B.Sc., BOTANY

SYLLABUS

FROM THE ACADEMIC YEAR

2023-2024

TAMILNADU STATE COUNCIL FOR

HIGHER EDUCATION, CHENNAI – 600 005

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 inwriting 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 andreflexivity of both self and society.

PO10 Information/digital literacy: Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data.

PO 11 Self-directed learning: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion.

PO 12 Multicultural competence: Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.

PO 13: Moral and ethical awareness/reasoning: Ability toembrace moral/ethical values in conducting one's life, formulate a position/argument about an ethical issue from multiple perspectives, and use ethical practices in all work. Capable of demonstratingthe ability to identify ethical issues related to one‟s work, avoid unethical behaviour such as fabrication, falsification or misrepresentation of data or committing plagiarism, not adhering to intellectual property rights; appreciating environmental and sustainability issues; and adopting objective, unbiased and truthful actions in all aspects of work.

PO 14: Leadership readiness/qualities: Capability for mapping out the tasks of a team or an organization, and setting direction, formulating an inspiring vision, building a team who can help achieve the vision, motivating and inspiring team members to engage with that vision, and using management skills to guide people to the right destination, in a smooth and efficient way.

PO 15: Lifelong learning: Ability to acquire knowledge and skills, including „learning how to learn‟, that are necessary for participating in learning activities throughout life, through self-paced and self-directed learning aimed at personal development, meeting economic, social and cultural objectives, and adapting to changing trades and demands of work place through knowledge/skill development/reskilling.

ProgrammeSpecific 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 contentwherever required.
- The Core subjects include latest developments in the education and scientific front, advancedprogramming 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 providemore job opportunities for the students.
- The Statistical Quality Control course is included to expose the students to real life problemsand 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 anedge 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 thelatest 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 makethem employable
		• Training on Computing / Computational skills enable the students gain knowledge and exposureon latest computational aspects
		• Data analytical skills will enable students gain internships, apprenticeships, field work involvingdata collection, compilation, analysis etc.
		• Entrepreneurial skill training will provide anopportunity 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 ICTtools
III, IV, V & VI	**Elective papers-** An open choice of topicscategorized underGeneric 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
IIyear Vacation activity	Internship / IndustrialTraining	• 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 isconceived 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 fromthe Courses		Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	13	13	22	18	92
Part IV	4	4	3	6	4	1	22
Part V	-	-	-	-	-	2	2
Total	23	23	22	25	26	21	**140**

*Part I. II, and Part III components will be separately taken into account for CGPA calculation and classification for the under graduate programme and the other components. IV, V haveto be completed during 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) tothe minimum.

The S, M, L is based on the Course outcomes. The mapping is based on the revised Bloom'sTaxonomy Verbs used to describe your Course outcomes.

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

ALAGAPPA UNIVERSITY, KARAIKUDI
NEW SYLLABUS UNDER CBCS PATTERN (w.e.f.2023-24)
UG– Botany-PROGRAMME STRUCTURE

Sem	Part	Courses	Course Code	Title of the Paper	T/P	Cr	Hrs/ Week	Max. Marks		
								Int	Ext	Total
I	I	T/OL	2311T	தமிழ் இலக்கிய வரலாறு-I /Other Languages -I	T	3	6	25	75	100
	II	E	2312E	General English – I	T	3	6	25	75	100
	III	CC-I	23BBO1C1	Plant Diversity I –Algae	T	4	5	25	75	100
		CC-II	23BBO1P1	Plant Diversity I-Algae Practical	P	4	4	25	75	100
		Generic Elective (Allied)	--	Zoology/ Chemistry/ Microbiology/ Biotechnology	T	3	3	25	75	100
			--	Respective Allied Theory Practical-I	P	2	2	25	75	100
	IV	SEC -I	23BBO1S1/ 23BBO1S2/ 23BBO1S3	A. Organic farming B. Environmental Biotechnology C. Nursery and Landscaping	T	2	2	25	75	100
		Foundation Course	23BBO1FC	Basics of Botany	T	2	2	25	75	100
				Total		**23**	**30**	**200**	**600**	**800**
II	I	T/OL	2321T	தமிழ் இலக்கிய வரலாறு-2 /Other Languages-II	T	3	6	25	75	100
	II	E	2322E	General English - II	T	3	6	25	75	100
	III	CC-III	23BBO2C1	Plant Diversity II –(Fungi, Bacteria, Viruses, Plant pathology and Lichens)	T	4	5	25	75	100
		CC-IV	23BBO2P1	Plant Diversity II —(Fungi, Bacteria, Viruses, Plant pathology and Lichens) Practical	P	4	4	25	75	100
		Generic Elective (Allied)	--	Zoology/ Chemistry/ Microbiology/ Biotechnology	T	3	3	25	75	100
			--	Respective Allied Theory Practical-I	P	2	2	25	75	100
	IV	SEC -II	23BBO2S1/ 23BBO2S2/ 23BBO2S3	A. Mushroom cultivation B. Herbal Medicine C. Global Climate change	T	2	2	25	75	100
		SEC-III	23BBO2S4	Botanical Garden and Landscaping	T	2	2	25	75	100
				Naan Mudhalvan Course						
				Total		**23**	**30**	**200**	**600**	**800**
III	I	T/OL	2331T	**தமிழக வரலாறும் பண்பாடும்** /Other Languages-III	T	3	6	25	75	100
	II	E	2332E	General English – III	T	3	6	25	75	100
	III	CC-V	23BBO3C1	Plant Diversity III -Bryophytes and Pteridophytes	T	4	5	25	75	100
		CC-VI	23BBO3P1	Plant Diversity III –Bryophytes and Pteridophytes Practical	P	4	4	25	75	100
		Generic Elective (Allied)	--	Zoology/ Chemistry/ Microbiology/ Biotechnology	T	3	3	25	75	100
			--	Respective Allied Theory Practical-I	P	2	2	25	75	100
	IV	SEC-IV	23BBO3S1	Herbal Technology	T	2	2	25	75	100
		SEC-V	233AT/ 23BBO3S2	Adipadai Tamil/Others-Entrepreneurial Opportunities in Botany	T	2	2	25	75	100
			--	Naan Mudhalvan Course						
				Total		**23**	**30**	**200**	**600**	**800**

IV	I	T/OL	2341T	தமிழும் அறிவியலும்/Other Languages– IV	T	3	6	25	75	100
	II	E	2342E	General English – IV	T	3	6	25	75	100
	III	CC-VII	23BB04C1	Plant Diversity IV –(Gymnosperms, Paleobotany and Evolution)	T	4	4	25	75	100
		CC-VIII	23BBO4P1	Plant Diversity IV–(Gymnosperms, Paleobotany and Evolution) Practical	P	4	4	25	75	100
		Generic Elective (Allied)	--	Zoology/ Chemistry/ Microbiology/ Biotechnology	T	3	3	25	75	100
			--	Respective Allied Theory Practical-I	P	2	2	25	75	100
	IV	SEC-VI	23BBO4S1	Fermentation technology	T	2	2	25	75	100
		SEC-VII	234AT/ 23BBO4S2	Adipadai Tamil/Others-Environmental Impact Analysis	T	2	2	25	75	100
		EVS	23BES4	Environmental Studies	T	2	2	25	75	100
			--	Naan Mudhalvan Course						
				Total		**25**	**30**	**225**	**675**	**900**
V	III	CC-IX	23BBO5C1	Plant Morphology, Taxonomy and Economic Botany	T	4	5	25	75	100
		CC-X	23BBO5C2	Plant Anatomy and Embryology	T	4	5	25	75	100
		CC-XI	23BBO5C3	Cell Biology, Genetics And Plant Breeding	T	4	5	25	75	100
		CC-XII	23BBO5P1	**Practical - V** (Plant Morphology, Taxonomy and Economic Botany, Plant Anatomy and Embryology and Cell Biology, Genetics And Plant Breeding)	P	4	5	25	75	100
		DSE-I	23BBO5E1/ 23BBO5E2/ 23BBO5E3	A. Bio-Analytical Techniques B. Aquatic Botany C. Entrepreneurial Botany	T	3	4	25	75	100
		DSE-II	23BBO5E4/ 23BBO5E5/ 23BBO5E6	A. Plant Bioresources B. Seed Biology C. Pomology	T	3	4	25	75	100
	IV		23BVE5	Value Education	T	2	2	25	75	100
			23BBO5I/ 23BBO5IT	Internship/Industrial Training	PR	2	-	25	75	100
			--	Naan Mudhalvan Course						
				Total		**26**	**30**	**200**	**600**	**800**
VI	III	CC-XIII	23BBO6C1	Plant Ecology and Phytogeography	T	4	4	25	75	100
		CC-XIV	23BBO6C2	Plant Biotechnology and Molecular Biology	T	4	4	25	75	100
		CC-XV	23BBO6C3	Plant Physiology and Plant Biochemistry	T	4	4	25	75	100
		CC-XVI	23BBO6P1	**Practical-VI (**Plant Ecology and Phytogeography and Plant Biotechnology and Molecular Biology and Plant Physiology and Plant Biochemistry)	P	4	4	25	75	100
			23BBO6D/ 23BBO6PR	Dissertation/ Group Project*	PR	3	6	25	75	100
		DSE-III	23BBO6E1/ 23BBO6E2/ 23BBO6E3	A. Horticulture B. Natural Resource Management C. Forestry	T	3	3	25	75	100
		DSE- IV	23BBO6E4/ 23BBO6E5/ 23BBO6E6	A. Bionanotechnology B. Computer applications in Botany C. Forensic Botany	T	3	3	25	75	100
		PCS	23BBO6S1/ 23BBO6S2	A.Botany for Competitive examinations B. Botany for Advanced Studies	T	1	2	25	75	100
			--	Naan Mudhalvan Course						
				Total		**26**	**30**	**200**	**600**	**800**

- TOL-Tamil/Other Languages,
- T/P – Theory/Practical
- E – English
- CC-Core course
- Sem- Semester
- SEC - Skill Enhancement Course
- FC - Foundation Course
- DSE - Discipline Specific Elective
- Int – Internal
- Ext- External
- Cr - Credit
- Hrs – Hours
- Dissertation/Group project * - It is a group project which contains maximum of 5 candidates

Chairperson details: Dr.K.Dharmar, Pasumpon Thiru Muturamalingam Thevar, memorial College, Kamuthi. Mobile No: 9443503439

CORE-I PLANT DIVERSITY I ALGAE

Title of the Course		**PLANT DIVERSITY I ALGAE**					
Paper Number		**CORE I**					
Category	Core	**Year**	I	**Credits**	4	**Course Code**	23BBO1C1
		Semester	I				
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	2		--	5	
Pre-requisite		Students should be familiar with the basics of different classes of algae.					

