure and function of cells and explain the development of cells.
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.

Recommended Texts

1. Singh,V.,Pande, P.C and Jain,D.K. 2021. A Text Book of Botany.Rastogi Publications, Meerut.
2. Bhatnagar,S.P and Alok Moitra.2020.Gymnosperms,New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co.New Delhi.
6. Rao,K.,Krishnamurthy, K.V and Rao, G.S.1979. Ancillary Botany,S.Viswanathan Pvt.Ltd., Madras.

Reference books

1. Parihar, N.S. 2012. An introduction to Embryophyta – Pteridophytes -Surjeet Publications, Delhi.

2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6. Parihar, N.S. 2013. An introduction to Embryophyta – Bryophytes -, Surjeet Publications, Delhi.

Web Resources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	2	3	3	3	3
CO 4	3	3	2	3	3
CO 5	3	2	2	2	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	1	3	3	1	3
CO 4	3	3	2	3	3
CO 5	2	2	1	2	2

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

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

<table>
<tr><td colspan="8">Programme: B.Sc. BOTANY</td></tr>
<tr><td>Title of the Course</td><td colspan="7">PLANT DIVERSITY-II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS</td></tr>
<tr><td>Paper Number</td><td colspan="7">CORE III</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Core III</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">5</td><td rowspan="2">Course Code</td><td rowspan="2">U23CB3</td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week: 5</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total Hours</td></tr>
<tr><td colspan="2">3</td><td colspan="2">2</td><td>--</td><td>75 hrs/Semester</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">Students should be familiar with the basics of fungi, bacteria, viruses and lichens.</td></tr>
<tr><td colspan="8">
<table>
<tr><td>Relevant to Global need</td><td></td><td>Employability Oriented</td><td>✓</td><td>Addresses Professional Ethics</td><td></td></tr>
<tr><td>Relevant to National need</td><td></td><td>Entrepreneurship Oriented</td><td></td><td>Addresses Gender Sensitization</td><td></td></tr>
<tr><td>Relevant to Regional need</td><td></td><td rowspan="2">Skill Development Oriented</td><td rowspan="2"></td><td>Addresses Environment and Sustainability</td><td></td></tr>
<tr><td>Relevant to Local need</td><td></td><td>Addresses Human Values</td><td></td></tr>
</table>
</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>C1</td><td colspan="7">To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.</td></tr>
<tr><td>C2</td><td colspan="7">To understand the biology of fungi and to discuss the importance of fungi in various ecological roles</td></tr>
<tr><td>C3</td><td colspan="7">To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.</td></tr>
<tr><td>C4</td><td colspan="7">To identify the main groups of plant pathogens, their symptoms.</td></tr>
<tr><td>C5</td><td colspan="7">To understand the various types of plant diseases.</td></tr>
<tr><td colspan="8">UNIT</td></tr>
<tr><td>I</td><td colspan="7">FUNGI
Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life cycle of classes: Zygomycotina - Mucor, Ascomycotina - Peziza, Basidiomycotina - Puccinia and Deuteromycotina – Cercospora.</td></tr>
<tr><td>II</td><td colspan="7">ECONOMIC IMPORTANCE OF FUNGI:
Cultivation of mushroom – Pleurotus (food). Fungi in agriculture application</td></tr>
</table>

	(biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi-Mycotoxins.
III	**BACTERIA AND VIRUS:** Classification (Bergey' s, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases- Etiology - Host-Pathogen relationships; Disease cycle, prevention and control of the following plant diseases. General characters of Bacteria and Viruses. Bacterial diseases – Citrus canker Viral diseases – Tobacco Mosaic Fungal diseases – Tikka disease.
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*. **Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to

CO1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.
CO2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.
CO3	Identify the common plant diseases, according to geographical locations and device control measures.
CO4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.
CO5	Determine the economic importance of microbes, fungi and 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. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.

Reference Books

Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
Sharma, O.P. 2011. Fungi and allied microbes The McGraw – Hill companies, New Delhi.
Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London.
Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.
Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.
Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company

Web Resources

https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html
http://www.freebookcentre.net/Biology/Mycology-Books.html
https://www.kobo.com/us/en/ebook/introduction-to-fungi
http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

Mapping with Programme Outcomes:

COs	COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	1
CO 2	3	3	2	2	3	3
CO 3	2	2	3	3	1	2
CO 4	3	3	3	3	3	2
CO 5	3	3	2	3	2	3

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO 2	3	2	1	2	1
CO 3	2	1	3	1	3
CO 4	2	3	3	3	3
CO 5	3	3	3	3	3

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

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

Programme: B.Sc. BOTANY							
Title of the Course		**PLANT DIVERSITY – I: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS – Practical II**					
Paper Number		CORE IV					
Category	Core	**Year**	I	**Credits**	3	**Course Code**	**U23CB4P**
		Semester	II				

Instructional Hours per week: 3	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	-	-	3	45 hrs/Semester
Pre-requisite	Students should be familiar with the basics of fungi and lichens.			

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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

EXPERIMENTS

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

Course outcomes	On completion of this course, the students will be able to:
CO1	Identify microbes, fungi and lichens using key identifying characters
CO2	Develop practical skills for culturing and cultivation of fungi.
CO3	Identify and select suitable control measures for the common plant diseases.
CO4	Analyze the characteristics of microbes, fungi and plant pathogens
CO5	Access the useful role of fungi in agriculture and pharmaceutical industry.

Recommended Texts:

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

Reference Books:

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

Web resources:

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

Mapping with Programme Outcomes:

COs	COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2	1
CO 2	2	3	2	2	3	3
CO 3	2	2	3	3	1	2
CO 4	3	3	3	3	3	2
CO 5	3	3	2	3	2	3

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	3	3
CO 3	2	1	3	1	2
CO 4	2	3	3	3	2
CO 5	3	3	3	2	3

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

SEC 2 - MUSHROOM CULTIVATION

Programme: B.Sc. BOTANY							
Title of the Course	**MUSHROOM CULTIVATION**						
Paper Number	SEC II						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	**U23SEB2**
		Semester	II				
Instructional Hours per week: 2		**Lecture**	**Tutorial**		**Lab Practice**	**Total Hours**	
		2	-		-	30 hrs/Semester	
Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented	✓	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Course 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.
UNIT	**CONTENTS**
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values.
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
III	Cultivation practices of *Pleurotus spp* and *Agaricus spp.*
IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
V	Diseases - Insect pests, nematodes. Post harvest technology – common mushroom recipies - Mushroom soup and Mushroom pickle.
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 competitiveexaminations 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

Course outcomes: On completion of this course, the students will be able to:

CO1	Recall various types and categories of mushroom.
CO2	Explain about various types of food technologies associated with mushroom industry.
CO3	Apply techniques studied for cultivation of various types of mushroom.
CO4	Analyze and decipher the environmental factors and economic value associated with mushroom cultivation
CO5	Develop new methods and strategies to contribute to mushroom production.

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 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

Web Resources

1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X
2. http://nrcmushroom.org/book-cultivation-merged.pdf
3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf
4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/
5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	1
CO 3	2	2	3	2	1
CO 4	3	3	2	3	1
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	3	1
CO 2	3	2	3	3	2
CO 3	2	1	3	2	3
CO 4	2	3	3	3	2
CO 5	3	1	3	3	2

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

SKILL ENHANCEMENT COURSE 3
BOTANICAL GARDEN AND LANDSCAPING

Programme: B.Sc. BOTANY							
Title of the Course	**BOTANICAL GARDEN AND LANDSCAPING**						
Paper Number	Skill Enhancement-3						
Category		**Year**	1	**Credits**	2	**Course Code**	**U23SEB3**
		Semester	II				
Instructional Hours per week: 2	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	2		-		-	30 hrs/Semester	
Pre-requisite	Students should know about the fundamental concepts of gardening and landscaping.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To know about the fundamental concepts of gardening and landscaping.
C2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.
C3	To illustrate the significance of garden adornments and propagation structures.
C4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.
C5	To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.
UNIT	**CONTENTS**
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.
II	Flower arrangement: importance, production, cultural operations, constraints, post┐ harvest practices. Bioaesthetic planning, definition, need, urban planning and river banks.
III	Vertical gardens, roof gardens. Bonsai - types. Parks and public gardens. Styles of garden, formal, informal and free style gardens.
IV	Establishment and maintenance of special types of gardens, Bio-aesthetic planning, eco-tourism, theme parks, indoor gardening.

V	Computer Aided Designing (CAD) for outdoor and indoor scaping Exposure to CAD (Computer Aided Designing).

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Recognize fundamental concepts of gardening and landscaping.
CO2	Explain about significance of garden adornments and propagation structures.
CO3	Apply techniques of landscaping for aesthetic purposes and gardening for recreation.
CO4	Distinguish between formal, informal and free style gardens and their applications.
CO5	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

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
CO1	3	3	1	3	2
CO 2	3	3	2	2	1
CO 3	2	2	3	2	1
CO 4	3	3	2	3	1
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	3	1
CO 2	3	2	3	3	2
CO 3	2	1	3	2	3
CO 4	2	3	3	3	2
CO 5	3	1	3	3	2

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

CORE-V PLANT DIVERSITY III PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT DIVERSITY-III PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY**						
Paper Number	CORE V						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	**U23CB5**
		Semester	III				
Instructional Hours per week: 5	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**			
	3	2	-	75 hrs/Semester			
Pre-requisite	Students should be familiar with the basics of Pteridophytes Gymnosperms and Paleobotany.						

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.
C2	To understand the morphological diversity and anatomy and reproduction of Pteridophytes.
C3	To know the evolution and economic importance of Pteridophytes.
C4	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
C5	To know the scope of paleobotany, types of fossils and geological time scale.
UNIT	**EXPERIMENTS**
I	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954)., homospory and heterospory, Apogamy and apospory. Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance of Pteridophytes.
II	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*).
III	**GYMNOSPERMS** Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber.

