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THIRUVALLUVAR UNIVERSITY

SERKKADU, VELLORE–632115

B.Sc. BOTANY

SYLLABUS

FROM THE ACADEMIC YEAR

2023 – 2024

Contents

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME	
Programme	**B.Sc. BOTANY**
Programme Code	
Duration	**3 Years (UG)**
Programme Outcomes	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study. **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply

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

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

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

2. Highlights of the Revamped Curriculum:

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

Value additions in the Revamped Curriculum:

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

		• Emerging topics in higher education / industry / communication network / health sector etc. are introduced with hands-on-training, facilitates designing of statistical models in the respective sectors
IV	DBMS and Programming skill, Biostatistics, Statistical Quality Control, Official Statistics, Operations Research	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Project with Viva – voce	• Self-learning is enhanced • Application of the concept to real situation is conceived resulting in tangible outcome
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners / Honors degree.		• To cater to the needs of peer learners / research aspirants.

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

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part.1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – IX Core Theory	4	5	6.1 Core Course – XIV Core Theory	4	6
Part.2 English	3	6	Part..2 English	3	4	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – X Core Practical-V	3	4	6.2 Core Course -XV Core Theory	3	6
1.3 Core Course – CC I (Core theory)	5	5	2..3 Core Course – CC III (Core theory)	5	5	3.3 Core Course CC- V (Core theory)	5	5	4.3 Core Course – CC VII (Core theory)	5	5	5. 3.Core Course XI Core Theory	3	4	6.3 Core Course –XVI Core Theory	3	6
1.4 Core Course – CC II (Core Prac-I)	4	4	2.4 Core Course – CC IV (Core Prac-II)	4	4	3.4 Core Course – CC VI (Core Prac-III)	4	4	4.4 Core Course – (Core Practical-IV)	4	4	5. 4.Core Course –XII Core Theory	3	5	6.4 Core Course –XVII Core Practical -VII	3	4
1.5 Elective I Allied Theory I	3	3	2.5 Elective II Allied Theory II	3	4	3.5 Elective III Allied Theory III	3	3	4.5 Elective IV Allied Theory IV	3	4	5.5 Core Course – XIII Core Practical-VI	3	4	6.5 Discipline Specific Elective II	3	4
1.6 Elective I Allied Practi-I	-	2	2.6 Elective II Allied Practi-I	2	2	3.6 Elective III Allied Practice-II	-	2	4.6 Elective IV Allied Practical-II	2	2	5.6 Discipline Specific Elective I	2	2	6.6 Discipline Specific Elective III	2	2
1.7 Skill Enhancement Course SEC-1	2	3	2.7 Skill Enhancement Course SEC-2	1	3	3.7 Skill Enhancement Course SEC-4,	1	2	4.7 Skill Enhancement Course SEC-6	3	3	5.7 Value Education	2	2	6.7 SEC-8 Professional Competency Skill	2	2
1.8 Skill Enhancement - (Foundation Course)	2	3	2.8 Skill Enhancement Course – SEC-3	1	2	3.8 Naan Mudalvan	2	2	4.8 Skill Enhancement Course SEC-7	2	2	5.8 Project with viva- voce	3	4	6.8 Extension Activity	1	
			2.9 Naan Mudalvan	2	2	3.9 E.V.S.	2	2				5.9 Summer internship / Industrial Training	2	-			
	22	**32**		**24**	**32**		**23**	**32**		**25**	**32**		**25**	**30**		**21**	**30**
Total – 140 Credits																	

Consolidated semester wise and component wise Credit Distribution

Parts	SEM I	SEM II	SEM III	SEM IV	SEM V	SEM VI	Total Credits
Part I	3	3	3	3			**12**
Part II	3	3	3	3			**12**
Part III	12	14	12	14	21	18	**91**
Part IV	4	4	5	5	4	2	**24**
Part V						1	**1**
TOTAL	**22**	**24**	**23**	**25**	**25**	**21**	**140**

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

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	

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 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	4	4
Elective Course EC 3	**Generic Elective** Part -III - Allied: Chemistry Paper – I	3	3
	Part -III -Allied Practical Chemistry -I	2	-
Skill Enhancement Courses SEC 4	Herbal Technology	2	1
Nan Mudalvan	Nan Mudalvan	2	2
Part IV	Environmental studies	2	2
Total		**32**	**23**
SEMESTER IV	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial**	**CREDIT**
Part I Part II	Language –Tamil – Paper IV	6	3
	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	4	4
Elective Course EC 4	**Generic Elective** Part -III - Allied: Chemistry Paper – IV	4	2
	Allied Chemistry Practical - II	2	1
Skill Enhancement Courses SEC 6	Fermentation Technology	3	3
Skill Enhancement Courses SEC 7	Environmental impact analysis	2	2
Total		**32**	**23**