Learning Objectives		
C1	To provide a comprehensive knowledge on the biology of algae.	
C2	To provide a basis for better understanding of the evolution higher of plants.	
C3	To understand reproductive biology, ecology of plants by studying the simpler systems in algae.	
C4	To understand the role of algae in ecosystems as primary producers of nutrition.	
C5	To understand importance of algae to animals and humans.	
Course outcomes:CO	On completion of this course, thestudents will beable to:	**Programme Outcomes**
CO1	Relate to the structural organization, reproduction significance of algae.	K1
CO2	Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	K2
CO3	Explain the benefits of various algal technologies on the ecosystem.	K3
CO4	Compare and contrast the thallus organization and modes of reproduction in algae.	K4
CO5	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	K5
	CONTENTS	
UNIT I	General characters of algae. Classification (Fritsch-1935-1945), criteria for classification, algal distribution.	
UNIT II	Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Ulva,* parenchymatous-*Sargassum, Gracilaria*).	
UNIT III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-*, Chlorella, Anabaena, Oedogonium* and *Volvox*, diplontic-*Diatoms* and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*)	
UNIT IV	Algal cultivation methods, Algal production systems; indoor cultivation methodsand large-scale cultivation of algae, harvesting of algae.	
UNIT V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO_2 sequestration, Algae asindicator of water pollution, algal bioinoculants, Bioluminescence.	

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

Recommended Texts:

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

References Books:

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

Web Resources:

1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
2. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
3. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
4. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678
5. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh
6. https://www.wileyindia.com/a-textbook-of-algae.html
7. https://www.kobo.com/in/en/ebook/algae-biotechnology
8. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping with Programme Outcomes:

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

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

CORE-II
PLANT DIVERSITY I ALGAE - PRACTICAL-I

Title of theCourse		**PLANT DIVERSITY – I: ALGAE Practical I**					
Paper Number		CORE II					
Category	Core	**Year**	I	**Credits**	4	**Course Code**	23BBO1P1
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**		**Total**
		1		-	4		4
Pre-requisite		Students should be familiar with the basics of algae.					

Learning Objectives	
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.
C2	To identify microalgae in a mixture.
C3	To develop skills to prepare the microslides of algae.
C4	To study the economic importance of few species.
C5	To understand importance of algae to animals and humans

Course outcomes:CO	On completion of this course, thestudents will beable to:	**Programme outcomes**
CO1	CO1 Recall andidentify algae using keyidentification characters.	K1
CO 2	CO2 Demonstrate practical skillsin preparationof fresh mountand identification ofalgal forms from algalmixture.	K2
CO 3	CO3 Describethe internal structure ofalgae prescribedin the syllabus	K3
CO 4	CO4 Decipherthe algal diversity infresh/marine water and their economic significance.	K4
CO 5	CO5 Evaluatethe varioustechniques usedto culture algae for commercialpurposes	K5

EXPERIMENTS

1. Micro-preparation of the types prescribed in the syllabus.
2. Identifying the micro slides relevant to the syllabus.
3. Identifying types of algal mixture.
4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v)Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth.
5. Field visit to study fresh water/marine water algal habitats.
6. Visit to nearby industry actively engaged in algal technology.

Extended Professional Component (is a part of internalcomponent only,Not to be included 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

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

Reference Books:

1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide.Accompanying
2. manual to algae identification field guide, Ottawa Agriculture and Agri foodCanada publisher.
3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London.
4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
5. Dehradun. Edwardlee, R. 2018. Phycology, 5^{th} Ed., Cambridge University Press,London.

Web resources:

1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492
2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&redir_esc=
3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae- (PDF-21P).html
4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/
5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

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

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

I YEAR- I SEMESTER COURSE CODE: 23BBO1P1
CORE II - PLANT DIVERSITY I (ALGAE) - PRACTICAL- I

INTERNAL QUESTION

Time: 3hrs **Max. Marks: 25**

1.	Take T.S of the given material **A (**Vegetative part) **& B** (Reproductive part) . Stain and mount in Glycerin. Identify, draw sketches and label it. Give reasons. Submit the slides for valuation. **(Section-1,Identification-1, , Diagram-1, Notes-1)**	**2x4 =8**
2.	Identify, draw sketches and write notes on **C (**Vegetative part) **& D** (Reproductive part) **(Identification-1, Sketches-1, Notes-1)**	**2×3=6**
3.	Identify the algal species **E** from the given mixture of algae **(Procedure-1, Identification of two Species – Each species 1+1)**	**1x3=3**
4.	Identify and write the economic importance of **F(Identification-1, Uses-2)**	**1x3=3**
5.	Continuous assessment	**5**
	Total	**25**

INTERNAL

KEY AND SCHEME OF VALUATION

1.	**A (**Vegetative part**) & B** (Reproductive part) (Green algae, Brown algae and Red algae) –materials to be given. **(Section-1, Identification-1, , Diagram-1, Notes-1)**	**2x4 =8**
2.	**C (**Vegetative part) **& D** (Reproductive part) **(**Chlorella/Volvox/Anabaena/ Oedogonium) Micro slides/Specimens/Photographs to be given **(Identification-1, Sketches-1, Notes-1)**	**2×3=6**
3.	**E** –Algal mixture to be given (**(**Chlorella/Volvox/Anabaena/ Oedogonium) **(Procedure-1, Identification of two Species– Each species 1+11)**	**1x3=3**
4.	**F** – Economic products of algae prescribed in the syllabus **(Identification-1, Uses-2)**	**1x3=3**
5.	Continuous assessment	**5**
	Total	**25**

I YEAR- I SEMESTER
COURSE CODE: 23BBO1P1
CORE II PLANT DIVERSITY I (ALGAE) - PRACTICAL- I
EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	Take T.S of the given material **A&B (**Vegetative part) **& C&D** (Reproductive part) . Stain and mount in Glycerin. Identify, draw sketches and label it. Give reasons. Submit the slides forvaluation. **(Section-2, Identification-1, Diagram-2, Notes-2)**	**4x7 =28**
2.	Identify, draw sketches and write notes on **E&F (**Vegetative part**& G&H** (Reproductive part) **(Identification-1, Sketches-2, Notes-2)**	**4×5=20**
3.	write the procedure and species name in the given Algal mixture - **I** **(Procedure-2, Identification of two Species– Each species 1+1)**	**1x4=4**
4.	Identify and write the economic importance of **J & K** **(Identification-1, Uses-3)**	**2x4=8**
	Submission of Herbarium	**5**
	Submission of Record Note Book	**10**
	Total	**75**

EXTERNAL
KEY AND SCHEME OF VALUATION

1.	**A&B (Vegetative part) & C&D (Reproductive part)** (Green algae, Brown algae and Red algae) –materials to be given. **(Identification-1, Section-2, Diagram-2, Notes-2)**	**4x7 =28**
2.	**E&F (**Vegetative part) **& G&H** (Reproductive part) **(**Chlorella/Volvox/Anabaena/ Oedogonium) Micro slides/Specimens/Photographs to be given **(Identification-1, Sketches-2, Notes-2)**	**4×5=20)**
3.	**I** –Algal mixture to be given **(Procedure-2, Identification of two Species– Each species 1+1)**	**1x4=4**
4.	**J & K** – Economic products of algae, prescribed in the syllabus **(Identification-1, Uses-3)**	**2x4=8**
	Submission of Herbarium	**5**
	Submission of Record Note Book	**10**
	Total	**75**

Skill Enhancement course -I

1. ORGANIC FARMING

Title of the Course		**ORGANIC FARMING**					
Paper Number		**Skill Enhancement course -I**					
Category	SEC-I A	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	I			**23BBO1S1**	
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		Students to gain knowledge on the scope of organic farming and its significance.					

Learning Objectives	
C1	To enable students to gain knowledge on the scope of organic farming and its significance.
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.
C3	To understand the physical and chemical properties of soil.
C4	To study sustainable agriculture.
C5	To know about the importance of biofertilizers.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the different forms of biofertilizers and their uses.	**K1**
2. Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.	**K2**
3. Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	**K3**
4. Analyze and decipher the significance of biofertilizers in soil fertility.	**K4**
5. Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	**K5**

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

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

Reference Books

1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers.
3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi.
4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh
5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi

Web Resources

1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY
2. https://www.e-booksdirectory.com/listing.php?category=323
3. http://www.freebookcentre.net/Biology/Agriculture-Books.html
4. https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF- downloads/TOFG-all.pdf
5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

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

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

Skill Enhancement course -I

2. ENVIRONMENTAL BIOTECHNOLOGY

Title of the Course		**ENVIRONMENTAL BIOTECHNOLOGY**					
Paper Number		**Skill Enhancement course -I**					
Category	SEC- I B	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	I			**23BBO1S2**	
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		To understand the various applications of environmental biotechnology.					

Learning Objectives

C1-To introduce the student to the various developed and applications of environmental biotechnology.

C2-To provide knowledge about the scope of bioremediation and bioleaching using GMOs.

C3-To study about pollution of water bodies.

C4-To know about bioremediation.

C5-To study about biomineralization.

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

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

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

Recommended Texts

1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited.
2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.
3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication.
4. Keeshav Thehan. 1997. Biotechnology, New age international)P) Limited, New Delhi.
5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.

Reference Books:

1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi.
2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K.
3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.
4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of Science Communication and Information Resources, CSIR New Delhi.
5. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.

Web Resources

1. https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8
2. http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html
3. https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI
4. https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&redir_esc=y
5. http://library.umac.mo/ebooks/b28045907.pdf

Mapping with Programme Outcomes:

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

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

Skill Enhancement course -I

3. NURSERY AND LANDSCAPING

Title of the Course	**NURSERY AND LANDSCAPING**						
Paper Number	**Skill Enhancement course -I**						
Category	SEC-I C	**Year**	I	**Credits**	2	**Course Code**	23BBO1S3
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite	Students should know about the fundamental concepts of nursery and landscaping.						

Learning Objectives	
C1	To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
C2	To be able to design gardens and become entrepreneur in Horticulture.
C3	To study the methods of propagation.
C4	To know about nursery structure.
C5	To learn about gardening.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the basic principles and components of gardening.	K1
2. Explain about bio-aesthetic planning and conceptualize flower arrangement.	K2
3. Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3 & K6
4. Compare and contrast different garden styles and landscaping patterns.	K4
5. Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6

	CONTENTS
UNIT I	Introduction, prospects and scope of nursery and landscaping.
UNIT II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.
UNIT III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.
UNIT IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.
UNIT V	Manures, composting – vermicomposting.

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. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi.

2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.

Reference Books

1.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi.
2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co.,San Francisco, USA.
4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.

Web Resources

1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath
2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788
3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031
4. https://in.pinterest.com/pin/496733033900458021/?lp=true
5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

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

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

FOUNDATION COURSE FOR BOTANY
BASICS OF BOTANY

Title of the Course		**BASICS OF BOTANY**					
Paper Number		Foundation Course					
Category	FC	**Year**	I	**Credits**	2	**Course Code**	23BBO1FC
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		To recall the students about the basic aspects of botany.					

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

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

	CONTENTS
UNIT I	**BIODIVERSITY** Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.
UNIT II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structureof Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane Plastids, Ribosomes.
UNIT III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
UNIT IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance.

UNIT V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts

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

Reference books

1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
1. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
2. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.