IV	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).
V	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni. Study of the following fossils: *Rhynia, Lepidocarpon*, *Calamites* and *Williamsonia sewardiana*.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Recognize morphological variations of Pteridophytes.
CO2	Explain the anatomy and reproduction of Pteridophytes.
CO3	Decipher the stages of plant evolution and their transition to land habitat.
CO4	Explain about the morphology and anatomy Gymnosperms.
CO5	Determine the various fossilization methods and their significance in paleobotany.

Recommended Texts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
5. Prem Puri. 2001. Bryophytes- morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
6. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi.
7. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. 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 - Pteriodophyta, Central book depot, Allahabad.
3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II- McGraw Hill, Chennai
4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Central Book Depot, Allahabad.
8. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.

9. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.

Web Resources:

1. http://www.bryoecol.mtu.edu/
2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
5. http://www.botany.ubc.ca/bryophyte/mossintro.html
6. aeTIUC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO 2	3	3	3	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	2	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	2
CO 2	2	2	3	2	2
CO 3	2	2	1	2	2
CO 4	2	3	3	2	3
CO 5	1	3	3	1	3

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

CORE-VI PLANT DIVERSITY III PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY – PRACTICAL-III

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT DIVERSITY III PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY- PRACTICAL-III**						
Paper Number	CORE VI						
Category	Core	**Year**	II	**Credits**	3	**Course Code**	**U23CB6P**
		Semester	III				
Instructional Hours per week: 3	**Lecture**		**Tutorial**		**Lab Practice**		**Total Hours**
			-		3		45 hrs/Semester
Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes Gymnosperms and Paleobotany.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To enable students gain expertise in hand sectioning technique.
C2	To study diversity of Pteridophytes.
C3	To understand the anatomical structure of the Pteridophytes.
C4	To enable students observe and record the anatomical features of selected species of Gymnosperms.
C5	Describe the structure of fossil forms prescribed in the syllabus.

EXPERIMENTS

Pteridophytes

1.Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus. Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*).

2. Identifying the micro slides relevant to the syllabus.

3. Botanical excursion.

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

Cycas, Pinus and *Gnetum.*

5. Identifying the micro slides relevant to the syllabus.

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

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

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

Course outcomes: On successful completion of this course the student will be able to:

CO1	Recognize the major groups of Non-vascular and Vascular cryptogams
CO2	Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.
CO3	Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes.
CO4	Develop comprehensive skills in sectioning and micro preparation.
CO5	Interpret the significance of reproductive structures in gymnosperms.

Recommended Texts

1. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
2. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.

Reference Books

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
3. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai.
4. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.

Web resources

1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883

3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html
4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual
5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	2
CO 2	3	2	3	3	2
CO 3	2	1	3	2	1
CO 4	2	3	2	2	3
CO 5	3	3	3	3	3

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

SKILL ENHANCEMENT COURSES SEC 4
*ENTREPRENEURIAL SKILL

Programme: B.Sc. BOTANY							
Title of the Course	**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**						
Paper Number	Skill Enhancement-4						
Category		**Year**	II	**Credits**	1	**Course Code**	**U23SEB4**
		Semester	III				
Instructional Hours per week: 1	**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**		
	1		-	-	15 hrs/Semester		

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented	✓	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Pre-requisite: To understand the concept of Entrepreneurial Opportunities in Botany.

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

UNIT	**CONTENTS**
I	**INTRODUCTION TO ENTREPRENEURSHIP** Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation.
II	**TOOLS AND TECHNIQUES** Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, organic acids, beverages, enzymes, antibiotics.
III	**NEW VENTURE CREATION** Production of Biofertilizers: *Spirulina* and *Azolla* cultivation, Bouquet making and Terrarium.

IV	**PRODUCT DEVELOPMENT AND COMMERCIALIZATION** Product commercialization and business strategy, Dyes, Cosmetics and Perfumes. Areca Leaf Plates, Jute Products - bags.
V	**BIO-BUSINESS PLANS, IPR AND BIOETHICS** Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues. Technology licensing and branding concerns.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)
Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved
(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach.
CO2	Explain the concept of Entrepreneurial Opportunities in Botany.
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.
CO5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.

Recommended Texts

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

Reference books

1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.
2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge UniversityPress, Cambridge

Web sources

1.https://www.brainkart.com/article/Entrepreneurial-Botany_38321/

2.https://www.youtube.com/watch?v=hnBla1FfcLo
3.https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation
4.http://www.brainkart.com/article/EconomicallyUseful-Plants-andEntrepreneurialBotany_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
CO1	3	3	1	1	2
CO 2	3	3	2	2	3
CO 3	2	2	3	1	2
CO 4	3	3	1	2	3
CO 5	3	3	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	2
CO 2	1	2	3	1	2
CO 3	2	1	3	2	1
CO 4	2	3	3	2	3
CO 5	3	3	3	3	3

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

SKILL ENHANCEMENT COURSES SEC 5

HERBAL TECHNOLOGY

Programme: B.Sc. BOTANY							
Title of the Course	**HERBAL TECHNOLOGY**						
Paper Number	Skill Enhancement-5						
Category		**Year**	II	**Credits**	2	**Course Code**	**U23SEB5**
		Semester	III				
Instructional Hours per week: 2		**Lecture**	**Tutorial**		**Lab Practice**	**Total Hours**	
		2	-		-	30 hrs/Semester	
Pre-requisite	To understand the importance of herbal technology.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented	✓	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.
UNIT	**CONTENTS**
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.
II	Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanical names, plant parts used, major chemical constituents.
III	Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs - Tulsi, Ginger, Curcuma, Fenugreek, Indian Withania somnifera, Centella asiatica - 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.
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Define and describe the principle of cultivation of herbal products.
CO2	List the major herbs, their botanical name and chemical constituents.
CO3	Apply techniques for monitoring drug adulteration through the biological testing.
CO4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.
CO5	Develop the skills for cultivation of plants and their value added processing / storage

Recommended Texts

1. AYUSH (www.indianmedicine.nic.in). About the systems–An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India.
2. Evans, W.C. 2009: Trease and Evans Pharmacognosy. 16th Edition, Saunders / Elsevier.
3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages.
4. Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .
5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pune.

Reference Books

1.Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17.
2. Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.
3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.
4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.
5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

Web resources

1. https://www.kopykitab.com/Herbal-Science
2. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu

3. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
4. https://www.dattanibookagency.com/books-herbs-science.html
5. https://www.springer.com/gp/book/9783540791157

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	3	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2
CO 2	3	3	1	3	1
CO 3	3	3	2	3	2
CO 4	3	3	1	3	1
CO 5	3	3	1	3	1

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

CORE-VII CULTIVATION OF ALGAE

Programme: B.Sc. BOTANY							
Title of the Course	**CULTIVATION OF ALGAE**						
Paper Number	**CORE-VI**						
Category	**CORE**	**Year**	II	**Credits**	4	**Course Code**	**U23CB7**
		Semester	IV				

Instructional Hours per week: 4	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	3	1	-	60 hrs/Semester
Pre-requisite	Students should know fundamental knowledge on algae and its biotechnological applications.			

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To impart sufficient information about the culture and cultivation of algae under laboratory andoutdoor conditions.
C2	To study the media composition for algae cultivation and high value products and its applications.
C3	To know about the important seaweeds and its cultivation practices.
C4	To study the SLF production and applications in agriculture crops.
C5	To understand about the Environment Impact Assessment of algal cultivation.
UNIT	**CONTENTS**
I	Morphology, life history and mass culture of microalgae: *Spirulina*, *Chlorella.*
II	High value products: Single Cell Protein (SCP), phycocyanin, β-carotene, astaxanthin –biofuel, media composition - scale up - lab to land - raceway ponds and photobioreactor.
III	Marine macroalgae: Morphology, life history and mass cultivation of *Gracilaria*, *Sargassum* and *Ulva.*

IV	Polysaccharides: agar, carrageen, alginate - economic importance - seaweed as food, feed and Seaweed Liquid Fertilizer (SLF).
V	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	1. Obtain an in-depth knowledge on culture and mass cultivation of algae and its differentmethods.
CO2	2. Exploration and recommendation of the commercial potential of algal products.
CO3	3. Understand the applied facet of algology and acquire a complete knowledge about thecultivation methods in algae.
CO4	4. Describe the preparation of seaweed liquid fertilizers and their applications in agricultureand horticulture.
CO5	5. Acquiring the information about algal applications in different industries and agriculturefields in the current scenario.

Recommended Texts

1. Kumar H.D. and Singh, H.N. 1976. A Text Book of Algae Affiliated East West Press Pvt. Ltd., New Delhi, Madras.
2. Kumar, H.D. 1990. Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi,Madras, Hyderabad, Bangalore.
3. Pandey, B.P. 1993. A Text book of Botany-Algae S. Chand & Co., (P) Ltd., New Delhi.
4. Sharma, O.P. 1990. Text Book of Algae Tata McGraw Hill Publishing Co., Ltd., New Delhi.
5. Vashista, B.R. 1988. Botany for degree students-Algae. S. Chand & Co., (P) Ltd., New Delhi

Reference Books

1. Bilgrami, K.S., and L.C. Saha. 1996. A Text Book of Algae, CBS Publishers & Distributors (P) Ltd., New Delhi.
2. Chapman, V.J. and Chapman, D.J., 1973. The Algae. 2nd Ed. ELBS & MacMillan, 498 pp.,
3. Fritsch F.E. 1935. The Structure and Reproduction of Algae 1945. Cambridge University Press,Cambridge, U.K. Vol. I-791 pp., Vol. II-939 pp.,
4. Round, F.E. 1973. Biology of the Algae. 2nd Ed. Edward Arnold, London. 278 pp.,
5. Sharma, O.P. 1990. Text Book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 396

Web Resources

1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production
2. https://link.springer.com/article/10.1007/s10811-013-9983-9

3. https://www.nrel.gov/docs/legosti/old/2360.pdf
4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf
5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed_aquaculture_Cultivation_technologies_chall.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	2	1	2	1
CO 3	2	1	1	3	2
CO 4	3	3	3	3	1
CO 5	3	3	2	2	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	1	3
CO 3	1	2	3	2	1
CO 4	2	1	3	1	2
CO 5	1	3	3	1	1

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

CORE-VIII CULTIVATION OF ALGAE – PRACTICAL IV

Programme: B.Sc. BOTANY							
Title of the Course	**CULTIVATION OF ALGAE- PRACTICAL IV**						
Paper Number	**CORE-VI**						
Category	**CORE**	**Year**	II	**Credits**	3	**Course Code**	**U23CB8P**
		Semester	IV				
Instructional Hours per week: 3		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		3			-	45 hrs/Semester	
Pre-requisite		Students should know fundamental knowledge on alga and its biotechnological applications.					