SEMESTER V	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part III Core IX	Part - III - Core - Plant Morphology, Taxonomy and Economic Botany	5	4
Core X	Practical covering - Core – IX Plant Morphology, Taxonomy And Economic Botany - Practical-V	4	3
Core XI	Part - III - Core - Plant Anatomy and Embryology	4	3
Core XII	Part - III - Core - Cell Biology, Genetics and Plant Breeding	5	3
Core XIII	Part - III - Practical covering – Core XI and XII- Practical VI	4	3
Elective course	EC I **Decipline specific** 1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial Botany	2	2
Project	Project with Viva-voce	4	3
Part IV	Value Education	2	2
Internship/ Training	Summer Internship or industrial Training (40 Hrs)		2
Total		**30**	**25**
SEMESTER VI	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial**	**CREDIT**
Core XIV	Part - III - Core – Plant Ecology and Phytogeography	6	4
Core XV	Part - III - Core - Plant Biotechnology and Molecular Biology	6	3
Core XVI	Part - III - Core -Plant Physiology and Plant Biochemistry	6	3
Core XVII	Part - III - Practical covering – Core XIV, XV and XVI - Practical-VII	4	3
Elective Course	**EC II- Decipline specific** 1. Horticulture 2. Natural Resource Management 3. Forestry	4	3
Elective Course	**ECIII – Decipline specific** 1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	2	2
Skill Enhancement Courses Professional Competency Enhancement	**SEC 8** Training for Competitive examinations • Botany for Competitive examinations (2 hours) • General Studies for Competitive examinations (2 hours)	2	2
Part V	Extension activity	-	1
Total		**30**	**21**
	TOTAL CREDITS	**----**	**140**

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

CORE-V PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	**PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES**						
Paper Number	**CORE V**						
Category	**Core**	**Year**	**II**	**Credits**	**5**	**Course Code**	
		Semester	**III**				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		3	**2**	**-**	**5**		
Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.						

Learning Objectives	
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.
C3	To know the evolution of Bryophytes and Pteridophytes.
C4	To understand the economic importance of the Bryophytes and Pteridophytes.
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Recognize morphological variations of Bryophytes and Pteridophytes.	K1
2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2
3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	K3
4. Decipher the stages of plant evolution and their transition to land habitat.	K4
5. Access the useful role of Bryophytes and Pteridophytes.	K5

UNIT	**EXPERIMENTS**
I	**BRYOPHYTES** General characters of Bryophytes, classification (Watson, 1971) (up to family). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Riccia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*). Evolution of Bryophytes
III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homospory and heterospory.
IV	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*). (Examples may be changed according to the availability of the specimens).
V	Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance of Pteridophytes.
Extended ProfessionalComponent (is a part	Questions related to the above topics, from various

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

Recommended Texts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.

Reference Books

1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad.
3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson *&* Co, UK.
6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Central Book Depot, Allahabad.

Web Resources:

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

Mapping with Programme Outcomes:

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

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

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

Title of the Course	**PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III**						
Paper Number	**CORE VI**						
Category	**Core**	**Year**	**II**	**Credits**	**5**	**Course Code**	
		Semester	**III**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	**-**	**3**	**4**

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

Learning Objectives	
C1	To enable students gain expertise in hand sectioning technique.
C2	To study diversity of Bryophytes and Pteridophytes.
C3	To understand the anatomical structure of the Bryophytes and Pteridophytes.
C4	Develop comprehensive skills in sectioning and micro preparation.
C5	Describe the structure of fossil forms prescribed in the syllabus.

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

EXPERIMENTS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida (*Riccia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*)

Pteridophytes

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

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

	discussed during the Tutorial hour).
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.

Reference Books

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi.
4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai.
5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.

Web resources

1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4
2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html
4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual
5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Mapping with Programme Outcomes:

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

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

CORE-VII PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AN EVOLUTION

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**						
Paper Number	**CORE VII**						
Category	**Core**	**Year**	**II**	**Credits**	**5**	**Course Code**	
		Semester	**IV**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**1**	**-**	**5**

Pre-requisite	Students should know about the fundaments of Gymnosperms, fossil records and evolution.

Learning Objectives	
C1	To enable the students to understand thallus organization,
C2	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
C3	to acquaint students with evidences of the past history of plant groups and significance of the fossilization.
C4	To know the scope of pleobotany, types of fossils and geological time scale.
C5	Understand the various fossil genera representing different fossil groups.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the general characteristics of Gymnosperms and fossil forms	K1
2. Explain about the morphology and anatomy Gymnosperms.	K2
3. Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3
4. Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	K4
5. Determine the various fossilization methods and their significance in paleobotany.	K5

UNIT	**CONTENTS**
I	**GYMNOSPERMS** Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
II	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).
III	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni

IV	**PALEOBOTANY** Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.