Web Resources

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

Mapping with Programme Outcomes:

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

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

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

Title of the Course		**PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES,PLANT PATHOLOGY AND LICHENS**					
Paper Number		CORE III					
Category	Core III	**Year**	I	**Credits**	4	**Course Code**	23BBO2C1
		Semester	II				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	2	--	5

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

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

Course outcomes:CO	On completion of thiscourse, the students will be able to:	**Programme outcomes**
CO1	1. Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
CO 2	2. Develop an understanding of microbes, fungi and lichens and appreciate theiradaptive strategiesbased on structural organization.	K2
CO 3	3. Identify the common plant diseases, according to geographical locations and device control measures.	K3
CO 4	4. Analyze the emerging trends infungal biotechnology withspecial reference toagricultural and pharmaceutical applications.	K4
CO 5	5. Determine theeconomic importance of microbes, fungiand lichens.	K5

	EXPERIMENTS
UNIT I	**FUNGI** Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (*Rhizopus*), Ascomycotina (*Peziza*), Basidiomycotina (*Pleurotus*) and Deuteromycotina (*Cercospora*). Importance of mycorrhizal association
UNIT II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – Pleurotus (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins

UNIT III	**BACTERIA,VIRUS:** Classification(Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.
UNIT IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses. **Bacterial diseases** – Citrus canker and Bacterial wilt of Banana, Viral diseases – Tobacco Mosaic and Vein clearing of Papaya, Fungal diseases – Blast disease in rice.
UNIT V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to Usnea. **Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,
Extended Professional Component (isa part ofinternal component only, Not to beincluded in the External Examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. Newage International (P) Ltd, Publishers, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrialresidues utilization. Springer.
4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, CurrentPerspectives and Potential Applications, IK International.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Bookagency, Kolkata.
6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. InternationalPublishing House, New Delhi.

ReferenceBooks

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

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

Title of the Course	**PLANT DIVERSITY** –II: **FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II**						
Paper Number	CORE IV						
Category	Core	**Year**	I	**Credits**	4	**Course Code**	23BBO2P1
		Semester	II				

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

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

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

Course outcomes:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1. Identify microbes, fungi and lichens using key identifying characters	K1
CO 2	2. Develop practical skills forculturing and cultivation offungi.	K2
CO 3	3. Identify and select suitable control measuresfor the common plant diseases.	K3
CO 4	4. Analyze the characteristics ofmicrobes, fungi and plantpathogens	K4
CO 5	5. Access the useful role of fungiin agriculture and pharmaceutical industry.	K5

EXPERIMENTS

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

12. Study of thallus and reproductive structures (apothecium) through permanent slides.
13. Economic importance of Lichens - Dye and perfume.

Recommended Texts:

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

Reference Books:

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

I YEAR- II SEMESTER COURSE CODE:
CORE IV - PLANT DIVERSITY II (PLANT DIVERSITY II –
(FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS)

INTERNAL QUESTION

Time: 3hrs **Max. Marks: 25**

1.	Take T.S of the given material **A&B.** Stain and mount in Glycerin. Identify, draw sketches and label it. Give reasons. Submit the slides forvaluation. **(Section-1, Identification-1, , Diagram-1, Notes-1)**	**2x4 =08**
2.	Write down the flow chart of **C & D** **(Flow chart -2)**	**2×2=04**
3.	Identify, draw sketches and write notes on **E, F&G** **(Identification-0.5, Sketches-0.5, Notes-1)**	**3×2=06**
4.	Identify and write notes on **H** **(Identification-1, Uses-1)**	**1×2=02**
	Continuous assessment	**5**
	Total	**25**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 25**

1.	**A** (*Pleurotus*/*Cercospora*) and **B** - (Usnea) Vegetative/reproductive part materials to be given. **(Section-1, Identification-1, Diagram-1, Notes-1)**	**2x4 =08**
2.	**C (**inoculation of fungal culture /Mushroom Cultivation**) & D** (Ethanol Production)- Specimens/Photographs/Model to be given **(Flow chart -2)**	**2×2=04**
3.	**E (**Fungi, Bacteria, Virus and Lichen), **F** **(**Mycoplasma/Virus) & **G** (Plant pathology) Micro slides/Specimens/Photographs to be given **(Identification-0.5, Sketches-0.5, Notes-1)**	**3×2=06**
4.	**H** – Economic important of lichen prescribed in the syllabus **(Identification-1, Uses-1)**	**1×2=02**
	Continuous assessment	**5**
	Total	**25**

I YEAR- II SEMESTER COURSE CODE: 23BBO2P1
CORE II - PLANT DIVERSITY II –
(FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS)

EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	Take T.S of the given material **A,B&C.** Stain and mount in Glycerin. Identify, draw sketches and label it. Give reasons. Submit the slides for valuation **(Section-3, Identification-1, , Diagram-2, Notes-2)**	**3x8 =24**
2.	Write down the flow chart of **D &E** **(Identification-1, Flow chart -4)**	**2×5=10**
3.	Identify, draw sketches and write notes on **F &G** **(Identification-1, Sketches-2, Notes-2)**	**2×5=10**
6.	Identify and write the economic importance of **H, I & J** **(Identification-1, Uses-2)**	**3x4=12**
7.	Identify, draw sketches and write notes on **K** **(Identification-1, Sketches-2, Notes-2)**	**1x5=05**
9.	Submission of Herbarium specimens of bacterial diseases/photograph	**04**
	Submission of Record Note Book	**10**
	Total	**75**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 75**

1.	**A, B** (*Pleurotus, Cercospora*) & **C -** (Usnea) – Vegetative and reproductive part materials to be given. **(Section-3, Identification-1, , Diagram-2, Notes-2)**	**3x8 =24**
2.	**D (**inoculation of fungal culture/ Mushroom Cultivation**) & E** (Ethanol Production)- Specimens/Photographs/Model to be given **(Identification-1, Flow chart -4)**	**2×5=10**
3.	Micro slides (Vegetative and reproductive) to be given **F (***Rhizopus*) & **F (***Peziza*). **(Identification-1, Sketches-2, Notes-2)**	**2×5=10**
4.	Micro slides/Photography to be given **H (**Bacteria), **I (**Mycoplasma/Virus), **J** – (Lichen) **(Identification-1, Sketches-2, Notes-2)**	**3x4=12**
7.	**K** - Specimen /Photography to be given plant pathology prescribed in the syllabus **(Identification-1, Sketches-2, Notes-2)**	**1x5=05**
9.	Submission of Herbarium specimens of bacterial diseases/photograph (any four sheets)	**04**
	Submission of Record Note Book	**10**
	Total	**75**

SKILL ENHANCEMENT COURSE -II

A. MUSHROOM CULTIVATION

Title of the Course	**MUSHROOM CULTIVATION**					
Paper Number	Skill Enhancement Course-II					
Category	SEC-II A	**Year**	I	**Credits**	2	**CourseCode**
		Semester	II			**23BBO2S1**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	-		-	2
Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.					

Course Objectives		
C1	To learn and develop skills in mushroom cultivation.	
C2	To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.	
C3	To cultivate mushroom cultivation in small scale industry.	
C4	To learn about diseases and post harvest technology.	
C5	To study new methods and strategies to contribute to mushroom production.	
Course outcomes:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1. Recall various types and categories ofmushroom.	K1
CO 2	2. Explain about various types of food technologies associated withmushroom industry.	K2
CO 3	3.Apply techniques studied for cultivation of various types of mushroom.	K3
CO 4	4. Analyze and decipher theenvironmental factors and economic value associated with mushroom cultivation	K4
CO 5	5. Develop new methods and strategies to contribute to mushroom production.	K5 & K 6

	CONTENTS
UNIT I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.
UNIT II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
UNIT III	Life cycle of *Pleurotus spp* and *Agaricus spp.*
UNIT IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
UNIT V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

Extended Professional Component (is a part ofinternal component only, Not to be included in the External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.

Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil NaduAgricultural University, Coimbatore.

3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printingand Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors,Dehradun.

5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovement with their marketing. Daya Publishing House.

ReferenceBooks

1.Handbook of Mushroom Cultivation. 1999. TNAU publication.

2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.

3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.

4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.

5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.

Web Resources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S			S	M	L	M	M
CO 2	S			M		S	M	S
CO 3	M			S		M		S
CO 4	S	S	S	S		M		S
CO 5	S	S	M				S	S

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

SKILL ENHANCEMENT COURSE -II
B.HERBAL MEDICINE

Title of the Course	**HERBAL MEDICINE**						
Paper Number	Skill Enhancement Course-II						
Category	SEC-II B	**Year**	I	**Credits**	2	**CourseCode**	**23BBO2S2**
		Semester	II				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	2	-	-	2			
Pre-requisite	To understand the importance of herbal medicine.						
Learning Objectives							
C1	To understand the nuances of medicinal phytoconstituents of their commercial value plants and						
C2	To design and develop medicinal garden.						
C3	To apply the knowledge to cultivate medical plants.						
C4	To know the pharmacological importance of medicinal plants.						
C5	To enlist phytochemicals and secondary metabolites of market and commercial value.						

Course outcomes:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1. Define and describe the principle of cultivation of herbal products.	K1
CO 2	2. Explain about the phytochemistryofeconomically important medicinal herbs	K2
CO 3	3. Apply techniques forevaluation of drugadulteration through biological testing.	K3
CO 4	. Formulate the value added processing / storage quality control for the betteruse of herbal medicine.	K4
CO 5	5. Develop the skills forcultivation of plants and their value added processing/storage/quality control.	K5 & K 6
	CONTENTS	
UNIT I	Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.	
UNIT II	Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons, some poisonous plants; their toxicity and action.	
UNIT III	Adulteration of crude drugs and its detection – methods of adulteration;types of adulteration. Medicinal plants of export values; rejuvenating herbs; Medicinal uses of Non-flowering plants.	

UNIT IV	Botanical description and active principles of Root drugs; Rhizomeswoods and bark drugs (Two examples for each plant organs).
UNIT V	Botanical description and active principles of leaves; Flowers; Fruits seedand entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).
Extended Professional Component (is apart of internalIncomponent only, Not to be included in the ExternalExamination 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 acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Somasundaram, S. 1997. Medicinal botany (MaruthuvarThavaraviyal) – (Tamil Medium Book).
2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. & A. ChurchillLtd., London,
3. Jains, S.K.. 1996. Medicinal Plants. Deep Publications, New Delhi.
4. Srivastava, A.K. 2006, Medicinal Plants, International BookDistributors, Dehradun.
5. Agarwal,O.P. 1985, Vol. II, Chemistry of organic – natural products.S Chand & Company, New Delhi.
6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency,Madras Volumes.
7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.

Reference Books

1. Nair, N.C and Henrry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India.
2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of IndianMedicinal Plants.
3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994,Indigenous drugs of India.
4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous plants inIndia.
5. Miller, L and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass*, *Fourth edition.*
6. Patri, F and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

Web Resources

1. https://www.barnesandnoble.com/b/free-ebooks/nook- books/alternative-medicine-natural-healing/herbal-medicine/_/N- ry0Z8qaZ11iu
2. https://www.springer.com/gp/book/9783540791157
3. https://www.gpatonline.com/gpat/book-reference-pharmacognosy
4. https://www.researchgate.net/publication/334670695_Book_review-_Herbal_Drug_Technology
5. http://www.eurekaselect.com/node/173492/herbal-medicine-back-to- the-future

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE -II
C. GLOBAL CLIMATE CHANGE

Title of the Course	**GLOBAL CLIMATE CHANGE**					
Paper Number	Skill Enhancement Course-II					
Category	SEC-II C	**Year**	I	**Credits**	2	**CourseCode 23BBO2S3**
		Semester	II			

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

Pre-requisite	To understand the implications of carbon and ecological footprint.