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To impart sufficient information about the culture and cultivation of algae under laboratory andoutdoor conditions..
C2	To study the media composition for algae cultivation and high value products and its applications.
C3	To know about the important seaweeds and its cultivation practices.
C4	To study the SLF production and applications in agriculture crops.
C5	To understand about the Environment Impact Assessment of algal cultivation.

EXPERIMENTS

1. Collection and identification of Algae.
2. Isolation and maintenance of pure culture of Algae.
3. Study of morphology and anatomy of micro and macro algae of the following:

   Microalgae - *Spirulina, Chlorella.*

   Macroalgae - *Gracilaria, Sargassum.*
4. Measurement of growth parameters in algae – cell density, chlorophyll content.
5. Cultivation of marine algae (demo).
6. Mass cultivation of *Spirulina.*

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

Course outcomes: On completion of this course, the students will be able to:

CO1	1. Obtain an in-depth knowledge on culture and mass cultivation of algae and its differentmethods.
CO2	2. Exploration and recommendation of the commercial potential of algal products.
CO3	3. Understand the applied facet of Algology and acquire a complete knowledge about thecultivation methods in algae.
CO4	4. Describe the preparation of seaweed liquid fertilizers and their applications in agricultureand horticulture.
CO5	5. Acquiring the information about algal applications in different industries and agriculturefields in the current scenario.

Recommended Texts

1. Kumar H.D. and Singh, H.N. 1976. A Text Book of Algae Affiliated East West Press Pvt. Ltd., New Delhi, Madras.
2. Kumar, H.D. 1990. Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi,Madras, Hyderabad, Bangalore.
3. Pandey, B.P. 1993. A Text book of Botany-Algae S. Chand & Co., (P) Ltd., New Delhi.
4. Sharma, O.P. 1990. Text Book of Algae Tata McGraw Hill Publishing Co., Ltd., New Delhi.
5. Vashista, B.R. 1988. Botany for degree students-Algae. S. Chand & Co., (P) Ltd., New Delhi

Reference Books

1. Bilgrami, K.S., and L.C. Saha. 1996. A Text Book of Algae, CBS Publishers & Distributors (P) Ltd., New Delhi.
2. Chapman, V.J. and Chapman, D.J., 1973. The Algae. 2nd Ed. ELBS & MacMillan, 498 pp.,
3. Fritsch F.E. 1935. The Structure and Reproduction of Algae 1945. Cambridge University Press,Cambridge, U.K. Vol. I-791 pp., Vol. II-939 pp.,
4. Round, F.E. 1973. Biology of the Algae. 2nd Ed. Edward Arnold, London. 278 pp.,

5.Sharma, O.P. 1990. Text Book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 396

Web Resources

1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production
2. https://link.springer.com/article/10.1007/s10811-013-9983-9
3. https://www.nrel.gov/docs/legosti/old/2360.pdf
4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf
5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed_aquaculture_Cultivation_technologies_ch all.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	2	1	2	1
CO 3	2	1	1	3	2
CO 4	3	3	3	3	1
CO 5	3	3	2	2	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	1	3
CO 3	1	2	3	2	1
CO 4	2	1	3	1	2
CO 5	1	3	3	1	1

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

SKILL ENHANCEMENT COURSES SEC 6
FERMENTATION TECHNOLOGY

Programme: B.Sc. BOTANY							
Title of the Course	**FERMENTATION TECHNOLOGY**						
Paper Number	Skill Enhancement 6						
Category	SEC	**Year**	II	**Credits**	2	**Course Code**	**U23SEB6**
		Semester	IV				
Instructional Hours per week: 2	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**			
	2	-	-	30 hrs/Semester			
Pre-requisite	To students to know about the various fermentation technology.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To appreciate the significance of microbes synthesizing fermented products.
C2	To gain insights on safety and quality control in large scale production of fermentative products.
C3	To design and operation of industrial practices in mass production of fermented products.
C4	To know about the various fermentation technology.
C5	To learn about the bioproduct recovery.
UNIT	**CONTENTS**
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
IV	Fermentative production of vinegar, alcohol (ethanol, wine), acids (citric acid), amino acids (glutamic acid) and antibiotics (penicillin).
V	Microbial production of enzymes: Amylase and Protease - product recovery.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Enumerate the significance of industrially useful microbes.
CO2	Explain the design and operation of industrial practices in mass production of fermented products.
CO3	Explain the process of maintenance and preservation of microorganisms.
CO4	Analyze the various aspects of the fermentation technology and apply for fermentative production.
CO5	Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.

Recommended Texts

1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.
4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P) Limited Publishers, New Delhi, India.
5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.
2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.
3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.
5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK.
6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY.
7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive

Microbial Metabolites. Springer publications, Germany.

Web resources

1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/
3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/
4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html
5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	3	2	2	1
CO 3	2	2	3	1	1
CO 4	3	3	2	1	3
CO 5	3	3	2	1	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	2
CO 2	2	3	2	2	3
CO 3	1	2	3	1	2
CO 4	2	1	3	2	1
CO 5	2	3	3	2	3

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

SKILL ENHANCEMENT COURSES SEC 7

ENVIRONMENTAL IMPACT ANALYSIS

Programme: B.Sc. BOTANY							
Title of the Course	**ENVIRONMENTAL IMPACT ANALYSIS**						
Paper Number	Skill Enhancement 7						
Category		**Year**	II	**Credits**	2	**Course Code**	**U23SEB7**
		Semester	IV				
Instructional Hours per week: 2		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		2		-	-	30 hrs/Semester	
Pre-requisite	To students to know about the environmental impact assessment.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To understand about the theory and practice of environmental impact assessment.
C2	To develop skills in identifying and solving problems of environmental concerns.
C3	Define and classify Environmental Impacts and the terminology.
C4	Understands the environmental Impact assessment procedure.
C5	List and describe environmental audits.
UNIT	**CONTENTS**
I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.
II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,
III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document.
IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA.
	Environmental Appraisal and Procedures in India and EIA Methodology, indicators

V	and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.

Extended ProfessionalComponent (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 competitiveexaminations 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

Course outcomes: On completion of this course, the students will be able to:

CO1	Enumerate the fundamental concepts and significance of environmental impact assessment.
CO2	Explain the important steps of EIA process.
CO3	Interpret the environmental appraisal and procedures in India.
CO4	Decipher how to prepare the various documents required by state and federal regulations.
CO5	Develop their own perspectives on impact assessment and be able to solve problems related to environment.

Recommended Texts

1 Morris, P. and Therivel, R. 1995. Methods of Environmental Impact Assessment, UCL Press, London.
2. Petts, J. 1999. Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford.
3. Therivel, R. and Partidario, M.R. 1996. The Practice of Strategic Environmental Assessment, Earthscan, London.
4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social Impact Assessment, Wiley & Sons, Chichester.
5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996

Reference Books

1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental Management, Capital Pub. Co. New Delhi.
2. Petts, J. 2005. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK.
3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction to Environmental Impact Assessment. Routledge, London.
4. Canter, W.L. 1995. Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York.
5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.

Web resources

1. https://www.amazon.in/Environmental-Impact-Assessment-Gajbhiye-Khandeshwar-ebook/dp/B06XTNQ5PW
2. https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-

assessment/9789382332930/
3. https://www.elsevier.com/books/environmental-impact-assessment/mareddy/978-0-12-811139-0
4. https://link.springer.com/book/10.1007/978-3-030-80942-3
5. https://onlinelibrary.wiley.com/doi/book/10.1002/0471722022

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	1	3	1
CO 4	3	3	3	3	2
CO 5	3	2	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO 2	3	2	3	2	3
CO 3	1	2	3	2	3
CO 4	2	3	3	3	3
CO 5	3	3	3	3	3

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

CORE IX PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	CORE IX						
Category	Core	**Year**	III	**Credits**	5	**Course Code**	**U23CB9**
		Semester	V				

Instructional Hours per week: 5	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	3	-	2	75 hrs/Semester
Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.			

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
C2	Students will know about the basic concepts of classification of plants.
C3	Understand major evolutionary trends in Angiospermic plants.
C4	To know the characteristic features of the selected families.
C5	To know the economic importance of plants.
UNIT	**CONTENTS**
I	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - types.
II	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, salient features of APG IV Classification. Herbarium technique– collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature– principles, typification and author citation.
III	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Cucurbitaceae and Asclepiadaceae.
	Study of the following families based on the natural system and their economic

IV	importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
V	Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.
CO2	Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.
CO3	Describe the core concepts of economic Botany and relate its applications in human life.
CO4	Analyze the characters of the families according to the Bentham and Hooker' s system of classification.
CO5	Assess terms and concepts related to Phylogenetic systematics.

Recommended Texts

1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi
Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London.
3. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Weslley Publicating Co. Ind USA.
4. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.
5. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
6. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.

Reference Books

1. Hutchinson, J. 1973. The Families of Flowering plants, Oxford University press, London.
2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta
3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh.
4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London.
6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.