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

Recommended Texts

1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra.
2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi.
3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi.
5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Reference Books

1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi.
2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.
3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.
5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Web Resources

1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false
2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC
4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
5. https://www.palaeontologyonline.com/

Mapping with Programme Outcomes:

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

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

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

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV**						
Paper Number	**CORE VIII**						
Category	**Core**	**Year**	**II**	**Credits**	**5**	**CourseCode**	
		Semester	**IV**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	**-**	**2**	**3**

Pre-requisite	Students should be familiar with the fundamentals of Gymnosperms, Paleobotany.

Learning Objectives	
C1	To enable students observe and record the morphological features of selected species of Gymnosperms.
C2	To enable students observe and record the anatomical features of selected species of Gymnosperms.
C3	To develop the skill of preparation of microslides of the gymnosperm samples.
C4	To enable students to gain insights into the basics of paleobotany and methods of fossilization.
C5	To understand the anatomy of the fossil plants through microscopy.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Analyze and observe and record the morphological features of selected species of Gymnosperms..	K1
2. Describe the structure of fossil forms prescribed in the syllabus.	K2
3. Identify and Illustrate the morphological and anatomical features of gymnosperms.	K3
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in gymnosperms.	K5

EXPERIMENTS

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

2. Identifying the micro slides relevant to the syllabus.

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

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

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 competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

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

Recommended Texts

1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.

Reference Books

1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.
2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.

Web resources

1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv =1&dq=gymnosperms&printsec=frontcover
2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721
3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996
5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

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

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

CORE IX : PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	**CORE IX**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**CourseCode**	
		Semester	**V**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**1**	**-**	**5**
Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.			

Learning Objectives

C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
C2	Students will know about the basic concepts of classification of plants.
C3	Understand major evolutionary trends in Angiospermic plants.
C4	To know the characteristic features of the selected families.
C5	To know the economic importance of plants.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1
2. Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2
3. Describe the core concepts of economic Botany and relate its applications in human life.	K3
4. Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
5. Assess terms and concepts related to Phylogenetic Systematics.	K5

UNIT	**CONTENTS**
I	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.
II	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, an overview of APG Classification. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.
III	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae,

IV	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 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

Recommended Texts

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

Reference Books

1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London.
2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta
3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh.
4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.
5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London.
6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.
7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.

Web Resources

1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y
2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y
3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y
5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

Mapping with Programme Outcomes:

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

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

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

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-PRACTICAL-V**						
Paper Number	**CORE X**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**CourseCode**	
		Semester	**V**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	**-**	**3**	**4**

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

Learning Objectives	
C1	To study morphological characters of the families.
C2	Able to describe the plant technically using the floral characteristics.
C3	To preserve the plants and prepare herbarium sheets.
C4	To be able to identify the local flora.
C5	To understand the economic importance of the plants.

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

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.

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.

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

Recommended Texts

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.
4. Pandely, B.P. 1987. Taxonomy of Angiosperms.
5. Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.

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.
2. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
3. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
4. 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	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO 2	3	3	2	2	3	3	2	3	2	2
CO 3	2	2	3	3	1	2	1	2	3	3
CO 4	3	3	3	3	3	2	3	3	3	3
CO 5	3	3	2	3	2	3	3	3	2	3

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

CORE XI PLANT ANATOMY AND EMBRYOLOGY

Title of the Course	**PLANT ANATOMY AND EMBRYOLOGY**						
Paper Number	**CORE XI**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**V**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**1**	**-**	**5**

Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.

Learning Objectives	
C1	To know fundamental concepts of plant anatomy and embryology.
C2	To understand the internal tissue organization of various plant organs.
C3	To differentiate normal and abnormal secondary growth.
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.
C5	To know embryology of plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1
2. Describe the internal tissue organization of various plant organs.	K2
3. Elucidate the stages of normal and abnormal secondary growth.	K3
4. Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
5. Access the various anatomical adaptations in plants.	K5

UNIT	**CONTENTS**
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in oot and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- *Boerhaavia, Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule**,** types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac.

V	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

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

Recommended Texts

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

Reference Books

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA.
8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.
9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi.

Web Resources

1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2
2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy
3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-

ebook/dp/B00UN5KPQG
5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811
6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y.

Mapping with Programme Outcomes:

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

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

CORE XII CELL BIOLOGY, GENETICS AND PLANT BREEDING

Title of the Course	**CELL BIOLOGY, GENETICS AND PLANT BREEDING**					
Paper Number	**CORE XII**					
Category	**Core**	**Year**	**III**	**Credits**	**5**	**CourseCode**
		Semester	**V**			

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	4	**1**	**-**	**5**

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

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

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

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

III	Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalaba.* Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex determination in plants.
IV	Sex linked inheritance – Haemophilia and colour blindness. Polyploidy origin, types and significance. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation . Extra nuclear inheritance and its significance - Male sterility in corn , Maternal inheritance – Plastid Inheritance in *Mirabilis jalaba*. Genetics of *Neurospora*. Population genetics – Hardy – Weinberg principle.
V	Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects. Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.