Learning Objectives

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

Course outcomes:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1. Relate to theanthropogenic pressure on theenvironment And carbon foot print.	K1
CO 2	2. Explain about the physical basis of natural green gas house effect on man and materials.	K2
CO 3	3. Evaluatehuman influenced driver of our climate system and its applications	K3
CO 4	4. Analyze the causes and Effects of depletion of the stratospheric ozone layer.	K4
CO 5	5. Develop newstrategies to mitigate issuesof global environmentalchange.	K5 & K 6

	CONTENTS
UNIT I	Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.
UNIT II	Stratospheric ozone layer: Evolution of ozone layer; Causes ofdepletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts formitigation ozone layer depletion.
UNIT III	Climate change: Green house effects; causes; Green house gases andtheir sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.
UNIT IV	Atmospheric deposition: Past and present scenario; Causes andconsequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.
UNIT V	Acid rain and its effects on plants, animals, microbes and ecosystems.

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 fromthis course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National AcademicPress.
2. Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.
3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage,Bengaluru.
4. Sharma P.D. 2019. Plant ecology and phytogeography, RastogiPublications, Meerut.
5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamicapproach. 2nd Edition GKP Access Publishing.

Reference Books

1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.
2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change.Royal Society of Chemistry.
3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences.2nd ed. Cambridge University Press. ISBN. 978-1107114234.
4. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity-Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4thedition.

Web Resources

1. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/
2. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and- nature/0/all_items.html
3. https://www.smashwords.com/books/category/4727/newest/0/free/any
4. https://www.free-ebooks.net/environmental-studies-academic/Global- Warming
5. https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE III
BOTANICAL GARDEN AND LANDSCAPING

Title of theCourse	**BOTANICAL GARDEN AND LANDSCAPING**						
Paper Number	Skill Enhancement-III						
Category	SEC-III	**Year**	III	**Credits**	2	**Course Code**	23BBO2S4
		Semester	VI				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite	Students should know about the fundamental concepts of gardeningand landscaping.						

Learning Objectives	
C1	To know about the fundamental concepts of gardening and landscaping.
C2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.
C3	To illustrate the significance of garden adornments and structures.
C4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.
C5	To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

Course outcomes:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1.Recognize fundamental concepts of gardening and landscaping.	K1
CO 2	2. Explain aboutsignificanceofgarden adornments and propagation structures.	K2
CO 3	3.Apply techniques of landscaping foraesthetic purposes and gardening for recreation.	K3&K6
CO 4	4. Distinguish between formal, informal and Free style gardens andtheir applications.	K4
CO 5	5. Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	K5 & K 6

	CONTENTS
UNIT I	Principles of gardening, garden components, adornments, lawn making, methodsof designing rockery, water garden, etc. Special types of gardens, their walk- paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.
UNIT II	Flower arrangement: importance, production EXPERIMENTS and cultural operations, constraints, post harvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.

UNIT III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parksand public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specificsituations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.
UNIT IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning,eco tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
UNIT V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).

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

Recommended Texts

1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition,PHI learning Pvt. Ltd.
2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC MillanIndia Ltd.
3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, NewCentral Book Agency
4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.

Reference Books

1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide .Smithsonian Books.
2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundredyears of People,Plans, and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in yourhands(Nature Guides).
4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition,PHI learning Pvt. Ltd.
5. Edment Senn Andrews. 1994. Fundamentals of Horticulture.Tata.McGraw Hill Publishing Co., Ltd., Delhi.

Web resources

1. https://www.amazon.in/Gardening-Landscape-Design-and- Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Gard en
2. https://www.overdrive.com/subjects/gardening
3. https://www.scribd.com/book/530538456/Opportunities-in- Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers
4. https://www.scribd.com/book/305542619/Botanic-Gardens
5. https://www.overdrive.com/subjects/gardening

Mapping with Programme Outcomes:

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

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

CORE-V PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES

Title of theCourse	**PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES**						
Paper Number	CORE V						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	23BBO3C1
		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 andPteridophytes.

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:CO	On completion of thiscourse, the students will be able to:CO	**Programme outcomes**
CO1	1. Recognize morphological variations of Bryophytes and Pteridophytes.	K1
CO 2	2. Explain the anatomy andreproduction of Bryophytes andPteridophytes.	K2
CO 3	3. Compare and contrast the variations in the internal cellular organization, gametophyte andsporophyte of Bryophytes and Pteridophytes.	K3
CO 4	4. Decipher the stages of plant evolutionand their transition to landhabitat.	K4
CO 5	5. Access the useful role of Bryophytes and Pteridophytes.	K5

	EXPERIMENTS
UNIT 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.
UNIT 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
UNIT III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homospory and heterospory.

UNIT IV	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (Psilotum), Lycopsida (Selaginella), Sphenopsida (Equisetum), Pteropsida (Marsilea).
UNIT V	Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance of Pteridophytes.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

RecommendedTexts

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.

ReferenceBooks

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.CentralBook Depot, Allahabad.

Web Resources:

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

Mapping with Programme Outcomes:

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

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

CORE-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**	4	**Course Code**	23BBO3P1
		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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1.Recognize the major groups of Non-vascularand Vascular cryptogams	K1
CO 2	2.Describe the structure ofBryophytes and Pteridophytes forms Prescribed inthe syllabus.	K2
CO 3	3.Identify and illustrate the morphologicaland anatomical features of bryophytes and Pteridophytes.	K3
CO 4	4.Develop comprehensiv e skills insectioning andmicro preparation.	K4
CO 5	5.Interpret thesignificance ofreproductive structures inBryophytes 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*/*Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria*/*Polytrichum*) (Examples may be changed according to the availability of the specimens) (need not study developmental aspects).

Pteridophytes

3. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus.
   Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium/Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum*/*Marsilea*). (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 partof internal component only, Not to be included in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired fromthis course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany,Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation.Atma Ram & Sons. Lucknow, India.
5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and ClimateChange. 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 Rastogipublication.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert AcademicPublishing.
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)

II YEAR- III SEMESTER COURSE CODE:
CORE – VI - PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES
INTERNAL QUESTION

Time: 3hrs **Max. Marks: 25**

1.	Take T.S of the material **A&B**. Stain, mount in Glycerine and submit the slides for valuation. Identify, draw sketches and label it. Give reasons **(Section-2, Identification-1, Diagram-1, Notes-1)**	**2x5=10**
2.	Identify, draw sketches and write notes on **C&D** **(Identification-1, Sketches-1, Notes-1)**	**2×3=06**
3.	Identify and write the genus and group of **E** **(Genus – 0.5, Group – 0.5)**	**1X1=01**
4.	Write the economic important of **F** (**Identification-1,Notes-2**)	**1x3=03**
	Continuous assessment	**5**
	Total	**25**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 25**

1.	**A -** (*Bryophytes*/Pteridophytes) Vegetative material and **B -** (*Bryophytes*/Pteridophytes) – Reproductive materials to be given. **(Section-2, Identification-1, Diagram-1, Notes-1)**	**2x5=10**
2.	**C** (Bryophytes/Pteridophytes- vegetative/reproductive parts) and **D** (Any one stele) microslides/Specimen to be given **(Identification-1, Sketches-1, Description-1)**	**2×3=06**
3.	**E** (Bryophytes/Pteridophytes) Specimens/Photographs to be given **(Genus – 0.5, Group – 0.5)**	**1X1=01**
4.	**F** (Bryophyte/Pteridophytes) – Specimens/Photographs to be given from the prescribed syllabus (**Identification-1,Notes-2**)	**1x3=03**
	Continuous assessment	**5**
	Total	**25**

II YEAR- III SEMESTER COURSE CODE:
CORE – VI - PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES
EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	Take T.S of the material **A,B,C&D**. Stain, mount in Glycerine and submit the slides for valuation. Identify, draw sketches and label it. Give reasons **(Section-3, Identification-1, Diagram-2, Notes-2)**	**4x8 =32**
2.	Identify, draw sketches and write notes on **E,F&G** **(Identification-1, Sketches-2, Notes -2)**	**3×5=15**
3.	Identify, draw sketches and write notes on **H** **(Identification-1, Sketches-2, Notes -2)**	**1X5=5**
4.	Identify and write the genus and group of **I & J** **(Genus – 1, Group - 1)**	**2X2=4**
5.	Write the economic important of **K&L** **(Identification-1,Notes-1)**	**2x2=4**
.	Field visit/Submission of any five Herbarium specimen from Bryophytes and Pteridophytes	**5**
.	Submission of Record Note Book	**10**
	Total	**75**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 75**

1.	**A** (Bryophytes-Vegetative part) B (Bryophytes-Reproductive part) C (Pteridophytes-Vegetative part) & D (Pteridophytes- Reproductive part) materials to be given.**(Section-3, Identification-1, Diagram-2, Notes-2)**	**4x8 =32**
2.	**E** (Bryophytes), **F&G** (Pteridophytes) – vegetative/ reproductive parts. Microslides/Specimen/Photographs to be given **(Identification-1, Sketches-2, Description-2)**	**3×5=15**
3.	Microslides/ Photograph to be given from the prescribed syllabus **H** (Any one stele) **(Identification-1, Sketches-2, Notes-2)**	**1X5=5**
4.	Identify and write the genus and group **I** (Bryophytes), **J** (Pteridophytes)**(Genus – 1, Group - 1)**	**2X2=4**
5.	**K** (Bryophyte) **& L** (Pteridophytes) – Economic important to be given in the prescribed syllabus **(Identification-1, Uses-1)**	**2x2=4**
	Field visit/Submission of any five Herbarium specimen from Bryophytes and Pteridophytes	**5**
	Submission of Record Note Book	**10**
	Total	**75**

SKILL ENHANCEMENT COURSES SEC IV
HERBAL TECHNOLOGY

Title of theCourse	**HERBAL TECHNOLOGY**						
Paper Number	Skill Enhancement-IV						
Category	SEC-IV	**Year**	III	**Credits**	2	**Course Code**	23BBO3S1
		Semester	VI				
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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Define anddescribe theprinciple ofcultivation ofherbal products.	K1
CO 2	2. List themajor herbs,their botanical name and chemical constituents.	K2
CO 3	3.Applytechniques for monitoring drug adulteration through the biologicaltesting.	K3
CO 4	4.Analyzeand decipherthe significance of various methods ofharvesting, dryi and storage ofmedicinal herbs.	K4
CO 5	5. Developthe skills for cultivation ofplants and their valueadded processin /storage	K5 & K 6

	CONTENTS
UNIT I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditionalsystems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.
UNIT II	Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmeticals and biopesticides, their Botanicalnames, plant parts used, major chemical constituents.
UNIT 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.

UNIT 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).
UNIT 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 Micropropagation of some medicinal plants (*Withania somnifera*, neem and tulsi),

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

RecommendedTexts

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 V
ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course	**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**					
Paper Number	Skill Enhancement-V					
Category	SEC-V	**Year**	III	**Credits**	2	**Course Code: 23BBO3S2**
		Semester	VI			
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**	
		2	-	-	2	
Pre-requisite		To understand the concept of Entrepreneurial Opportunities in Botany.				