7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.

Web Resources

1.https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y

2.https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y

3.https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y

4.https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y

5.https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	1	2
CO 2	3	2	3	3	2
CO 3	2	1	3	2	1
CO 4	2	3	2	2	3
CO 5	3	3	3	3	3

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

CORE X PLANT ANATOMY, EMBRYOLOGY AND EVOLUTION

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT ANATOMY, EMBRYOLOGY AND EVOLUTION**						
Paper Number	CORE X						
Category	Core	**Year**	III	**Credits**	5	**Course Code**	**U23CB10**
		Semester	V				
Instructional Hours per week: 5		**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**
		3		2		-	75 hrs/Semester
Pre-requisite		To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To know fundamental concepts of plant anatomy and embryology.
C2	To understand the internal tissue organization of various plant organs.
C3	To differentiate normal and abnormal secondary growth.
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.
C5	Understand the various fossil genera representing different fossil groups.
UNIT	**CONTENTS**
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Theories on shoot apex – Apical cell theory, Tunica-Corpus theory - Root apex - Histogen theory Korper - Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- *Boerhaavia,* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
	Structure of anther - and male gametophyte. Ovule: Structure of mature ovule**,** types

IV	of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac. Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamarck and modern synthetic theory. Variation - analysis and sources, adaptive variation, Concept of speciation - Allopatric and sympatric.

Extended ProfessionalComponent (is a part of internal component only,Not to be included in the External Examinationquestion paper)

Questions related to the above topics, from various competitiveexaminations 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

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to the fundamental concepts of plant anatomy and embryology.
CO2	Describe the internal tissue organization of various plant organs.
CO3	Elucidate the stages of normal and abnormal secondary growth.
CO4	Compare the structural organization of flower in relation to the process of pollination and fertilization.
CO5	Determine the various fossilization methods

Recommended Texts

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.

Reference Books

1. Esau, K. 1985. Anatomy of Seed Plants – John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.

6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA.
8. Evert, R.F. 2006. Esau' s Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.
9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi.
10. 10. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.

Web Resources

1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2
2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG
5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811
6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	3	3
CO 3	2	1	3	1	2
CO 4	2	3	3	3	2
CO 5	3	3	3	2	3

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

CORE XI PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY & PLANT ANATOMY, EMBRYOLOGY AND EVOLUTION -PRACTICAL-V

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY & PLANT ANATOMY, EMBRYOLOGY AND EVOLUTION -PRACTICAL-V**						
Paper Number	CORE XI						
Category	Core	**Year**	III	**Credits**	3	**Course Code**	**U23CB11P**
		Semester	V				

Instructional Hours per week: 6	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	3	-	3	90 hrs/Semester

Pre-requisite	Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To study morphological characters of the families and describe the plant technically using the floral characteristics.
C2	To preserve the plants and prepare herbarium sheets.
C3	To enable students to gain insights into cell wall organization and its functions.
C4	To familiarize with various cell organelles and their functions.
C5	To understand the anatomy of the fossil plants through microscopy.

EXPERIMENTS

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

ANATOMY

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

EMBRYOLOGY

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

EVOLUTION

1. Photograph of evolution scientists.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Recognize the distinguishing plant morphological characters.
CO2	Identify locally available plants to their respective families.
CO3	Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.
CO4	Enumerate the structure and functions of cells, cellular structures and organelles.

CO5	Describe the structure of fossil forms prescribed in the syllabus.

Recommended Texts

Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.

Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.

Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.

Pandely, B.P. 1987. Taxonomy of Angiosperms.

Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.

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.

Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.

Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.

Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.

Web resources

1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210
2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html
3. https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8
4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C
5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592
6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	1	2	2	1	3
CO 2	3	2	3	2	2
CO 3	2	1	2	3	3
CO 4	2	3	3	3	3
CO 5	3	3	3	2	3

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

CORE XII PLANT ECOLOGY AND PHYTOGEOGRAPHY

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT ECOLOGY AND PHYTOGEOGRAPHY**						
Paper Number	CORE XII						
Category	Core	**Year**	III	**Credits**	4	**Course Code**	**U23CB12**
		Semester	V				
Instructional Hours per week: 4	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	2		2		-	60 hrs/Semester	
Pre-requisite	Understanding the environmental factors impacting biodiversity is crucial after taking this course.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To relate to the significance of the biotic and abiotic components of the ecosystems.
C2	To understand the energy flow in ecosystem.
C3	To conceptualize the biodiversity.
C4	To know implication of pollution on the environment.
C5	To familiarize with the phytogeography.

Unit	CONTENTS
I	Biotic components- Association, Consociation, Society. Abiotic factors and their influence on vegetation – soil, wind, light, temperature. Methods of study of vegetation (Quadrat and transect). Plant succession – Hydrosere and Xerosere.
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Loss of Biodiversity-Causes and Conservation (*In situ* and *ex situ*) - Natural resources and its conservation.
IV	**Pollution:** Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil- causes and consequences.
V	**Phytogeography:** Introduction, continuous and discontinuous distribution, Phytogeography of India, Vegetational regions of India. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.
CO2	Summarize the phytogeographical division of India.
CO3	Explain the implication of pollution on the environment.
CO4	Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.
CO5	Develop mitigations for the effective conservation of biodiversity and disaster management.

Recommended Texts

Reference Books

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest: Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.

6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.
9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
10. **Ambasht, R.S.** 2017. **A textbook of plant ecology 15ed (pb 2019).** CBS Publishers Distributors.

Web Resources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	1	3	3	3
CO 3	2	1	3	1	2
CO 4	1	3	3	3	1
CO 5	2	3	1	1	2

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

DSCE I BIO-ANALYTICAL TECHNIQUES

Programme: B.Sc. BOTANY							
Title of the Course	**BIO-ANALYTICAL TECHNIQUES**						
Paper Number	**DSCE I**						
Category		**Year**	III	**Credits**	3	**Course Code**	**U23DB01**
		Semester	V				
Instructional Hours per week: 4		**Lecture**	**Tutorial**		**Lab Practice**	**Total Hours**	
		3	1		-	60 hrs/Semester	
Pre-requisite	To impart expertise about analysis and research.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.
UNIT	**CONTENTS**
I	**I MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.
II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
III	**ELECTROPHORESIS AND pH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	**IV SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:** Principle and law of absorption, construction, operation and uses of colorimeter and UV-Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	**BIOSTATISTICS:** Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical- Histogram – frequency curve – Bar diagram- measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit – t- test.
Extended Professional Component (is a part of internal 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
Course outcomes: On completion of this course, the students will be able to:	
CO1	Relate to the various biological techniques and its importance.
CO2	Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.
CO3	Apply suitable strategies in data collections and disseminating research findings.
CO4	Compare and contrast the significance of different types of chromatography techniques.
CO5	Develop methodologies for extraction and analysis of biochemical compounds.

Recommended Texts

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House.
3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi.

5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.

Reference Books

1.Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications.
2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York.
6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London.
7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. Ltd.
8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi.
9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England Cliffs, New Jersy.

Web Resources

1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1
2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857
3. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pandey-ebook/dp/B01JP3M9TW
4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-Khandpur-ebook/dp/B0129ZDO9W?ref=kindlecontentin50-21&tag=kindlecontentin50-21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpY8D9JNpJZsOcXQCQ4pZlRzTrYH2lopaVP1xxoClPgQAvD_BwE
5. https://www.kobo.com/us/en/ebooks/biostatistics
6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	2	3	2
CO 2	3	3	2	2	1
CO 3	2	2	3	2	1
CO 4	3	2	1	1	3
CO 5	3	2	1	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	3	2
CO 2	3	2	3	3	3

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

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

AQUATIC BOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**AQUATIC BOTANY**						
Paper Number	Elective-I						
Category	Elective	**Year**	III	**Credits**	3	**Course Code**	**U23DB02**
		Semester	V				
Instructional Hours per week: 4	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	3		1		-	60 hrs/Semester	
Pre-requisite	To understand ecological functions and economic uses of aquatic plants.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.
UNIT	**CONTENTS**
	MARINE AND LIMNETIC MACRO ALGAE:

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

Extended 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

Course outcomes: On completion of this course, the students will be able to:

CO1	Recognize aquatic plants and their ecological importance.
CO2	Explain about commonly occurring marine and limnetic algae of the Indian coasts.
CO3	Apply techniques for conservation of aquatic plants for value addition.
CO4	Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.
CO5	Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.

Recommended Texts

1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge.
2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott' s Microbiology. 9th Edition. Mc Graw Hill International.
3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.
5. Daubenmire, R.F.1973. Plant and Environment. John Willey.
6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi.

7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.

Reference Books

1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.
2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands.
3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp.
4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp.
5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp.
6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.

Web Resources

1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf
2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf
3. https://www.springer.com/gp/book/9788132221777
4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf
5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	2	1	1	2
CO 3	2	2	3	1	1
CO 4	3	3	3	3	3
CO 5	3	2	1	1	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	2	3
CO 3	2	1	3	1	2
CO 4	2	1	2	3	2

CO 5	3	3	3	2	3

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

DSCE II FORESTRY

Programme: B.Sc. BOTANY							
Title of the Course	**FORESTRY**						
Paper Number	**DSCE II**						
Category		**Year**	III	**Credits**	3	**Course Code**	**U23DB04**
		Semester	V				

Instructional Hours per week: 4	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	3	1	-	60 hrs/Semester
Pre-requisite	Prior knowledge on trees, forests and their importance.			