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

Recommended Texts

1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55.
2. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.
3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.
4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.
5. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.

Reference Books

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.
4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.
7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.

8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.

Web Resources

1. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html
2. https://www.us.elsevierhealth.com/medicine/cell-biology
3. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A
4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html
5. https://www.us.elsevierhealth.com/medicine/genetics
6. https://libguides.uthsc.edu/genetics/ebooks
7. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding
8. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson

Mapping with Programme Outcomes:

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

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

CORE XIII COVERING PRACTICAL COVERING – CORE XI AND XII- PRACTICAL-VI

Title of the Course	**PRACTICAL-VI**						
Paper Number	**CORE XIII**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**CourseCode**	
		Semester	**V**				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		1	**-**		**3**	**4**	
Pre-requisite	Theoretical understanding of anatomy, embryology, cell biology, genetics and plant breeding as well as basic laboratory skills for the relevant core course.						

Learning Objectives	
C1	To study the anatomy of the plant organs using various techniques.
C2	To study the embryology of the plant.
C3	To identify the structure of various cell organelles.
C4	To understand genetics through problem solving.
C5	To study various plant breeding techniques.

Course outcomes: On completion of this course, the students will be able to:**CO**	**Programme Outcomes**
1. Identify the structure of cell organelles and stages of cell division.	K1
2. Classify the types of stomata and ovules.	K2
3. Compare the functions of various ergastic substances present in plant tissues.	K3
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K4
5. Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	K5

EXPERIMENTS

Anatomy

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

Embryology

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

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

Cell biology

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

Genetics

1. Genetic problems – test cross, back cross and allelic interaction.
2. Construction of chromosome map – three point test cross
3. Multiple alleles problems.

Plant Breeding

1. Emasculation technique.
2. To test the viability of seeds using Tetrazolium chloride.
3. Genetic models of heterosis.
4. Phenotype of heterosis (Maize).

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

Recommended Texts

1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut.
5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.

Reference Books

1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.
3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall.
4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.
6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises

for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
Web resources 1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509 2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_ Em.html?id =Cq1KPwAACAAJ&redir_esc=y 3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219 4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X 5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498

Mapping with Programme Outcomes:

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

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

CORE XIV PLANT ECOLOGY AND PHYTOGEOGRAPHY

Title of the Course	**PLANT ECOLOGY AND PHYTOGEOGRAPHY**						
Paper Number	**CORE XIV**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		4		**1**	**-**	**5**	
Pre-requisite		Understanding the environmental factors impacting biodiversity is crucial after taking this course.					

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

Course outcomes: On completion of this course, the students will be able to:**CO**	**Programme Outcomes**
1. Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1
2. Summarize the phytogeographical division of India.	K2
3. Explain the implication of pollution on the environment.	K3
4. Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.	K4
5. Develop mitigations for the effective conservation of biodiversity and disaster management.	K5

Unit	**CONTENTS**
I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*).
IV	**Pollution:** Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.
	Phytogeography Introduction, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators.

V	Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance. Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation (*In situ* and *ex situ* methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.
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

Recommended Texts

1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.

Reference Books

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.
9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.

Web Resources

1. https://www.kobo.com/us/en/ebook/plant-ecology-3.
2. https://www.worldcat.org/title/plant-ecology/oclc/613206385
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP 5.
http://www.freebookcentre.net/Biology/Ecology-Books.html
6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X

7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity)
8. https://link.springer.com/journal/11258 (Plant Ecology)

Mapping with Programme Outcomes:

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

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

CORE XV PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

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

Learning Objectives

C1	To know 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.

Course outcomes: On the completion of the course the students will be able to: **CO:**	**Programme Outcomes**
1. Recognize the fundamentals concepts of plant biotechnology and genetic engineering.	K1
2. Explain various steps in transcription, protein synthesis and protein modification.	K2
3. Elucidate gene cloning and evaluate different methods of gene transfer.	K3
4. Analyze the major concerns and applications of transgenic technology.	K4
5. Develop their competency on different types of plant tissue culture.	K5

UNIT	**CONTENTS**
I	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (*Aspergillus niger*) and Proteases production (*Bacillus sps*).
II	Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropogation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, *Agrobacterium* mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.

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

Recommended Texts

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

Reference Books

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

Web Resources

1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html
2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C
3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1
5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183
6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html
7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3

Mapping with Programme Outcomes:

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

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

CORE XVI PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**						
Paper Number	**CORE XVI**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**VI**				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	4	**1**	**-**	**5**			
Pre-requisite	Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.						