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

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to how various fields of botany could be understood with an entrepreneurialapproach.	K1
CO 2	2. Explain the concept of Entrepreneurial Opportunities in Botany.	K2
CO 3	3. Make of the knowledge gained to startnew venture using Plant tissue culture and plant products for commercial exploitations	K3
CO 4	4.Deciphereffective waysof makingbioproducts like organicacids, solvents,beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
CO 5	5.Developnew strategiesto describemarketing and business management strategy including therole of IPR and bioethics regulations for licensing.	K5 & K 6

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

UNIT II	**TOOLS AND TECHNIQUES** Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.
UNIT III	**NEW VENTURE CREATION** Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
UNIT IV	**PRODUCT DEVELOPMENT AND COMMERCIALIZATION** Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
UNIT V	**BIO-BUSINESS PLANS, IPR AND BIOETHICS** Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.

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

Recommended Texts

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

Reference books

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

Web sources

1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/
2. https://www.youtube.com/watch?v=hnBla1FfcLo
3. https://www.slideshare.net/krishnashah5891004/ram-power-point- presentation
4. http://www.brainkart.com/article/Economically-Useful-Plants-and Entrepreneurial Botany_38301
4. https://www.ebooks.com/en-us/subjects/gardening/
5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes:

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

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

CORE-VII PLANT DIVERSITY IV
GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Title of the course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**						
Paper Number	CORE VII						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	23BBO4C1
		Semester	IV				

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

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:CO	On completion of this course, thestudents will be able to:	**Programme outcomes**
CO1	1. Relate to the generalcharacteristics ofGymnosperm and fossil forms	K1
CO 2	2. Explain about themorphology, anatomy and Gymnosperms.	K2
CO 3	3. Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3
CO 4	4. Analyze the anatomy andreproduction Gymnosperms along with theirecological andeconomical importance.	K4
CO 5	5. Determine the various fossilization methods and their significance in paleobotany.	K5

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

UNIT IV	**PALEOBOTANY** Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
UNIT 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 ofinternal component only, Not tobe included In the External Examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

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 InternationalPublishers, New Delhi, India.
4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. NewDelhi.
5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New AgeInternational Pvt Ltd Publishers. New Delhi.

ReferenceBooks

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 ofPlants. Cambridge University Press.
4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. SanFrancisco: W.H. Freeman, 1971.
5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New AgeInternational 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=4dvyNckni8w C
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 ANDEVOLUTION - PRACTICAL-IV

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV**						
Paper Number	CORE VIII						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	23BBO4P1
		Semester	IV				

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

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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Analyze and observeand record themorphological features ofselected species of Gymnosperms..	K1
CO 2	2. Describe the structure offossil formsprescribed in the syllabus.	K2
CO 3	3. Identify andIllustrate themorphological and anatomical features ofgymnosperms.	K3
CO 4	4. Develop comprehensive skills in sectioning andmicro preparation.	K4
CO 5	5. Interpret the significanceof 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 Williamsonia sewardiana* through permanent slides.

2. Photograph of evolution scientists.

Extended Professional Component (is apar of internalcomponent 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 acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, 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., NewDelhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. ChicagoReprinted 1950). New York.
5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age InternationalPublishers, 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=gy mnosperms&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)

II YEAR- IV SEMESTER COURSE CODE:
CORE – VIII - PLANT DIVERSITY - IV- GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV
INTERNAL QUESTION

Time: 3hrs **Max. Marks: 25**

1.	Take T.S of the material **A&B**. Stain, mount in Glycerine and submit the slides for valuation. Identify, draw sketches and label it. Give reasons **(Section-1, Identification-1, Diagram-1, Notes-1)**	2x4=08
2.	Identify, draw sketches and write notes on **C** **(Identification-1, Sketches-1, Notes - 1)**	1x3=03
3.	Identify and write the genus and group of **D** **(Genus – 0.5, Group -0.5)**	1x1=01
4.	Identify, draw sketches and write notes on **E** (**Identification-1, Sketches-1, Notes -1)**	1x3=03
5.	Write the era and period of **F** **(Era-0.5, Period-0.5)**	1x1=01
6.	Write the economic importance of **G** (**Identification-1,Notes-1**)	1x2=02
7.	Identify and write notes on **H** **Identification-1, Notes -1)**	1x2=02
	Continuous assessment	05
	Total	**25**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 25**

1.	**A** - **(**Vegetative part) **B** – (Reproductive part) Gymnosperms material to be given. **(Section-1, Identification-1, Diagram-1, Notes-1)**	2x4=08
2.	**C** - (Gymnosperms) Micro slides/Specimens to be given **(Identification-1, Sketches-1, Notes -1)**	1x3=03
3.	**D** (Gymnosperms) Microslies/specimens/photographs to be given (Genus – 0.5, Group -0.5)	1x1=01
4.	**E –** Specimen/Photograph to be given from fossils (**Identification-1, Sketches-1, Notes -1)**	1x3=03
5.	**F –**Fossil specimens/Photographs to be given **(Era-0.5, Period-0.5)**	1x1=01
6	**G** (Gymnosperms- **E**onomic importance**)** Specimens/photographs to be given (**Identification-1,Notes-1**)	1x2=02
7.	**H** - Evolution scientist photograph to be given **Identification-1, Notes -1)**	1x2=02
	Continuous assessment	05
	Total	**25**

II YEAR- IV SEMESTER COURSE CODE:
CORE – VIII - PLANT DIVERSITY - IV- GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	Take T.S of the material **A,B&C**. Stain, mount in Glycerine and submit the slides for valuation. Identify, draw sketches and label it. Give reasons **(Section-3, Identification-1, Diagram-2, Notes-2)**	3x8 =24
2.	Identify, draw sketches and write notes on **D &E** **(Identification-1, Sketches-2, Notes-2)**	2x5=10
3.	Identify and write the genus and group of **F& G** **(Genus – 1, Group - 1)**	2x2=04
4.	Identify, draw sketches and write notes on the given specimen **'H'** **(Identification-1, Sketches-1, Description-1)**	1X5=5
5.	Write the era and period of fossil specimen/photograph of **I&J** **(Era-1, Period-1)**	2X2=4
6.	Write the economic importance of **K&L** (**Identification-1,Uses-2**)	2x4=08
7.	Identify the evolution of scientist **M** **Identification-1, Notes-4)**	1X5=05
	Field visit to study the habitat - Hill station	5
	Submission of Record Note Book	10
	Total	**75**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 75**

1.	**A** & **B** (Gymnosperms- Vegetative part) **& C** (Gymnosperms- Reproductive part- Vegetative materials to be given. **(Section-3, Identification-1, Diagram-2, Notes-2)**	3x8 =24
2.	**D&E (**Gymnosperms) Micro slides/specimens/Phtographs to be given **(Identification-1, Diagram-2, Notes-2)**	2x5=10
3.	Identify and write the genus and group **F**&**G** **(Gymnosperms) (Group-1, Genus-1)**	2x2=04
4.	**H–** Specimen/Photograph to be given from fossils **(Identification-1, Sketches-2, Description-2)**	1X5=05
5.	Identify and write the era and period of fossil of **I&J** **(Era-1, Period-1)**	2X2=04
6	**K&L Gymnosperms** – Economic important of gymnoperms prescribed in the syllabus **(Identification-1, Uses-3)**	2x4=08

7.	Identify and write the evolution scientist **M** **(Identification-1, Notes-4)**		1X5=05
	Field visit to study the habitat - Hill station		5
	Submission of Record Note Book		10
		Total	**75**

SKILL ENHANCEMENT COURSES SEC VI
FERMENTATION TECHNOLOGY

Title of theCourse		**FERMENTATION TECHNOLOGY**					
Paper Number		Skill Enhancement-6					
Category	SEC-VI	**Year**	III	**Credits**	2	**Course Code**	23BBO4S1
		Semester	VI				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		To students to know about the various fermentation technology.					

Learning Objectives	
C1	To appreciate the significance of microbes synthesizing fermented products.
C2	To gain insights 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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Enumerate the significance ofindustrially useful microbes.	K1
CO 2	2. Explain the design and operation of industrial practicesin mass production of fermentedproducts.	K2
CO 3	*3.* Explain the process of maintenance and preservation of microorganisms.	K3
CO 4	4. Analyze thevarious aspectsof the fermentation technology andapply for fermentative production.	K4
CO 5	5. Validate the experimental techniques formicrobial production ofenzymes: amylase and protease, bioproduct recover.	K5 & K6

	CONTENTS
UNIT I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
UNIT II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
UNITIII	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
UNIT 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).
UNIT V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Extended Professio nal Component (is a part of internal compone ntonly,Not to beincluded in the External Examinat ion questionpaper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7thEdition, Blackwell Science, London, UK.
2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn'sIndustrial Microbiology, 4th Edition, AVI Pub. Co., USA.
3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4thEdition, AVI Pub. Co., USA.
4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New AgeInternational (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, BlackwellScience, 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
   https://www.amazon.in/Principles-Fermentation-Technology-Peter- Stanbury-ebook/dp/B01E3IC73W
3. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html
4. https://www.ebooks.com/en-us/book/2698294/principles-of-

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 VII
ENVIRONMENTAL IMPACT ANALYSIS

Title of thecourse	**ENVIRONMENTAL IMPACT ANALYSIS**					
Paper Number	Skill Enhancement-7					
Category	SEC-VII	**Year**	III	**Credits**	2	**Course Code 23BBO4S2**
		Semester	VI			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	-		-	2
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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Enumerate thefundamental concepts and significance of environmental impact assessment.	K1
CO 2	2. Explain the important steps of EIA process.	K2
CO 3	3. Interpret theenvironmental appraisal and Procedures inIndia.	K3
CO 4	4. Decipher how to prepare thevarious documents required by state And federal regulations.	K4
CO 5	5. Develop their own perspectiveson impactassessment andbe able to solveproblems related to environment.	K5 & K6

	CONTENTS
UNIT 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.
UNIT II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,
UNIT 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.
UNIT IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.

UNIT 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 ProfessionalComponent (is a part ofinternal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1 Morris, P. and Therivel, R. 1995. Methods of Environmental ImpactAssessment, UCL Press, London.

2. Petts, J. 1999. Handbook of Environmental Impact Assessment, volume1 and 2, Blackwell Science, Oxford.

3. Therivel, R. and Partidario, M.R. 1996. The Practice of StrategicEnvironmental Assessment, Earthscan, London.

4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social ImpactAssessment, 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- Volume1 and 2. Blackwell Publishers, UK.

3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction toEnvironmental Impact Assessment. Routledge, London.

4. Canter, W.L. 1995. Environmental Impact Assessment, McGraw-HillScience/ 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)

CORE IX
PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of theCourse	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	CORE IX						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	**23BBO5C1**
		Semester	V				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	3	-	2	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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Define the concepts inplant morphology and rules of IUCN inbotanical nomenclature.	K1
CO 2	2. Classify systems of plant classification and recognizethe importanceof herbarium and virtual herbarium.	K2
CO 3	3. Describe the core concepts ofeconomic Botany and Relate itsapplications inhuman life.	K3
CO 4	4. Analyze the characters of the families according to the Benthamand Hooker'ssystem ofclassification.	K4
CO 5	5. Assess terms andconcepts related toPhylogenetic Systematics.	K5

	CONTENTS
UNIT 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.
UNIT 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.
UNIT 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.