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To study the distribution pattern, composition and diversity of forest ecosystem
C2	To understand the method of forest management principles and conservation.
C3	To enable them to meaningfully contribute in the forest conservation.
C4	To raise student awareness of the need to create a sustainable way of living and the

	current global issues with forestry caused by human interference.
C5	To provide a platform to appreciate biodiversity and the importance.
UNIT	**CONTENTS**
I	**SILVICULTURE:** Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and Clonal propagation techniques and methods - macro and micro propagation techniques.
II	**FOREST MENSURATION AND MANAGEMENT:** Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees - methods and principles - tree stem form - form factor. Volume estimation of stand - age - basal area determinations Stem and Stump Analysis. Yield calculation - CAI and MAI - volume, yield and stand tables preparation.
III	**FOREST UTILIZATION AND WOOD TECHNOLOGY:** Logging - extraction of timber - felling rules and methods - conversion methods - conversion season. Implements used - cross cutting system - sawing - different types - extraction methods. Grading of timbers. Transportation of timbers - major and minor transportation methods Storage and sales of logs - sales depot - management of depots. Forest products - timber, fuel, pulp, paper and rayon.
IV	**FOREST BOTANY:** Importance of Forest botany - taxonomic classification of plant species - identification of species - composition and association. Dendrology - principles and establishment of herbaria and arboreta. Tree Improvement - Forest Genetics and Tree Breeding - Definition and concepts - Steps in tree improvement -Variation and selection - Progeny Evaluation Test (PET) - Candidate Tree, Plus Tree, Elite trees - use of provenances and seed sources - heritability and genetic gains - hybrids in tree improvement - heterosis exploitation. Exotics - role of exotic forest trees in India.
V	**AGRO FORESTRY AND SOCIAL FORESTRY:** Agro forestry - definition, concept and objectives. Classification of agro forestry systems - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation and JFM. Urban

	Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.
CO2	Understand complex interactions of humans and forest ecosystems in a global context.
CO3	Demonstrate skills for ecological measurements and interpretation of forest ecology management.
CO4	Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation
CO5	Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.

Recommended Texts

1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.
2. Roger Sands. 2013. Forestry in a global context, CAB international.
3. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun.
4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi.
5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.
8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.

Reference Books

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.
5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from thebamboo 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.
6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. Wertz Kanounnik off. 2007. Incentives and constraints shape forest outcomes. In: At loggerheads? Agricultural expansion, poverty reduction and environment in tropical forests. The World Bank, Washington, DC.
7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.

Web resources

1. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
2. https://www.britannica.com/science/forestry
3. https://en.wikipedia.org/wiki/Forestry.
4. https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its- conservation/25119
5. https://academic.oop.com
6. https://www.cbd.int>development>doc.
7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO 2	3	3	3	3	2
CO 3	3	3	3	2	3
CO 4	3	2	3	1	2
CO 5	3	2	1	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	3	3	2
CO 2	3	1	1	3	1

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

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

COMPUTER APPLICATIONS IN BOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**COMPUTER APPLICATIONS IN BOTANY**						
Paper Number	Elective-III						
Category	Elective	**Year**	III	**Credits**	3	**Course Code**	**U23DB05**
		Semester	VI				

Instructional Hours per week: 4	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**
	3	1	-	60 hrs/Semester
Pre-requisite	To equip students with computational skills for drug design.			

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To familiarize the student with the fundamentals concepts of bioinformatics.
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.
UNIT	**CONTENTS**
I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media
II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.
III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.
V	**Applications:** Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS.Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).

Extended ProfessionalComponent (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 competitiveexaminations 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
Course outcomes: On completion of this course, the students will be able to:	
CO1	1. Recognize advanced resources for accessing scholarly literature from the internet.
CO2	2. Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.
CO3	3. Apply various software resources with advanced functions to carry out analysis of data procured through research.
CO4	4. Decipher the effective utilization of bibliography management software while typing and downloading citations.
CO5	5. Determine how the knowledge gained can be used for designing experiments and data interpretation.

Recommended Texts

1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi Publications, 7th Reprint (1st Edition.
2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press.
3. Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House.
5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.
6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell.
7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.

Reference Books

1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O' Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun.
4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press.

5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.
6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition.
7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Molecular Biologists. Volume III 2nd Edn. Horizontal Scientific Press, Norwich, UK.

Web Resources:

1. http://www.agrimoon.com/introduction-to-computer-applications-pdf-book/
2. https://www.ebooks.com/en-us/subjects/computers/
3. https://it.careers360.com/download/ebooks
4. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformatics22.23-4-2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20Amira.pdf
5. http://www.freebookcentre.net/Biology/BioInformatics-Books.html
6. https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO 2	3	3	3	2	1
CO 3	3	3	3	1	2
CO 4	3	3	3	1	2
CO 5	3	3	3	1	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	3	3	3	3
CO 2	3	3	2	3	2
CO 3	1	3	2	3	1
CO 4	1	3	2	3	1
CO 5	1	3	2	3	1

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

CORE XIII PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**						
Paper Number	CORE XIII						
Category	Core	**Year**	III	**Credits**	5	**Course Code**	**U23CB13**
		Semester	VI				
Instructional Hours per week: 6		**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**
		3		3		-	90 hrs/Semester
Pre-requisite		Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.					

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to water relation of plants with respect to various physiological phenomenon.
CO2	Explain the process and significance of photosynthesis and respiration.
CO3	Elucidate properties of nutrients and their deficiency symptoms in plants.

CO4	Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.
CO5	Decipher the phenomenon of seed dormancy and germination in plants.

Recommended Texts

1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi.
3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi.
5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi.
7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay.
8. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.

Reference Books

1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England.
3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA.
4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands.
5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA.
6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, NewYork, USA.
7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

Web Resources

1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants
2.https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6
3. https://www.kobo.com/us/en/ebook/plant-biochemistry
4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1

5.https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA
6.https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692
7.https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	2
CO 2	3	2	3	2	3
CO 3	2	1	3	1	3
CO 4	2	3	3	3	3
CO 5	3	3	3	3	3

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

CORE XIV PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY**						
Paper Number	CORE XIV						
Category	Core	**Year**	III	**Credits**	5	**Course Code**	**U23CB14**
		Semester	VI				
Instructional Hours per week: 6		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		3		3	-	90 hrs/Semester	
Pre-requisite	To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.						

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To know various aspects of biotechnology

C2	To know the concept and techniques of plant tissue culture.
C3	To familiarize with the gene transfer techniques.
C4	To know about DNA replication and repair.
C5	To familiarize with gene regulation.
UNIT	**CONTENTS**
I	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (*Aspergillus niger*) and Proteases production (*Bacillus sps*).
II	Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropogation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, *Agrobacterium* mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.
IV	Nature and function of genetic materials, Nucleic acid – base paring – Chargaff' s rule, DNA – structure. Types, denaturation - renaturation. Replication of DNA in prokaryotes. RNA structure and types. DNA repair mechanism.
V	Transcription – Enzymology – RNA polymerase – classes of RNA molecules – transcription in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Gene regulation in Prokaryotes – *lac* operon and *trp* operon
Extended ProfessionalComponent (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
Course outcomes: On the completion of the course the students will be able to:	
CO1	Recognize the fundamentals concepts of plant biotechnology and genetic engineering.
CO2	Explain various steps in transcription, protein synthesis and protein modification.
CO3	Elucidate gene cloning and evaluate different methods of gene transfer.
CO4	Analyze the major concerns and applications of transgenic technology.
CO5	Develop their competency on different types of plant tissue culture.

Recommended Texts

1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.
2. ***Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.***
3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi.
4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd.
5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.
6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag

Reference Books

1.Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.
3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein.
4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York.
5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York.
6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.
7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York.
8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin.
9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin.
10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac million, New York.
11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.

Web Resources

1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html
2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C
3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183
6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	3	2	2	3

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

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	2	1	3
CO 2	3	2	3	2	2
CO 3	1	2	1	3	3
CO 4	2	3	2	3	3
CO 5	3	3	3	2	3

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

CORE XV PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY & PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY- PRACTICAL-VI

Programme: B.Sc. BOTANY							
Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY & PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY- PRACTICAL-VI**						
Paper Number	CORE XV						
Category	Core	**Year**	III	**Credits**	3	**Course Code**	**U23CB15P**
		Semester	VI				
Instructional Hours per week: 6	**Lecture**		**Tutorial**		**Lab Practice**		**Total Hours**
	3		-		3		90 hrs/Semester
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.

EXPERIMENTS

Plant Physiology

1. Determination of water potential by plasmolytic method.
2. Effect of chemicals on membrane permeability.
3. Effect of environmental factors on rate of transpiration by gravimetric method.
4. Separation of plant pigments by paper chromatography.
5. Study the rate of photosynthesis under different light intensities by using Willmott' s bubble counter.
6. Study of rate of photosynthesis under different wavelengths (red & blue) of light.
7. Enzyme activity – catalase.

Demonstration – Experiments

1. Study the rate of transpiration by using Ganong' s photometer
2. Demonstration of stomatal movement.

Plant Biochemistry

1. Biochemical test for carbohydrates, proteins and lipids

Plant Biotechnology - Demonstration

1. Sterilization techniques in plant tissue culture.
2. MS - Media preparation.
3. Explant sterilization, Callus induction, Plantlet, hardening.

Molecular Biology – Photographs

1. DNA Structure
2. tRNA
3. DNA – Replication
4. DNA – Repair
5. Genetic code

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

Course outcomes: On completion of this course, the students will be able to:	
CO1	Relate to the distribution and adaptions of plants pertaining to their habitat
CO2	Demonstrate skills in green planning and callus culture.
CO3	Elucidate the basic principles involved in the plant physiology and biochemistry experiments.
CO4	Appreciate the structure and functions of DNA and RNA.
CO5	Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.

Recommended Texts

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
4 Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw‑Hill Publishing Company Ltd., New Delhi.
5. Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited,New Delhi.
7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.