Learning Objectives	
C1	To relate to water relation of plants with respect to various physiological phenomenon.
C2	To know the pathways of photosynthesis.
C3	To familiarize with respiration and nitrogen metabolism.
C4	To know about plant growth regulators.
C5	To familiarize with plant biochemistry.

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

UNIT	**CONTENTS**
I	**WATER RELATIONS:** Properties of water—imbibition, diffusion, osmosis and plasmolysis- ascent of sap, mechanism of water absorption – active and passive, apoplast and symplast pathway. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of transpiration.
II	**PHOTOSYNTHESIS:** Radiant energy, Photosynthetic unit, photosynthetic pigments and their role, photo systems, path of carbon in photosynthesis - Light reaction, electron transport system in the chloroplast (Z-Scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespiration
III	**RESPIRATION** Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient. **NITROGEN METABOLISM** Biological nitrogen fixation, nitrogen cycle.

IV	**GROWTH:** Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid) - Practical applications - Photo morphogenesis – photoperiodism – vernalization – dormancy- phytochromes. **Stress Physiology:** Concepts of plant responses to stresses (water, salt, temperature).
V	**PLANT BIOCHEMISTRY:** Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper).	Questions related to the above topics, from various 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

Recommended Texts

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

Reference Books

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

Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.

Web Resources

1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants
2.https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6
3. https://www.kobo.com/us/en/ebook/plant-biochemistry
4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1
5.https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA
6.https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692
7.https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

Mapping with Programme Outcomes:

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

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

CORE XVII PRACTICAL COVERING – CORE XIV, XV AND XVI - PRACTICAL-VII

Title of the Course	**PRACTICAL-VII**						
Paper Number	**CORE XVII**						
Category	**Core**	**Year**	**III**	**Credits**	**5**	**Course Code**	
		Semester	**VI**				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	**-**	**3**	**4**

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

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the distribution and adaptions of plants pertaining to their habitat	K1
2. Demonstrate skills in green planning and callus culture.	K2
3. Elucidate the basic principles involved in the plant physiology and biochemistry experiments.	K3
4. Appreciate the structure and functions of DNA and RNA.	K4
5. Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.	K5

EXPERIMENTS

Plant Ecology and Phytogeography

1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.
   - Hydrophytes : *Nymphaea, Hydrilla*
   - Xerophytes : *Nerium, Casuarina*
   - Mesophytes : *Tridax, Vernonia*
   - Halophytes : *Avicennia, Rhizophora*
   - Epiphytes : *Vanda*

2. Map of the phytogeographical regions of India.
3. Quadrate study and line transect.
4. Plan for a green building.
5. Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub jungle/Pallikaranai Marsh/Siruthavur Scrub/Vedanthangal Bird Sanctuary/Kelampakkam Marsh/Adyar Poonga).

Plant 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

Plant Physiology and Plant Biochemistry

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

Biochemical test for carbohydrates, proteins and lipids

Demonstration – Experiments

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

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

Recommended Texts

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

Reference Books

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

Web resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE EC -I
1.BIO-ANALYTICAL TECHNIQUES

Title of the Course	**BIO-ANALYTICAL TECHNIQUES**					
Paper Number	**Elective**					
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**CourseCode**
		Semester	**V**			
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	
		2	**-**	**-**	**2**	
Pre-requisite	To impart expertise about analysis and research.					

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the various biological techniques and its importance.	K1
2. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	K2
3. Apply suitable strategies in data collections and disseminating research findings.	K3& K6
4. Compare and contrast the significance of different types of chromatography techniques.	K4
5. Develop methodologies for extraction and analysis of biochemical compounds.	K5

UNIT	**CONTENTS**
I	**I MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.

II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	**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 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

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

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

ELECTIVE EC -I
2. AQUATIC BOTANY

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

Learning Objectives	
C1	To give an overview of the distribution of lower plants forms and its ecological significance.
C2	To enable students to understand the ecological functions and economic uses of aquatic plants.
C3	To equip students to collect, analyze and identify the planktons.
C4	To give an exposure to various forms seaweeds.
C5	To know about the values and uses of aquatic plants..

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize aquatic plants and their ecological importance.	K1
2. Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
3. Apply techniques for conservation of aquatic plants for value addition.	K3
4. Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
5. Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.	K5 & K6

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

III	**PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS:** Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.
IV	**AQUATIC ANGIOSPERMS:** Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
V	**VALUES AND USES OF AQUATIC PLANTS:** Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.

Extended 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

Recommended Texts

1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge.
2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International.
3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.
5. Daubenmire, R.F.1973. Plant and Environment. John Willey.
6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi.
7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.

Reference Books

1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited.

2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands.

3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp.

4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp.

5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp.

6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.