UNIT IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
UNIT V	Brief study of the following economic products with special reference to the Botanical name, Family, morphology of useful part and uses. Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), spices (Cardamom), natural rubber and timber plants (Teak) and Fibre (Cotton). Source and the extraction/processing of the economically important products of the following: Beverage (Coffee), Oil seed (Groundnut), and essential oil (Rose),

Extended Professional Component (is apart of internalcomponent only,Not to beincluded in theExternal 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 acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central BookDepot, Allahabad.
2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia PublicationsHouse, New Delhi
3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. TheMacMillan 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 Universitypress, 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 AngiospermTaxonomy, Oliver and Boyd Edinburgh.
4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and HallInc. 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 XI- PLANT ANATOMY AND EMBRYOLOGY

Title of theCourse	**PLANT ANATOMY AND EMBRYOLOGY**					
Paper Number	CORE XI					
Category	Core	**Year**	III	**Credits**	4	**CourseCode 23BBO5C2**
		Semester	V			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		3	2		-	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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate tothe fundamental concepts of plant anatomy andembryology.	K1
CO 2	2. Describe the internal tissue organization of various plant organs.	K2
CO 3	3. Elucidate the stages of normal and abnormal secondary growth.	K3
CO 4	4. Compare the structuralorganization of flower inrelation to theprocess of pollination and fertilization.	K4
CO 5	5. Access the variousanatomical adaptations in plants.	K5
	CONTENTS	
UNIT 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.	
UNIT 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 root and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types	

UNIT III	Primary structure of dicot and monocot stem and root, Secondary thickening in dicots stem and 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.
UNIT 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.
UNIT 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 ofinternal component only, Not tobe included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms,Vikas.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4^{th} revised and enlarged edition). Vikas Publishing House,New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. CambridgeUniversity 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. NewDelhi.
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 ofAngiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : TheHidden 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 – WesleyPublishing 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 AcademicPress, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/CummingsPublisher, USA.
8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissuesof the Plant Body:

Their Structure, Function and Development. John
Wiley and Sons, Inc. Any local/state/regional flora published by BSI orany other agency.
9. 9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .TataMcGraw 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 ofthe Course		**CELL BIOLOGY, GENETICS AND PLANT BREEDING**					
Paper Number		CORE XII					
Category	Core	**Year**	III	**Credits**	4	**Course Code**	**23BBO5C3**
		Semester	V				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		3		2	-	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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Enumerate the structureand functions of cells,cellular structures andorganelles.	K1
CO 2	2. Explain about cell cycle, cell division and laws of inheritance with suitableexamples.	K2
CO 3	3. Elucidate concepts of sexdetermination and sex linked inheritance.	K3
CO 4	4. Analyze the importanceof genesinteractions atpopulation andevolutionary levels.	K4
CO 5	5. Develop conceptual understanding of plant genetic resources, plant breeding,gene bank andgene pool.	K5

	CONTENTS
UNIT 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.
UNIT 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.

UNIT 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.
UNIT 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.
UNIT 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, causesand 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 o finternal component only, Not to beincluded in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., NewDelhi-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, SanFrancisco.
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_eboo ks_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 X PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY, PLANT ANATOMY AND EMBRYOLOGY AND CELL BIOLOGY, GENETICS AND PLANT BREEDING -PRACTICAL-V

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY, PLANT ANATOMY AND EMBRYOLOGY AND CELL BIOLOGY, GENETICS AND PLANT BREEDING -PRACTICAL-V**						
Paper Number	CORE X						
Category	Core	**Year**	III	**Credits**	3	**CourseCode**	**23BBO5P1**
		Semester	V				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	-	3	5

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

Learning Objectives	
C1	To study morphological and floral characters of the families
C2	Identify the local flora and prepare herbarium sheets.
C3	To understand the economic importance of the plants.
C4	To study the anatomy, embryology and structure of the plant organs
C5	To study the genetics and plant breeding techniques

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Recognize the distinguishing plant morphologicalcharacters and families. Construct the floral diagram and floralformula for a given flower.	K1
CO 2	2. Develop comprehensiveskills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.	K2
CO 3	3. Validate the plant specimen byanalyzing and dissecting the vegetative and floral characters.	K3
CO 4	4. 1.Identify the cell organelles, stomata, ovules, stages ofcell division and ergastic substances preset in plant tissues.	K4
CO 5	5. Interpretthe given genetic datato develop genetic mapbased on theprinciples ofMendelian inheritance and gene interaction.	K5

EXPERIMENTS

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

1. Study of simple and complex (Primary and Secondary) tissues, dicot and monocot stem, leaves and roots**,** Anomalous secondary growth in the stems of *Boerhaavia, Nycthanthes* and *Dracaena* and stomatal types.

2. Dissect and display the T.S of (young and mature) anther (section from *Datura* or *Cassia* flower), Observation of pollinia (Asclepidaceae) and any two stages of embryo of *Tridax*

3. Study the types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous(Permanent slides) and Types of Endosperm - Nuclear, cellular helobial.

4. Study of the photomicrographs of cell organelles, Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide.

5. Study the polytene and lamp brush chromosome structure through photograph and Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.

6. Genetic problems – test cross, back cross, incomplete dominance and allelic interaction, Construction of chromosome map – three point test cross and Multiple alleles problems.

7. Plant breeding-Emasculation technique, To test the viability of seeds using Tetrazolium chloride, Genetic models of heterosis and Phenotype of heterosis (Maize).

Extended Professional Component (is a partof internal component only, Not to be included in theExternal Examination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. VikasPublishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy ofTraditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), VikasStudents Education.
4. Pandely, B.P. 1987. Taxonomy of Angiosperms.
5. Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21stCentury. Portlant Press Ltd., London.
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. 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. NutritiveValue of Indian Foods. National Institute of Nutrition, Hyderabad.
3. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. RiemanEducational Book Ltd., London.
5. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in PlantSpecies. Hiemand & Co. Educational Books Ltd. London.
6. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1sted, Anmol Publications, ISBN-812610668.
7. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.
8. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall.
9. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John Wiley & Sons, New York.
10. 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.
11. 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-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=uWg76rCqA 68C
5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592
6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.
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
7. 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	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)**

III YEAR- V SEMESTER COURSE CODE:
CORE – XII
PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY, PLANT ANATOMY AND EMBRYOLOGY AND CELL BIOLOGY, GENETICS AND PLANT BREEDING

INTERNAL QUESTION

Time: 3hrs **Max. Marks: 25**

1.	**A –** Dissect out the given plant material, identify and draw sketches of the L.S. of flower, Floral Diagram, Floral Formula and describe the Floral parts. **(Identification- 1, Notes- 1, L.S. of Flower-1, Floral diagram & Floral formula - 1)**	1x4= 04
2.	**B** - Work out the specimen and identify their respective families through elimination process **(Identification-1, Elimination process -1, Family Characters -1)**	1x3= 03
3.	**C** - Write Botanical name, Family, Morphology of useful part and uses. **(Botanical name – 0.5, Family – 0.5 , Morphology of useful part - 0.5, uses – 0.5)**	1x2= 02
4.	Take T.S of given material **D**. Stain, mount in Glycerin and submit the slide for valuation. Identify, Draw sketches and label it. Give reasons. **(Identification-1, Notes-1)**	1x2= 02
5.	**E** - Take T.S. of anther/ Dissect and display anyone stage of the embryo from the given material, mount in Glycerin and submit it for valuation. Write notes and draw sketch. **(Slide-1, Sketch-1, Notes-1)**	1x3= 03
6.	F -Solve the genetic problem and interpret **(Identification – 1, Derivation /Notes– 1)**	1x2= 02
7.	**G –** Write down the flow chart of emasculation technique/ Genetic heterosis/ Phenotype of heterosis (Maize)- **(Flow Chart - 02)**	1x2=02
8.	Identify and write notes on **H - (Identification-1, Notes-1)**	1x2=02
	Continuous assessment	5
	Total	25

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 25**

1.	**A** – Angiosperm specimen with flower to be given from the families prescribed in the syllabus **(Identification- 1, Notes- 1, Floral diagram – 1, Floral formula - 1)**	1x4= 04
2.	**B** – Angiosperm specimen selected from families prescribed in the syllabus **(Identification-1, Elimination process -1, Reason -1)**	1x3= 03
3.	**C** – Specimens/Models to be given from Economic Botany **(Botanical name – 0.5, Family – 0.5 , Morphology of useful part - 0.5, uses – 0.5)**	1x2= 02
4.	**D** (Dicot or Monocot stem/Dicot or monocot root/Anamolous Secondary Growth - *Boerhaavia, Nycthanthes* and *Dracaena*) materials to be given **(Identification-1 , Notes-1)**	1x2= 02
5.	**E** – Anther- *(Datura/C*assia)/Pollinium- (Calotropis) Embryo/Endosperm from *Tridax/ Cucumber* **(Slide-1, Notes-2)**	1x3= 03

6.	**F** - Genetic problem (test cross/back cross/ Incomplete dominance/Construct the chromosomal mapping in the given data **(Identification – 1, Derivation/Notes – 1)**	1x2= 02
7.	**G** – Protocol emasculation techniques/ model of Genetic heterosis/ Phenotype of heterosis (Maize) - **(Flow Chart – 2)**	1x2=02
8.	**H –** Photographs/Models/Specimens to be given from the cell organelles/Ovules **(Identification-1, Notes-1)**	1x2=02
	Continuous assessment	5
	Total	**25**

III YEAR- V SEMESTER COURSE CODE:

CORE – XII - PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY, PLANT ANATOMY AND EMBRYOLOGY AND CELL BIOLOGY, GENETICS AND PLANT BREEDING

EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	**A –** Dissect out the given plant material, identify and draw sketches of the L.S. of flower, Floral Diagram, Floral Formula and describe the Floral parts. **(Identification- 1, Notes- 2, Floral diagram – 1, Floral formula - 1)**	1x5= 05
2.	**B** - Work out the specimen and identify their respective families through elimination process **(Identification-1, Elimination process -2, Reason -2)**	1x5= 05
3.	**C&D** -Write Botanical name, Family, Morphology of useful part and uses **(Botanical name - 1, Family – 0.5 , Morphology of useful part - 0.5, uses – 1)**	2x3= 6
4.	Take T.S of given material **E &F**. Stain, mount in Glycerin and submit the slide for valuation. Identify, Draw sketches and label it. Give reasons. **(Section - 2, Identification-1, Diagram - 1, Notes-1)**	2x5= 10
5.	**G&H** - Take T.S. of anther/ Dissect and display anyone stage of the embryo from the given material, mount in Glycerin and submit it for valuation. Write notes and draw sketch. **(Slide-2, Notes-2, Sketch-1)**	2x5= 10
6.	I -Solve the genetic problem and interpret **(Identification – 1, Derivation – 1, Interpretation - 1)**	1x3= 3
7.	**J –** Write critical notes on emasculation technique **(Flow Chart - 4)**	1x4=4
8.	K – Identify and write notes on given Model/Photograph/Drawing **(Identification -1, Flow Chart – 2)**	1x3= 3
9.	Identify, draw sketches and write notes on **L,M&N** **(Identification-1, Diagram-1, Notes-1)**	3x3= 9
	Submission of 20 Herbarium & Field note book	10
	Submission of Record note book	10
	Total	75