Reference Books

1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.
2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology 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

CO1	3	3	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	2	3	1
CO 2	3	2	3	3	2
CO 3	2	1	2	2	3
CO 4	2	3	3	3	3
CO 5	3	3	3	3	2

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

DSEC 3 HORTICULTURE

Programme: B.Sc. BOTANY							
Title of the Course	**HORTICULTURE**						
Paper Number	**DSEC 3**						
Category		**Year**	III	**Credits**	3	**Course Code**	**U23DB06**
		Semester	VI				
Instructional Hours per week: 5	**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**		
	3		2	-	75 hrs/Semester		
Pre-requisite	Students should know fundamental knowledge on horticulture applications.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented	✓	Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Enumerate the concepts in horticulture and nursery management.

CO2	Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.
CO3	Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.
CO4	Analyze different methods of weed control in horticultural crops.
CO5	Develop their competency on pre and post-harvest technology in horticultural crops.

Recommended Texts

1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – principles and practices. Half of India. New Delhi.
2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash.
3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi.
4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi.
5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta.
6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore.
7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books

1.Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca.
2. Bailey, S. 1971. Perpectual flowering carnation, Fabner and Fabner, London.
3. Laurie, A., Kiplingr, D.D and Nelson, K.S. 1968. Commercial flower forcing. Mc Graw-Hill Book, London.
4. Cumming, R.W. 1964. The chrysanthemum Book. D.Van., Nostrand Inc.
5. Biswas, T.D. 1984. Rose growing – Principles and Practices – Assoc., Pub., Co., New Delhi.
6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.
7. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden, Trivandrum.
8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta.
9. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., London.
10. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening Chartwell Book, Inc., New Jercy.

Web Resources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	1	2
CO 2	3	3	2	1	1
CO 3	2	2	3	3	1
CO 4	3	3	2	2	3
CO 5	3	3	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	1	3	1	3
CO 3	2	2	3	1	2
CO 4	2	3	1	3	2
CO 5	3	2	3	1	3

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

NATURAL RESOURCE MANAGEMENT

Programme: B.Sc. BOTANY							
Title of the Course	**NATURAL RESOURCE MANAGEMENT**						
Paper Number	Elective-II						
Category	Elective	**Year**	III	**Credits**	3	**Course Code**	**U23DB07**
		Semester	VI				
Instructional Hours per week: 4		**Lecture**	**Tutorial**		**Lab Practice**	**Total Hours**	
		3	1		-	60 hrs/Semester	
Pre-requisite	To understand the concept of different natural resources and their utilization.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To develop an appreciation for the natural resources and their ecological and economic impact.
C2	To gain an understanding of various strategies of natural resource management.
C3	To understand the concept of different natural resources and their utilization.
C4	To create the models of natural resource conservation and maintenance.
C5	To study the significance of natural resources pertaining to economy and environment.
UNIT	**CONTENTS**
I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.
II	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.
III	Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish resource,

	unsustainable harvesting, issues and challenges for resource supply, new prospects.
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.

Extended ProfessionalComponent (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 competitiveexaminations 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

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to significance of natural resources pertaining to economy and environment
CO2	Understand the concept of different natural resources and their utilization.
CO3	Evaluate the management strategies of different natural resources.
CO4	Critically analyze the sustainable utilization land, water, forest and energy resources.
CO5	Design new models of natural resource conservation and maintenance.

Recommended Texts

1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.

4. United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition
5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House
6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.

Reference Books

1. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303.
2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.
3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.
4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.
5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.
6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).
7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.
8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.
9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.

Web resources

https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&redir_esc=y
https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
https://www.kobo.com/us/en/ebooks/natural-resources
https://www.igi-global.com/chapter/natural-resources-management/195183
6crLIC&redir_esc=y
https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
https://www.kobo.com/us/en/ebooks/natural-resources
https://www.igi-global.com/chapter/natural-resources-management/195183

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	1	2	1	2
CO 2	3	1	2	1	3
CO 3	2	2	3	3	1

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

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	2	2	2	1
CO 2	3	2	3	3	3
CO 3	2	1	2	1	2
CO 4	2	2	1	3	2
CO 5	3	3	3	1	3

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

DSEC 4 FORENSIC BOTANY

Programme: B.Sc. BOTANY							
Title of the Course	**FORENSIC BOTANY**						
Paper Number	**DSEC 4**						
Category		**Year**	III	**Credits**	3	**Course Code**	**U23DB08**
		Semester	VI				
Instructional Hours per week: 5	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	3		2		-	75 hrs/Semester	
Pre-requisite	The course will provide basic knowledge about the application of						

	Botany to Forensic investigations and legal disputes.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.
C3	To learn classification of plants from forensic point of view.
C4	To understand forensic importance of different parts of plants.
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.
UNIT	**CONTENTS**
I	Forensic botany- scope and importance - forensic plant anatomy, forensic plant systematic, forensic palynology, forensic plant ecology, limnology. Plant architecture- roots, stems, flowers, leaves.
II	Various types of woods, timbers, seeds and leaves and their forensic importance. 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.
III	Various types of poisonous plants: *Abrus precatorius*, *Anacardium occidentale*, *Argemone mexicana*, *Gloriosa superba*, *Nerium indicum*, *Strychnos nux vomica*. Types of plants yielding drugs of abuse – opium, cannabis, tobacco, *Psilocybin* mushrooms.
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.
V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.
CO2	Summarize the forensic importance of different parts of plants.
CO3	Apply techniques for the collection and preserve of botanical evidences of crime.
CO4	Analyze and decipher the significance of classic and DNA based forensic botany cases.
CO5	Interpret and deduce new methods for the detection of plant poisons used in crime.

Recommended Texts

1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.
2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition.
3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom.
4. Jane H Bock, David Norris.2015. Forensic Plant Science. Elesvier.
5. **Patricia E. J. Wiltshire**.2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation.
   Criminal and Environmental Soil Forensics pp 129‑149

Reference Books

1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition.
2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press.
3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell.
4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell.
5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details ‑‑ David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.

Web Resources

1. https://www.kobo.com/us/en/ebook/forensic-botany
2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574
3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/
4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299
5. http://docshare02.docshare.tips/files/25818/258183613.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	2	1	3	2
CO 2	3	3	2	1	1

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

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	1	2	2	2	1
CO 2	3	2	3	1	3
CO 3	2	1	3	1	2
CO 4	1	3	3	2	1
CO 5	3	1	2	2	3

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

BIONANOTECHNOLOGY

Programme: B.Sc. BOTANY							
Title of the Course	BIONANOTECHNOLOGY						
Paper Number	Elective-III						
Category	Elective	**Year**	III	**Credits**	3	**Course Code**	**U23DB09**
		Semester	VI				
Instructional Hours per week: 4		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	

	3	1	-	60 hrs/Semester
Pre-requisite	To provide an insight into the principles of nanotechnology in biological and medical research.			

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.
UNIT	**CONTENTS**
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) – Polimeric 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.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology
CO2	Explain the synthesis of nanomaterials and their applications.
CO3	Apply the knowledge gained to develop nanomaterials
CO4	Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.
CO5	Construct various types of nanomaterial for application and evaluate the impact on environment.

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.
7. Sharma P.K. 2008. Understanding Nanotechnology. Vista International Publishing House, Delhi.
8. 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.
6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.
7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

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.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179
4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
5. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/
7. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html
8. http://www.particle-works.com/applications/controlled-drug-release/Applications

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	3	3	3	2	3
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO 2	3	2	1	2	1
CO 3	3	3	2	3	2
CO 4	3	3	3	3	3
CO 5	3	3	3	3	3

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

SKILL ENHANCEMENT COURSES (SEC 8) - TRAINING FOR COMPETITIVE EXAMINATIONS.

BOTANY FOR COMPETITIVE EXAMINATIONS (2 hours)

Programme: B.Sc. BOTANY							
Title of the Course	**BOTANY FOR COMPETITIVE EXAMINATIONS**						
Paper Number	Skill Enhancement						
Category	Elective	**Year**	III	**Credits**	2	**Course Code**	**U23PCB1**
		Semester	VI				
Instructional Hours per week: 2		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		2		-	-	30 hrs/Semester	

Pre-requisite	To develop the students for preparing various competitive examination.

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To develop the student for competitive examination.
C2	To select the important topics as far as possible, with reference to the examination point of view. It gives a comprehensive account of botany.
C3	To understand not only the basics of botany and also gives the broader perspective to prepare for the competitive examinations.
C4	The essays give a detailed account of each aspect of botany to help students preparing for IAS, IFS and state civil services.
C5	General understanding of plants around us, the different biophysical and biochemical processes that occur within them and their importance to human life.

UNIT	**CONTENTS**
I	**PLANT WORLD:** Plant science and its branches . Five kingdom classification. Outline of Kingdom plantae General characters and Economic importance of Algae, Fungi and Lichens.
II	**GENERAL CHARACTERS OF PLANT GROUPS:** General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms .Palaeobotany- Types of fossils, Geological time scale ,Fossil beds of Tamil Nadu.
III	**PLANT MORPHOLOGY AND TAXONOMY:** Root system and shoot system. Modifications (Pneumatophore, Stilt root, Epiphytic root, Cladode, Phylloclade ,Pitcher and Phyllode) Parts of a flower - Fruits types(Outline) Parthenocarpy- Pollination – types, Seed dispersal – types, Seed Germination types. Taxonomy –definition. Types of classification- Taxonomic hierarchy, ICN, Binomial nomenclature and BSI. Herbarium and Major Herbaria of the world.
IV	**CYTOLOGY AND GENETICS:** Cell –Prokaryotic and Eukaryotic – Cell organelles with functions . DNA and RNA (Basic concepts) -Cell division and its significance -Mitosis and Meiosis (outline) Mendelism – Monohybrid and Dihybrid cross, Sex linked inheritance
	ECOLOGY AND BIODIVERSITY: Ecosystem – abiotic and biotic components. Energy flow in an ecosystem, Aforestation, Deforestation- Chipko movement –-Forest Conservation act- Pollution

V	types and effects- Eutrophication, Global warming, Ozone depletion, Climate change. Biodiversity and types- Hot spots, Mega diversity countries, Conservation – *ex situ* and *in situ* methods. Endangered plants and Red data Book. Rio -Earth summit. Biodiversity Management Policies - IUCN, UNEP, WWF, ICSU, WCMC.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Identify and define different groups of plants with their taxonomic position. Compare the different groups of plants and evaluate their economic importance.
CO2	List down the general characters of Bryophytes, Pteridophytes and Gymnosperms Classify the types of fossils and recognize the fossil beds of Tamil Nadu. Analyse and trace the origin of different plant groups using Geological Time scale.
CO3	Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.
CO4	Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked inheritance. Tabulate the different cell organelles with their functions.
CO5	Define and appreciates biodiversity. Identify the cause and solve environmental related issues . Design eco friendly approaches to protect earth and generate new conservation strategies.