Web Resources

1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf

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

Mapping with Programme Outcomes:

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

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

ELECTIVE EC -I

3. ENTREPRENEURIAL BOTANY

Title of the Course	**ENTREPRENEURIAL BOTANY**					
Paper Number	**Elective**					
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**CourseCode**
		Semester	**V**			
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	
		2	**-**	**-**	**2**	
Pre-requisite		To develop innovative ideas to exploit the economically useful plant products for commercial purposes.				

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

Course outcomes: On completion of this course, the students will be able to:CO	**Programme Outcomes**
1. Recognize the significance of government agencies for entrepreneurship development.	K1
2. Explain about entrepreneurial values, risk assessment and solutions	K2
3. Make use of entrepreneurial opportunities.	K3
4. Analyze and decipher the significance of bioventure and value added products.	K4
5. Devise innovative methods for making value added products.	K5 & K6

UNIT	**CONTENTS**
I	**INTRODUCTION:** Need - definition and concept - Types and characterization - entrepreneurial values-motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
II	**BIOVENTURE:** Industry - overview of *Spirulina*, *Pleurotus*, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	**VALUE ADDED PRODUCTS:** Canning of fruits - process and equipment, fruit and vegetable based products (squash) - ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and

	jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.
IV	**ORGANIZATIONS AND AGENCIES:** TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurshoip – various government schemes.
V	**ENTREPRENEURIAL OPPORTUNITIES:** Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), steps in filing patents, trademarks and copyright, Intellectual Property Rights, export and import license.

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

Recommended Texts

1. Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New venture creation, Galgeha publication company, New Delhi.ISSN: 2321-8916.
2. Desai,V.,2015. Entrepreneurship development, First edition.Himalaya publication house, Mumbai. ISBN:9789350973837.
3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand company limited, New Delhi.ISBN:9788121918015.
4. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10th ed).Rastogi Publications, Meerut.
5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.

Reference Books

1. Manohar,D.1989. Entrepreneurship of small scale industries,vol.III.Deepanddeep publication, New Delhi. ISSN: 09735925.
2. Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservation of fruits and vegetables. Indian Council of Agricultural Research (ICAR). ISSN:0101-2061.
3. Ranganna,S.,2001.Handbook of analysis and quality control of fruits and Vegetable products, Second edition, Tata Mc Graw hill, New Delhi.ISBN: 780074518519.
4. Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, Meerut.
5. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co.New Delhi.

Web resources

1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entrepreneurship/

2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/value-added-products-microalgae-faizal-bux
3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3
4. https://www.elsevier.com/books/value-addition-in-food-products-and-processing-through-enzyme-technology/kuddus/978-0-323-89929-1
5. https://www.oreilly.com/library/view/selling-today-partnering/9780134477404/xhtml/fileP700101194000000000000000001DEB.xhtm

Mapping with Programme Outcomes:

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

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

ELECTIVE-EC-II

1. HORTICULTURE

Title of the Course	HORTICULTURE					
Paper Number	Elective					
Category	Elective	Year	III	Credits	2	CourseCode
		Semester	V			

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

Pre-requisite	Students should know fundamental knowledge on horticulture applications.

Learning Objectives	
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.
C3	To know about hydroponic culture.
C4	To develop the various horticultural crop protection.
C5	To impart the knowledge on market preparation.

Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes
1. Enumerate the concepts in horticulture and nursery management.	K1
2. Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.	K2
3. Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
4. Analyze different methods of weed control in horticultural crops.	K4
5. Develop their competency on pre and post-harvest technology in horticultural crops.	K5 &K6

UNIT	CONTENTS
I	Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (greenhouses), environment controls.
II	Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural

	crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.
III	Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation - cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
IV	A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.
V	Technology of horticultural crops - market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and canning, drying and chemical preservation.

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

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

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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.

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

Mapping with Programme Outcomes:

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

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

ELECTIVE EC-II

2. NATURAL RESOURCE MANAGEMENT

Title of the Course	**NATURAL RESOURCE MANAGEMENT**					
Paper Number	**Elective**					
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**CourseCode**
		Semester	**V**			
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	
		2	**-**	**-**	**2**	
Pre-requisite	To understand the concept of different natural resources and their utilization.					

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

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

UNIT	**CONTENTS**
I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.
II	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.
III	Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate

	energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, new prospects.
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
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

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.

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2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
4. https://www.kobo.com/us/en/ebooks/natural-resources
5. https://www.igi-global.com/chapter/natural-resources-management/195183
6. 6crLIC&redir_esc=y
7. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
8. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
9. https://www.kobo.com/us/en/ebooks/natural-resources
10. https://www.igi-global.com/chapter/natural-resources-management/195183

Mapping with Programme Outcomes:

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

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

ELECTIVE EC- II

3. FORESTRY

Title of the Course	**FORESTRY**					
Paper Number	**Elective**					
Category	**Elective**	**Year**	**II**	**Credits**	**2**	**CourseCode**
		Semester	**VI**			
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	
		2	**-**	**-**	**2**	
Pre-requisite	Prior knowledge on trees, forests and their importance.					