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 75**

1.	**A** – Plant material with flower to be given from the families prescribed in the syllabus **(Identification- 1, Notes- 2, Floral diagram – 1, Floral formula - 1)**	1x5= 05
2.	**B** – Angiosperm specimen selected from families prescribed in the syllabus **(Identification-1, Elimination process -2, Reason -2)**	1x5= 05
3.	**C & D** - Specimens/Models to be given from Economic Botany **(Botanical name - 1, Family – 0.5 , Morphology of useful part - 0.5, uses – 1)**	2x3= 6
4.	Materials to be given from plant anatomy - **E** (Dicot/Monocot stem and root), **F** - (Anamolous Secondary Growth - *Boerhaavia, Nycthanthes* and *Dracaena*) **(Section - 2, Identification-1, Diagram - 1, Notes-1)**	2x5= 10
5.	**G&H** – Anther- *(Datura/C*assia)/Pollinium- (Calotropis) Embryo/Endosperm from *Tridax/ Cucumber* **(Slide-2, Identification -1 Notes-2,)**	2x5= 10

6.	**I-** Genetic problem (test cross/back cross/ Incomplete dominance/Construct the chromosomal mapping in the given data **(Identification – 1, Derivation – 1, Interpretation - 1**	1x3= 3
7.	**J** - Protocol emasculation techniques **(Identification -1Flow Chart -3)**	1x4=4
8.	**K** – Model/ Flow chart of Genetic heterosis/ Phenotype of heterosis (Maize) to be given **(Identification -1, Flow Chart – 2)**	1x3= 3
9.	**L&M –** Photographs/Models/Specimens to be given from the cell organelles and **N-** Ovules **(Identification-1, Diagram-2, Notes-2)**	3x3= 9
	Submission of 20 Herbarium & Field note book	10
	Submission of Record note book	10
	Total	**75**

DISCIPLINE SPECIFIC ELECTIVE- DSE I
A. BIO-ANALYTICAL TECHNIQUES

Title of the Course		**BIO-ANALYTICAL TECHNIQUES**					
Paper Number		Discipline Specific Elective-I					
Category	DSE-I A	**Year**	III	**Credits**	3	**Course Code**	**23BBO5E1**
		Semester	V				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		3		1	-	4	
Pre-requisite		To impart expertise about analysis and research.					

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

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to the various biological techniques and itsimportance.	K1
CO 2	2.Explain theprinciples of Lightmicroscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	K2
CO 3	3. Apply suitable strategies in data collections and disseminating research findings.	K3&K6
CO 4	4. Compare and contrast the significance of different types ofchromatography techniques.	K4
CO 5	5.Develop methodologies for extraction and analysis of biochemicalcompounds.	K5

	CONTENTS
UNIT 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.
UNIT II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).

UNIT III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
UNIT 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.
UNIT 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.

Extende d Professional Component (is a part of internal component only,Not to beincluded in the External Examina tion questionpaper)	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. 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, 20thcentury publications, Palkalai nagar, Madurai.

ReferenceBooks

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 researchmethods, 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. TataMcGraw 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)

DISCIPLINE SPECIFIC ELECTIVE- DSE I
B. AQUATIC BOTANY

Title of the Course	**AQUATIC BOTANY**						
Paper Number	Discipline Specific Elective-I						
Category	DSE-I B	**Year**	III	**Credits**	3	**Course Code**	**23BBO5E2**
		Semester	V				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	3	1	-	4			
Pre-requisite	To understand ecological functions and economic uses of aquatic plants.						

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme outcomes**
1.Recognizeaquatic plants and their ecological importance.	K1
2.Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
3.Apply techniques forconservation of aquatic plants For valueaddition.	K3
4. Analyze anddecipher the significance and properties ofmangroves, other aquatic angiosperms and microalgae.	K4
5. Develop new strategies to conserve mangroves anddevice innovative methods for cultivationofaquatic plants.	K5 &K6

	CONTENTS
UNIT 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.*
UNIT 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.

UNIT III	**PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES ANDDIATOMS:** Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.
UNIT IV	**AQUATIC ANGIOSPERMS:** Common aquatic angiosperms of India, including Lotus, Water Lilly, Waterhyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
UNIT 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 ofinternal 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'sMicrobiology. 9th Edition. Mc Graw Hill International.
3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-WestPress, Delhi.
4. Hoek, C. Van, D. 1999. An Introduction to Phycology. CambridgeUniversity 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 MangroveEcosystems. 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 NostrandReinhold Co.,NY.375 pp.
5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw HillInternat.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- science.pdf
6. 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)**

DISCIPLINE SPECIFIC ELECTIVE- DSE I
C. ENTREPRENEURIAL BOTANY

Title of the Course	**ENTREPRENEURIAL BOTANY**					
Paper Number	Discipline Specific Elective-I					
Category	DSE-IC	**Year**	III	**Credits**	3	**Course Code 23BBO5E3**
		Semester	V			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		3	1		-	4
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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Recognize the significance of government agencies for entrepreneurship development.	K1
CO 2	2. Explainabout entrepreneurial values, riskassessment and solutions	K2
CO 3	3. Make use of entrepreneurialopportunities.	K3
CO 4	4. Analyze and decipher the significance of bioventure and value added products.	K4
CO 5	5. Devise innovative method formaking value added products.	K5 &K6

	CONTENTS
UNIT I	**INTRODUCTION:** Need - definition and concept - Types and characterization – entrepreneurial values- motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
UNIT 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.
UNIT 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.

UNIT 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.
UNIT 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 Professional Component (is a part of internalcomponent only,Not to be included in theExternal 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 acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

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.Himalayapublication house, Mumbai. ISBN:9789350973837.
3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand companylimited, New Delhi.ISBN:9788121918015.
4. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book ofPractical Botany 1 (10^{th} ed).Rastogi Publications, Meerut.
5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d EditionAgrobios (India), Jodhpur.

ReferenceBooks

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 andvegetables. Indian Council of Agricultural Research (ICAR). ISSN:0101-2061.
3. Ranganna,S.,2001.Handbook of analysis and quality control of fruitsand 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 HillBook 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)**

DISCIPLINE SPECIFIC ELECTIVE- DSE II

A. PLANT BIORESOURCES

Title of the course	**PLANT BIORESOURCES**					
Paper Number	Discipline Specific Elective-II					
Category	DSE- II A	**Year**	III	**Credits**	3	**Course Code 23BBO5E4**
		Semester	V			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		3	1		-	4
Pre-requisite	Knowledge gained on structure, reproduction & life cycle of different plant groups in XII Std & I yr UG.					

Learning Objectives		
C1	To know the existing usages of various plant Bioresources	
C2	Gain knowledge on various production process & applications of the plant Bioresources	
C3	Encourage research and enterpreuner ideas about plant Bioresources & its utilization in different fields.	
C4	To know about the organic farming	
C5	To understand market value of cryptogams and gymnosperms	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Understand algae as bioresourses in field of soil fertility, medicine and research; role of algae in pollution studies.	K1
CO2	Learn about algal commercial products.	K2
CO3	Appreciate industrial uses of Fungi.	K3
CO4	Explore the use of Lichens, Bryophytes, Pteridophytes and Gymnosperms.	K4
CO5	Expose to production of Industrial products.	K5
	CONTENTS	
UNIT I	**AGRICULTURE USES OF ALGAE:** Algae- Role of algae in soil fertility, green manure, nitrogen fixation, symbiosis. Medicinal uses, biofuels, research tools. Algae as pollution indicators, algae and sewage disposal (sewage oxidation ponds) water blooms, eutrophication, neurotoxins and parasitic algae.	
UNIT II	**INDUSTRIAL USES OF ALGAE:** Role of algae as food and fodder. Commercial products- Agar- Agar, 50arrageenan, Alginic acid, diatomite and their uses in various industries. Algae and space travel and future food. Methods of cultivation of seaweeds.	
UNIT III	**INDUSTRIAL USES OF MICROBES** Fungi and bacteria: Role in medicine, food, industrial uses –alcohol, enzyme, organic acid, hormones, cheese, proteins, vitamins, antibiotics, probiotics. Harmful effects of fungi on man and plants (outline only).	

UNIT IV	**ORGANIC FARMING & BIO-REMEDIATIONS:** Organic farming- definition and basic concepts, farm manures, mulches, mycorhizal association, types.VAM and its uses. Recycling of biodegradable municipal, agricultural and industrial wastes, bio composting, Effective micro-organisms.
UNIT V	**USES OF CRYPTOGAMS AND GYMNOSPERMS:** 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 Professional Component (is a part ofinternal component only, Not to be included in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Vashishta, B.R., Sinha, A.K. and Singh, V.P. 2008. Botany for DegreeStudents: Algae. S. Chand & Company Ltd., New Delhi.
2 Vashishta, B.R. 1990. Botany for Degree Students: Fungi. S. Chand &Company Ltd., New Delhi.
3. Vashista, P.C. 1997. Botany for Degree StudentsPteridophyta. S. Chand andCompany Ltd., New Delhi.
4 Vashishta, P.C. 1996. Botany for Degree Students-Gymnosperms (2nd Edn.,).
S. Chand and Company Ltd., New Delhi.
5. Pandey, B.P. 2001. College Botany Vol. I: Algae, Fungi, Lichens, Bacteria,
Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand &Company Ltd., New Delhi.

ReferenceBooks

1. Kumar, H.D. 1999. Introductory Phycology (2nd edition). Affiliated EastWestPress Pvt. Ltd. Delhi.
2. Sharma OP. 1989. Text Book of fungi. Tata McGraw Hill, New York.
3. Hale, 1996. The biology of Lichens, New Age International Publishers, NewDelhi.
4. Smith, G.M. 1955. Cryptogamic Botany Vol. II Bryophytes and Pteridophytes(2nd edn.). Tata McGraw Hill Publishing Co., New Delhi.
5. Pandey. 1998. A Text Book of Botany Vol. II. S. Chand & Co. Ltd. 1980.
5. Palaniappan, S.P and K. Annadurai. 2018. Organic farming theory and practice,Scientific Publishers Jodhpur, India.

Web resources

1. https://www.mooc-list.com/course/introduction-algae-coursera
2. https://swayam.gov.in/nd2_cec20_bt11/preview
3. https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice,- Oil,-Fibre,-Timber-yielding-plant_1095/
https://onlinelibrary.wiley.com/doi/book/10.1002/9781118460566 5.