Recommended Texts

1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany for Competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams.) Astral Cracker.

2. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers.

3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House.

4.Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

5. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies Taxonomy: Nair Datta

6. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.

Reference Books

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc.,

8th Edn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Power, C.B and Daginawa, H.F. 2010. General Microbiology : Himalaya Publishing House Pvt Ltd,
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
9. 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.

Web resources

1. https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898
2. https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competive/dp/B08VWB64BC
3. https://www.ssclatestnews.com/botany-book-pdf-free-download-for-competitive-exams/
4. https://sscstudy.com/botany-for-competitive-exams-pdf/
5. https://www.amazon.in/Botany-Entrance-Examination-Anupam-Rajak-ebook/dp/B089S1GLMP

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	1	3	2
CO 2	3	2	1	2	3
CO 3	2	2	3	3	1
CO 4	3	3	3	3	3
CO 5	3	3	2	3	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	1	1	2	3	1
CO 2	3	2	3	2	1
CO 3	2	1	3	2	3
CO 4	2	3	3	3	3
CO 5	1	3	3	3	2

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

LIST OF GEC COURSES OFFERFED BY THE DEPARTMENT OF BOTANY

UG TEMPLATE – FOR ALLIED BOTANY

OFFERED BY BOTANY DEPARTMENT TO I B.Sc. ZOOLOGY STUDENTS (2023-2026 BATCH)

Part	Course Code	Course Type	Title of the Course	Hrs / Week	Credits	Exam Hrs	Marks		
							Int	Ext	Total
Semester – I									

III	U23GB52	GEC 1(T)	Allied Botany I	4	4	3	25	75	100
III	U23GB53P	GEC 2 (P)	Allied Botany Practical - I	2	2	3	25	75	100
Semester -II									
III	U23GB53P	GEC 2 (P)	Allied Botany Practical - I	2	2	3	25	75	100
III	U23GB54	GEC 3 (T)	Allied Botany II	4	4	3	25	75	100
Total				12	10				300

ELECTIVE ALLIED BOTANY-I

Programme: B.Sc. BOTANY							
Title of the Course	**ALLIED BOTANY-I**						
Paper Number	Core-Allied-I						
Category	Core	**Year**	I	**Credits**	4	**Course Code**	**U23GB52**
		Semester	I				
Instructional Hours per week: 4		**Lecture**		**Tutorial**	**Lab Practice**	**Total Hours**	
		3		1	-	60 hrs/Semester	
Pre-requisite	To study the basics of botany.						

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved
(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
CO4	Compare the structure and function of cells and explain the development of cells.
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.

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
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3

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

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	1	3	3	3	3
CO 4	3	2	3	2	3
CO 5	2	2	1	2	1

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

ELECTIVE ALLIED BOTANY-II

Programme: B.Sc. BOTANY							
Title of the Course	ALLIED BOTANY-II						
Paper Number	Core-Allied-II						
Category	Core	**Year**	I	**Credits**	4	**Course Code**	**U23GB54**
		Semester	II				
Instructional Hours per week: 4	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	3		1		-	60 hrs/Semester	
Pre-requisite	To study basics of botany.						

Relevant to Global need		Employability Oriented	✓	Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

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.

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Understand the fundamental concepts of plant anatomy and embryology.
CO2	Analyze and recognize the different organs of plants and secondary growth.
CO3	Understand water relation of plants with respect to various physiological processes.
CO4	Classify aerobic and anaerobic respiration.
CO5	Classify plant systematics and recognize the importance of herbarium and virtual herbarium.

Recommended Texts

1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.

Reference books

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

Web Resources

1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG
5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5

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

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	1	3	3	3	3
CO 4	3	3	2	3	2
CO 5	2	2	1	2	2

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

ELECTIVE ALLIED BOTANY PRACTICALS

Programme: B.Sc. BOTANY							
Title of the Course	**ALLIED BOTANY PRACTICALS**						
Paper Number	Core-Allied Practicals-I						
Category	Core	**Year**	I	**Credits**	2	**Course Code**	**U23GB53P**
		Semester	II				
Instructional Hours per week: 2	**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**			
	-	-	2	30 hrs/Semester			
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.						

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

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

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. Demonstration experiments
    1. Ganong' s Light screen
    2. Ganong' s respiroscope
7. To make suitable micro preparations of anatomy materials prescribed in the syllabus.
8. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy, Embryology, Cell biology and Biotechnology.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)

Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

(To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	To study the internal organization of algae and fungi.
CO2	Develop critical understanding on morphology, anatomy and reproduction of

	Bryophytes, Pteridophytes and Gymnosperms.
CO3	To study the classical taxonomy with reference to different parameters.
CO4	Understand the fundamental concepts of plant anatomy and embryology
CO5	To study the effect of various physical factors on photosynthesis.

Recommended Texts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England.
5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.

Reference Books

1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.
3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.
5. Steward, F.C. 2012. Plant Physiology Academic Press, US

Web sources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3

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

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

Mapping with Programme Specific Outcomes:

COs	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO 1	3	3	3	3	3
CO 2	3	3	3	3	3
CO 3	1	3	3	1	3
CO 4	3	3	2	3	3
CO 5	2	2	1	2	2

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

UG TEMPLATE – FOR ALLIED ENVIRONMENTAL BIOLOGY

OFFERED BY BOTANY DEPARTMENT TO I B.Sc. GEOGRAPHY STUDENTS (2023-2026 BATCH)

Part	**Course Code**	**Course Type**	**Title of the Course**	**Hrs / Week**	**Credits**	**Exam Hrs**	**Marks**		
							Int	**Ext**	**Total**
Semester – I									
III	U23GB55	GEC1 (T)	Introduction to Ecobiology	4	4	3	25	75	100

III	U23GB56P	GEC2 (P)	Allied Environmental Biology Practical – I	2	2	3	25	75	100
Semester – II									
III	U23GB56P	GEC2 (P)	Allied Environmental Biology Practical – I	2	2	3	25	75	100
III	U23GB57	GEC3 (T)	Basic Forest Botany	4	4	3	25	75	100
Total				12	10				300

ELECTIVE ALLIED ENVIRONMENTAL BIOLOGY – I

Programme: B.Sc. BOTANY							
Title of the Course	**ALLIED ENVIRONMENTAL BIOLOGY I - INTRODUCTION TO ECOBIOLOGY**						
Paper Number	Allied-I						
Category		**Year**	I	**Credits**	4	**Course Code**	**U23GB55**
		Semester	I				
Instructional Hours per week: 4	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	
	3		1		-	60 hrs/Semester	

Pre-requisite	To study basics of environmental biology.

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	Relate the anatomical and Morphological modifications with reference to their eco system and environment.
C2	Appreciate dual nature of lichens and their importance and mode of nutrition and interactions in plants.
C3	Understand the concept of eco system.
C4	Trace the evolutionary origins and inter relatedness of different forms with reference to habitat.
C5	Build knowledge to study vegetation, using quadrat and transect.
UNIT	**CONTENTS**
I	Environment: Definition and various zones of environment, Hydrosphere: physical and chemical properties of water, Lithosphere: soil profile, Atmosphere: various zones of Atmosphere. Concept of biosphere, Adaptations - Hydrophytes: *Hydrilla*, Xerophytes: *Opuntia* and Halophytes: *Rhizophora* .
II	Biotic interactions: Mutualism- *Rhizobium;* Commensalism- Vanda; Parasitism- *Cuscuta*; Insectivorous plants-*Nepenthes*.
III	Structure of Ecosystem: Abiotic and Biotic components; Functions of Ecosystem; Food Chain, Food web, Ecological pyramid, Energy flow and productivity.
IV	Ecological succession – causes and basic types of succession, General process – Nudation, Invasion, Competition and Stabilization- Hydrosere and Xerosere.
V	Methods of study of vegetation: Quadrat and Transect methods- Parameters- Frequency-Density-Abundance.

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

Course outcomes: On completion of this course, the students will be able to:

CO1	Understand and analyze different zones of environment and relates adaptations of plants to respective environment.

CO2	Differentiate positive and negative interrogations
CO3	Understand relationship between biotic and abiotic components.
CO4	Develop concept on hydrosere and Xerosere. Causes and basic types of succession.
CO5	Enable students to carry out vegetation studies.

Recommended Texts

1. Sharma. P.D., 1995, Ecology and *Environment,* Rakesh Kumar Publications, New Delhi.
2. Shukla, R.S. and Chandel, P.S. 2006, *A text book of plant Ecology*, S. Chand & Company Ltd., New Delhi.