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	K1
2. Understand complex interactions of humans and forest ecosystems in a global context.	K2
3. Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
4. Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation	K4
5. Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	K5 & K6

UNIT	**CONTENTS**
I	**SILVICULTURE:** Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu - revised classification - pure and mixed stands - even and uneven aged stands. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.
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.

	Forest inventory - sampling techniques and methods - measurement of crops - sample plots. 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. Recent trends in logging - Ergonomics and RIL. Forest products - Timber - timber, fuel, pulp, paper, rayon and match. Wood Composites - plywood, particle board, fiber boards, MDF, hardboard, insulation boards - production technology. Non timber forest products (NTFP) - collection - processing and storage of NTFP - fibres and flosses - bamboos and canes - katha and bidi leaves - essential oils and oil seeds - gums and resins - tans and dyes - drugs - insecticides - lac and shellac - tassar silk - role of tribal co-operative societies.
IV	**FOREST BIOLOGY AND BOTANY:** Forest ecology - definition - biotic and abiotic components - forest ecosystem - forest community - concepts - succession - primary productivity - nutrient cycling. Composition of forest types in India - classification of India's forests - species composition - association and diversity. Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation. Biodiversity - Definition, origin, types - factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book. Biodiversity assessments - principles and methods.
V	**FOREST BOTANY:** Importance of 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. Seed production Area and seed orchards - types and establishment. In situ and ex situ gene conservation. Exotics - role of exotic forest trees in India - application of biotechnological methods in forestry. **AGRO FORESTRY AND SOCIAL FORESTRY:** Agro forestry - definition, concept and objectives. Classification of agro forestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of agro forestry - 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. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry.

	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

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 the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia.
6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. WertzKanounnikoff. 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.

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

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

ELECTIVE-EC-III

1. BIONANOTECHNOLOGY

Title of the Course	BIONANOTECHNOLOGY					
Paper Number	Elective-III					
Category	Elective	Year	III	Credits	2	Course Code
		Semester	VI			

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

Pre-requisite	To provide an insight into the principles of nanotechnolgoy in biological and medical research.
Learning Objectives	
C1	To provide students with comprehensive knowledge of basics in nanotechnology.
C2	To enable the students understand and appreciate the various applications of nanoparticles.
C3	To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.
C4	To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.
C5	To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology	K1
2. Explain the synthesis of nanomaterials and their applications.	K2
3. Apply the knowledge gained to develop nanomaterials	K3
4. Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.	K4
5. Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6

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

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.

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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.

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

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

ELECTIVE EC-III

2. COMPUTER APPLICATIONS IN BOTANY

Title of the Course	**COMPUTER APPLICATIONS IN BOTANY**						
Paper Number	**Elective-III**						
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**CourseCode**	
		Semester	**VI**				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**-**		**-**	**2**	
Pre-requisite		To equip students with computational skills for drug design.					

Learning Objectives	
C1	To familiarize the student with the fundamentals concepts of bioinformatics.
C2	To equip students with computational skills for drug design.
C3	To learn about the bioinformatics database, data format and data retrieval from online sources.
C4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.
C5	Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.

Course outcomes: On completion of this course, the students will be able to:CO	**Programme Outcomes**
1. Recognize advanced resources for accessing scholarly literature from the internet.	K1
2. Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.	K2
3. Apply various software resources with advanced functions to carry out analysis of data procured through research.	K3
4. Decipher the effective utilization of bibliography management software while typing and downloading citations.	K4
5. Determine how the knowledge gained can be used for designing experiments and data interpretation.	K5 & K6

UNIT	**CONTENTS**
I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media
II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.

III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.
V	**Applications:** Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS.Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).

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

Recommended Texts

1. 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. https://www.ebooks.com/en-us/subjects/computers/
2. http://www.agrimoon.com/introduction-to-computer-applications-pdf-book/
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	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3	1	3	3		
CO 2	3	3	3	2	1	3	3	2		
CO 3	3	3	3	1	2	1	3	2		
CO 4	3	3	3	1	2	1	3	2		
CO 5	3	3	3	1	2	1	3	2		

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

ELECTIVE-III
3. FORENSIC BOTANY

Title of the Course	**FORENSIC BOTANY**						
Paper Number	**Elective-III**						
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**Course Code**	
		Semester	**VI**				

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

Pre-requisite	The course will provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.