REFERENCES:

1.Krishnamurthy. T 1993, *Minor Forest products of India,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi
2.Eugene P. Odum, 1971, *Fundamentals of Ecology*, W.B. Saunders Company, Philadelphia, London.
3.Sharma. P.D., 1995, Ecology and *Environment,* Rakesh Kumar Publications, New Delhi.
4.Shukla, R.S. and Chandel, P.S. 2006, *A text book of plant Ecology*, S. Chand & Company Ltd., New Delhi.
5.Verma, P.S. and Agarwal, V.K. 1998, *Concept of Ecology*, S. Chand & Company Ltd., New Delhi.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO 1	2	3	2	3	2
CO 2	3	2	1	2	2
CO 3	1	3	2	2	2
CO 4	2	1	3	3	2
CO 5	1	2	3	2	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	2	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	2	2
CO 4	1	2	1	3	2
CO 5	2	3	2	2	1

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

ELECTIVE ALLIED B ENVIRONMENTAL BIOLOGY –II

Programme: B.Sc. BOTANY							
Title of the Course	**ALLIED ENVIRONMENTAL BIOLOGY II – BASIC FOREST BOTANY**						
Paper Number	Allied-II						
Category		**Year**	I	**Credits**	4	**Course Code**	**U23GB57**
		Semester	II				
Instructional Hours per week: 4	**Lecture**		**Tutorial**		**Lab Practice**	**Total Hours**	

	3	1	-	60 hrs/Semester
Pre-requisite	To study basics of environmental biology.			

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

Learning Objectives	
C1	To enable the students to know about natural forests.
C2	To know about social forestry and Agroforestry.
C3	To acquire the knowledge of threats to forests
C4	To make aware the students the causes and effects of deforestation
C5	To develop in them the need for conservation of forests
UNIT	**CONTENTS**
I	Introduction, types of forest in India, Threats to forest-causes and effects of deforestation.
II	Social forestry:- components and significance. Agroforestry- various models of Agroforestry,plants suitable for Agroforestry, Agronomic importance of Agroforestry.
III	Major forest products: wood (Sandal wood and Rose wood), timber (Neem and Teak),fuel wood (Prosopis). Essential oil: Lemon grass, Spices and condiments: cinnamon, pepper, clove.
IV	Forest management – Nursery development, transplantation, weeding, manuring, mulching, plant protection, rotation, fixation and harvesting. Forest conservation-insitu exsitu conservation.
V	Forest Legislation with reference to national parks and sanctuaries – Wild life protection act, forest conservation act, vanamahotsava, joint forest management.

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
Course outcomes: On completion of this course, the students will be able to:	
CO1	Understands the different types of forests in India
CO2	Learns the components of social forest and Agroforests
CO3	Understands and compares the major and minor forest products
CO4	Enable the students to develop nursery and recognizes the forest conservation strategies
CO5	Develops keen interest in forest legislation and management

Recommended Texts

1. P.S. VermaV.K. Agarwal., 2001*Environmental Biology: Principles of Ecology,* S.Chand & Company Ltd., New Delhi.
2. Odum H.T., E.P.Odum., 1957, *Fundamentals of Ecology*, W.B.Saunders Company, Philadelphia, London.

REFERENCES:

1. P.D. Sharma, 2009, *Environmental Biology*, Rastogi Publications, Meerut.
2. R. Rajagopalan, 2005, *Environmental Studies*, Oxford University.
3. Juneja, Kavita, *2002,* Ecology, Anmol Publications Pvt. Ltd., New Delhi

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO 1	2	3	2	3	2
CO 2	3	2	1	2	2
CO 3	1	3	2	2	2
CO 4	2	1	3	3	2
CO 5	1	2	3	2	2

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	2	2	2	3	3
CO 2	3	2	3	3	3
CO 3	3	2	3	2	2
CO 4	1	2	1	3	2

CO 5	2	3	2	2	1

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

ELECTIVE ALLIED ENVIRONMENTAL BIOLOGY PRACTICALS

Programme: B.Sc. BOTANY							
Title of the Course	**ALLIED ENVIRONMENTAL BIOLOGY PRACTICALS**						
Paper Number	Allied Practical-I						
Category	Core	**Year**	I	**Credits**		**Course**	**U23GB56P**

		Semester	II		2	**Code**	
Instructional Hours per week: 2		**Lecture**	**Tutorial**	**Lab Practice**	**Total Hours**		
			-	2	30 hrs/Semester		
Pre-requisite		Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.					

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented	✓	Addresses Environment and Sustainability	
Relevant to Local need				Addresses Human Values	

Learning Objectives

C1	To help the students know about the habitats of plants
C2	To understand the positive and negative interaction.
C3	To acquire knowledge in Ecosystem
C4	To understand the major and minor forest products.
C5	To acquire knowledge about the study of vegetation.

EXPERIMENTS

1. Positive Interactions-Mutualism -*Rhizobium*, Commensalism – *Vanda*.
2. Negative Interactions – Parasitism - *Cuscuta*.
3. Insectivorous plants- *Nepenthes*.
4. Ecosystem, food chain, food web, Ecological pyramid.
5. Study of vegetation using Quadrat method.
6. Photographs showing social and agro forestry.
7. Major and Minor Forest Products.
8. Map showing National parks and Sanctuaries.

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 solve (To be discussed during the Tutorial hour)

Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course outcomes: On completion of this course, the students will be able to:

CO1	Able to compare the distinguishing features of plants of various habitats.

CO2	Apply the knowledge of plant interaction and identify them with special features.
CO3	Develops the knowledge of locating parks and sanctuaries in the country.
CO4	Identify the types of forests and the products obtained from it.
CO5	Enable the students to study vegetation using quadrat method.

Recommended Texts

1. Sharma. P.D., 1995, Ecology and *Environment,* Rakesh Kumar Publications, New Delhi.
2. Shukla, R.S. and Chandel, P.S. 2006, *A text book of plant Ecology*, S. Chand & Company Ltd., New Delhi.
3. P.S. VermaV.K. Agarwal., 2001*Environmental Biology: Principles of Ecology,* S.Chand & Company Ltd., New Delhi.
4. Odum H.T., E.P.Odum., 1957, *Fundamentals of Ecology*, W.B.Saunders Company, Philadelphia, London.

Reference Books

.1. Krishnamurthy. T 1993, *Minor Forest products of India,* Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi

2.Eugene P. Odum, 1971, *Fundamentals of Ecology*, W.B. Saunders Company, Philadelphia, London.

3.Sharma. P.D., 1995, Ecology and *Environment,* Rakesh Kumar Publications, New Delhi.

4.Shukla, R.S. and Chandel, P.S. 2006, *A text book of plant Ecology*, S. Chand & Company Ltd., New Delhi.

5.Verma, P.S. and Agarwal, V.K. 1998, *Concept of Ecology*, S. Chand & Company Ltd., New Delhi.

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5
CO 1	3	2	1	3	2
CO 2	3	3	2	2	3
CO 3	2	2	1	3	1
CO 4	3	3	3	3	2
CO 5	3	2	2	3	1

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

Mapping with Programme Specific Outcomes:

COs	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	1	2	2	2	2
CO 2	3	2	3	2	3
CO 3	1	2	3	2	3

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

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

ENVIRONMENTAL STUDIES FOR DEGREE STUDENTS UNDER PART IV

Programme: B.Sc. BOTANY	
Title of the Course	**ENVIRONMENTAL STUDIES FOR DEGREE STUDENTS**
Paper Number	**E.V.S**

Category	Part IV	Year	II	Credits	2	Course Code	U23EVS1
		Semester	III				
Instructional Hours per week: 1		Lecture	Tutorial	Lab Practice	Total Hours		
		1	-	-	15 hrs/Semester		
Pre-requisite		Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.					

Relevant to Global need		Employability Oriented		Addresses Professional Ethics	
Relevant to National need		Entrepreneurship Oriented		Addresses Gender Sensitization	
Relevant to Regional need		Skill Development Oriented		Addresses Environment and Sustainability	✓
Relevant to Local need				Addresses Human Values	

UNIT 1: ENVIRONMENT AND ITS RESOURCES:

- Definition, scope and importance of environmental studies
- Need for public awareness
- Natural Resources: Renewable and Non renewable

a) Forest resources: Use and over exploitation, deforestation.
b) Water resources: Use and over utilization of surface and ground water, floods, drought, conflicts over water, dams, benefits and problems.
c) Mineral resources: Use and exploitation
d) Food resources: World food problems, effects of modern agriculture.
e) Energy resources: Growing energy needs, renewable and non renewable energy sources.
f) Land resources: Land as a resource, land degradation, man induced land slides, soil erosion and desertification.

UNIT II: ECOSYSTEMS:

- Concept of an ecosystem.
- Structure and function of an ecosystem
- Food chains, Food web and Ecological pyramids.
- Introduction, types, characteristic features, structure and function of the following ecosystem: a) Forest ecosystem b) Aquatic ecosystem (pong, streams, lakes, rivers, oceans, estuaries).

UNIT III: BIODIVERSITY AND ITS CONSERVATION:

- Introduction-Definition: Genetic, Species and Ecosystem diversity.
- Biogeographical classification of India.
- Values of Biodiversity: Consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, national and local levels.

- India as a mega diversity nation.
- Hot spots of diversity.
- Threats to biodiversity: Habitat loss, poaching of wild life, man- wild life conflicts.
- Endangered and Endemic species of India.
- Conservation of Biodiversity: In situ and Ex situ conservation of biodiversity.

UNIT IV: ENVIRONMENTAL POLLUTION:

- Definition, causes, effects and control measures of
  a) Air pollution
  b) Water pollution
  c) Noise pollution
  d) Nuclear hazards
- Solid waste management: Causes, effects and control measures of urban and industrial wastes.
  a) Role of an individual in prevention of pollution
  b) Pollution case studies.
  c) Disaster management: floods, earth quakes, cyclone and land slides.

UNIT V: SOCIAL ISSUES AND ENVIRONMENT:

- From unsustainable to sustainable development.
- Urban problems related to energy.
- Climate change, global warming, acid rain, ozone layer depletion nuclear accidents and holocaust. Case studies.
- Environment Protection Act.
- Air (Prevention and control of pollution) Act.
- Water (Prevention and control of pollution) Act.
- Wild life protection Act.
- Forest conservation Act.
- Issues involved in enforcement of environmental legislations.
- Public awareness.
- Population growth, variations among nations.
- Environment and human health.
- Human rights.
- Role of information technology in Environment and human health.