Learning Objectives	
C1	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.
C3	To learn classification of plants from forensic point of view.
C4	To understand forensic importance of different parts of plants.
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1
2. Summarize the forensic importance of different parts of plants.	K2
3. Apply techniques for the collection and preserve of botanical evidences of crime.	K3
4. Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
5. Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6

UNIT	**CONTENTS**
I	General plant classification schemes, Sub specialization of forensic botany-plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.
II	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man–made and natural

	fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
III	Various types of poisonous plants: *Abrus precatorius*, *Aconitum napellus*, *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Claviceps purpuria*, *Croton tiglium*, *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana tabacum*, *Strychnos nux vomica*, *Thevetia nerifolia*. Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, *Psilocybin* mushrooms.
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.
V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper).	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour).
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts

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

Reference Books

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

Web Resources

1. https://www.kobo.com/us/en/ebook/forensic-botany
2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574
3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/

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

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 4

HERBAL TECHNOLOGY

Title of the Course	**HERBAL TECHNOLOGY**						
Paper Number	**Skill Enhancement-4**						
Category	**Elective**	**Year**	**II**	**Credits**	**1**	**CourseCode**	
		Semester	**III**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		**-**	**-**	**2**	
Pre-requisite	To understand the importance of herbal technology.						

Learning Objectives	
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
C4	To apply the knowledge to cultivate medical plants.
C5	To know the pharmacological importance of medicinal plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Define and describe the principle of cultivation of herbal products.	K1
2. List the major herbs, their botanical name and chemical constituents.	K2
3. Apply techniques for monitoring drug adulteration through the biological testing.	K3
4. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
5. Develop the skills for cultivation of plants and their value added processing / storage	K5& K6

UNIT	**CONTENTS**
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and 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 Gooseberry, Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalmegh, Giloe (Tinospora), Saravar.

	Herbal foods, future of pharmacognosy.
IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (*Withania somnifera*, neem and tulsi),
Extended 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

Recommended Texts

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

Reference Books

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

Web resources

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE
3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural- healing/herbal-medicine/_/ N-ry0Z8qaZ11iu
4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
5. https://www.dattanibookagency.com/books-herbs-science.html
6. https://www.springer.com/gp/book/9783540791157

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 6

FERMENTATION TECHNOLOGY

Title of the Course	**FERMENTATION TECHNOLOGY**						
Paper Number	**Skill Enhancement**						
Category	**Elective**	**Year**	**II**	**Credits**	**1**	**Course Code**	
		Semester	**IV**				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		1	**-**	**-**	**1**		
Pre-requisite	To students to know about the various fermentation technology.						

Learning Objectives

C1	To appreciate the significance of microbes synthesizing fermented products.
C2	To gain insights 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.

Course outcomes: On completion of this course, the students will be able to:CO	**Programme Outcomes**
1. Enumerate the significance of industrially useful microbes.	K1
2. Explain the design and operation of industrial practices in mass production of fermented products.	K2
3. Explain the process of maintenance and preservation of microorganisms.	K3
4. Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
5. Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6

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

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

Recommended Texts

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

Reference Books

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.

2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.

3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.

4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.

5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK.

6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY.

7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.

Web resources

1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ
3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W
4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html
5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 7

ENVIRONMENTAL IMPACT ANALYSIS

Title of the Course	**ENVIRONMENTAL IMPACT ANALYSIS**						
Paper Number	**Skill Enhancement**						
Category	**Elective**	**Year**	**II**	**Credits**	**1**	**Course Code**	
		Semester	**IV**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		1		**-**	**-**	**1**	
Pre-requisite		To students to know about the environmental impact assessment.					

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.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Enumerate the fundamental concepts and significance of environmental impact assessment.	K1
2. Explain the important steps of EIA process.	K2
3. Interpret the environmental appraisal and procedures in India.	K3
4. Decipher how to prepare the various documents required by state and federal regulations.	K4
5. Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6

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. Public participation.
V	Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.
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

Text Books

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

Title of the Course	**BOTANY FOR COMPETITIVE EXAMINATIONS**						
Paper Number	**Skill Enhancement**						
Category	**Elective**	**Year**	**III**	**Credits**	**2**	**Course Code**	
		Semester	**V**				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		**-**	**-**	**2**	
Pre-requisite		To develop the students for preparing various competitive examination.					

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.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Identify and define different groups of plants with their taxonomic position Compare the different groups of plants and evaluate their economic importance	K1, K2 & K5
2.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	K1,K3 & K5
3.Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.	K3 & K5
4.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.	K2, K3 & K5
5. Define and appreciates biodiversity. Identify the cause and solve environmental related issues . Design eco friendly approaches to protect earth and generate new conservation strategies.	K1, K5 & K6
GENERAL STUDIES FOR COMPETITIVE EXAMINATIONS (2 hours)	

Physical Geography
Indian and World Geography
Indian and World History
International Organizations
Everyday Science
Awards and Honors
Indian Economy
Indian Polity

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
V	**ECOLOGY AND BIODIVERSITY:** Ecosystem – abiotic and biotic components. Energy flow in an ecosystem, Aforestation, Deforestation- Chipko movement –-Forest Conservation act- Pollution 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

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

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