Mapping with Programme Outcomes:

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

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

DISCIPLINE SPECIFIC ELECTIVE- DSE II
B. SEED BIOLOGY

Title of theCourse	**SEED BIOLOGY**					
Paper Number	Discipline Specific Elective-II					
Category	DSE-II B	**Year**	III	**Credits**	3	**CourseCode**
		Semester	V			**23BBO5E5**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		3	1		-	4
Pre-requisite	**Knowledge on seeds, germination, viability and seed dormancy gained during lower classes.**					

Learning Objectives		
C1	Study the morphology, structural details of economicaly important seeds.	
C2	Know about chemical composition and seed germination techniques.	
C3	Perform seed germination test.	
C4	Understand seed viability, tetrazolium test and seed vigour test.	
C5	Learn dormancy, it's various kinds and significant factors to break dormancy.	
Course outcomes:CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Understand seed biology and morphology of different seeds.	K1 & K2
CO2	Learn about seed viability test (Tetrazolium test), seed vigour concepts .	K3
CO3	Know about chemical composition of the above seeds, their germination, factors affecting it and treatment to quicken germination.	K4
CO4	Gain knowledge on various seed germination tests. seed germination.	K5
CO5	Overview what is dormancy, its kind, significance and how to break it.	K6

	CONTENTS
UNIT I	**INTRODUCTION TO SEED BIOLOGY:** Morphology and structural details of seeds: Cereals : Paddy / Wheat Pulses : Dolichos /Glycine Oil seeds : Castor Fibers : Cotton Vegetables : Cucurbita Study on importance of seed.
UNIT II	**SEED GERMINATION:** Chemical composition of seeds mentioned above. Germination - General account. Factors affecting germination. Changes that take place during germination (physical and chemical) Treatments given to quicken germination.
UNIT III	**SEED GERMINATION TEST AND EVALUATION:** Seed germination test under laboratory conditions. Using paper (BP & TP) sand and soil. The environmental test conditions also are discussed. Evaluation of germination test.

UNIT IV	**SEED VIABILITY:** Seed viability; Topographical Tetrazolium Test. Preparation of solution and methods of application & evaluation. Seed vigour: Concept, Direct and Indirect vigour tests.
UNIT V	**SEED DORMANCY:** Dormancy – Primary and secondary dormancies. Significance, factors involved, methods used to break dormancy.

Extended Professional Component (isa part ofinternal component only, Not to beincluded in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Mayer A. M & Poljakoff Mayer. 1975. Germination of seeds. Springer.Pergamon Press, Oxford—New York—Toronto—Sydney—Paris
2.Bryant, J. A.1985. Seed physiology -–Edward Arnold. London.
3. Agarwal, R.L. 1982. Seed Technology -. Oxford and IBH Publishing Company,New Delhi.
4. Bewley, J.D and M. Black.1978. Seed Biology Vol. I & II Academic press,New York.
5. Agarwal, R.L. Seed Technology. 2020. CBS Publishers and Distributors PvtLtd.

ReferenceBooks

1. Mayer, AM and Poljakoff-Mayber, A. 1989. The Germination of Seeds 4thedn. Pergamon Press, England.
2 Baskin, C.C and Baskin, J.M. 2001. Seeds: Ecology, Biogeography and Evolution of Dormancy and Germination, Academic Press, San Diego.3 Bedell, PE. 1998. Seed Science and Technology: Indian Forestry Species.Allied Publishers Limited, New Delhi. 4 Bewley, J.D and Black, M. 1994. Seeds: Physiology of Development and Germination. 2nd edn. Plenum Press, New York.5 Khan, A.A. (Latest Edition) (Ed.). 1977. The Physiology and Biochemistry of seed Dormancy and germination. North-Holland Publishing Company: AmsterdamNew York-Oxford.

Web resources

1. https://swayam.gov.in/nc_details/NPTEL 2 https://swayam.gov.in/NPTEL 3
2.https://swayam.gov.in/explorer 4
3.https://www.classcentral.com/course/swayam-principles-of-seed-technology- 17741
4. https://www.classcentral.com/course/swayam-plant-groups-19787 6
5.https://www.kanchiuniv.ac.in/assets/SWAYAM-BOOKLET.pdf 7
6.https://www.hindiyojana.in/swayam-free-online-course-registration/ 87.https://www.aicte-india.org/sites/default/files/SWAYAM_1.pd

Mapping with Programme Outcomes:

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

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

DISCIPLINE SPECIFIC ELECTIVE- DSE II
C. POMOLOGY

Title of theCourse	**POMOLOGY**					
Paper Number	Discipline Specific Elective-II					
Category	DSE-II C	**Year**	III	**Credits**	3	**CourseCode 23BBO5E6**
		Semester	V			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		3	1		-	4
Pre-requisite	Basic knowledge on fruit cultivation, harvesting and disease management gained during Class XII.					

Learning Objectives		
C1	Understand pomology, tropical fruit cultivation, its status, fruit growing regions of India and in Tamil Nadu.	
C2	Find out the overall strategies and techniques to grow different commercial fruits.	
C3	Impart knowledge on cultivation methods of some prominent fruit varieties.	
C4	Learn about the cultivation methods of subtropical and tropical fruits.	
C5	Study about temperate fruits and their propagation methods.	
Course outcomes:CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Gain information about cultivation of Indian fruits.	K1
CO2	Understand pomology, tropical fruit cultivation of India.	K2
CO3	Identify methods for producing subtropical humid zone fruits.	K3 & K4
CO4	Get a thorough knowledge about classification and production methods of temperate fruits.	K5
CO5	Learn about the production of export varieties of fruits.	K6

	CONTENTS
UNIT I	**INTRODUCTION TO TROPICAL FRUITS:** Tropical fruit cultivation – Past and present status or tropical fruits in India. General appraisal of fruit growing regions / Zones in India and Tamil Nadu.
UNIT II	**TROPICAL FRUIT CULTIVATION:** Production, productivity, varieties- exportable varieties. Climate and soil requirements-propagation techniques-planting. Nutrition-nutrient deficiency and management– flowering, fruit set, bearing problems - special horticultural technique. Harvesting techniques – post harvest handling & post-harvest treatments - ripening of fruits - storage and processing of Mango, Banana.
UNIT III	**EDAPHIC FACTOR FOR FRUIT CULTIVATION:** Climate and Soil environments- varieties- Propagation-Planting requirements, manures and manuring of Papaya, Guava, Sapota, Lemon, Sweet orange, Jack fruit and Pine apple.

UNIT IV	**MANAGEMENT OF FRUIT CROPS:** Subtropical and humid zones of India and Tamil Nadu – importance and scope of fruit crops in these zones – varieties, propagation and planting and aftercare, – management of nutrient – water needs – weed management – Training and pruning method – physiology of flowering, use of plant growth regulators – harvesting procedures – post harvest aspects of the following crops: Mandarin, Avocado, Litchi, Carambola.
UNIT V	**PRODUCTION AND POST HARVEST MANAGEMENT OF FRUIT CROPS:** Classification of temperate fruits – detailed study of area, production, varieties, climate and soil requirements – propagation – planting density – cropping systems– training and pruning –use of growth regulators – nutrient and weed management – harvesting – post harvest handling and storage in the following crops: Apple, Pear, Plum, Strawberry, Cherries.
Extended Professional Component (isa part of internal component only, Not to beincluded in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. Bose, T. K.S K. Mitra, and D. S. Rathore. 1998. Temperate Fruits –Nayaprakash, Calcutta.
2. Bose, T.K. 1996. Fruits of India – Tropical and sub – tropical. Nayaprakash,Calcutta.
3. Bose T.K. S. K. Mitra and M. K. Sadhu. 1988. Mineral Nutrition of FruitCrops. Naya Prokash,Calcutta.
4. Bose, T. K., S. K. Mitra and D. Sanyal, 2001. Fruits: Tropical and subtropicalvolume I. Naya Udyog, Calcutta.
5. Gardener, Bradford and Hooker. 1952. Fundamentals of fruit production. McGraw Hill Book Co. Inc. London.
6. Singh, S., Krishnamoorthy. S., and Katyal, S. L. 1967. Fruit culture in India.ICAR, New Delhi.

ReferenceBooks

1. Bose, T.K & S. K. Mitra, Nayaprakash. 1990. Fruits: Tropical andsubtropical.206 Bidhan Saram, Calcutta –700 116, India.
2. Mithra, S. K. T. K. Bose and D.S. Rathore. 1990. Temperate fruits.Horticulture and Allied Publisher.
3. Chattopadhyay, T. K. 1994. A text book of Pomology (Vol 1-3) KalyaniPublishers, New Delhi.
4.Pal, J.S. 1997. Fruit Growing, Kalyani Publishers, New Delhi.
3. 5. Singh, S.P. 1995. Commercial Fruits, Kalyan Publishers, Ludhiyana.

Web resources

1. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php 8
2.https://www.indiacustomercare.com/swayam-online-education-toll-free- number-18001219025 9
3.https://www.britannica.com/science/pomology 104.https://www.thefreedictionary.com/pomolog
5. 2 https://swayam.gov.in/NPTEL

Mapping with Programme Outcomes:

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

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

ACADEMIC-INDUSTRIAL ACTIVITY
Internship/Industrial Training

Title of the Course	**ACADEMIC-INDUSTRIAL ACTIVITY**						
Paper Number	**Skill Enhancement**						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	23BBO5I/ 23BBO5IT
		Semester	II				
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
			-				
Pre-requisite	The summer vacation academic-industrail activity programme will give students the chance to experience real-world organisational situations, learn about processes and rules, and grasp the operations of the industry.						

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

Course Outcom:CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	For students in those pertinent core areas, the internship is preparing them to become professionals after graduation	K1
CO2	Compile data and familiarize yourself with techniques and carrying out tests	K2
CO3	Collect data and educate yourself on how to analyze the res Your scientific studies.	K3 & K5
CO4	This in-the-moment industrial exposure helps them become knowledgeble and skilled in the latest technology.	K4
CO5	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur	K5 & K6

	CONTENTS	No. of Hours
UNIT I	**Guidelines for Internship Programme:** 1. To give students the opportunity to spend at least fifteen days on their own during the IV Semester vocation in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures. 2. Individual instruction is provided for the internship. The internship programme must be completed in order to receive a credential. 3. Students are required to indentify a research labs/industry/recognized institution for their Internship Programme Coordinator in consultation with and approval of their faculty guide. The choice of the research labs/industry/recognized institution should be intimated to the Internship coordinator before commencement of the Internship. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship Program. 4. Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or shareholders, the nature of business, organizational structure, reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter. 5. Before leaving the research labs/industry/recognized institution, obtain the Internship Programme completion certificate on the letterhead of a research lab/industry/, or an accredited institution. 6. Maintain Internship Programme record with details on activities and personal learning during their project period. 7. The department head and the coordinator of the internship programme form a committee to ensure that the internship is followed. 8. At least two copies of the report must be prepared by the intern at the conclusion of the internship program—one for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labeled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages. 9. The internship training report should be submitted to the department within a month from the date of commencement of Fifth semester. 10. However, such submission shall not be accepted after the end of Fifth semester Examinations.	

UNIT II	**Evaluation of the Internship:** i. The internship program will be assessed by the assigned Internship Programme Coordinator from the host institute. ii. Evaluation will be done by the Internship Programme Coordinator of the host institute and through seminar presentation/viva-voce. iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information. iv. According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the internship coordinator.	
UNIT III	**College Guide Manual – Summer Internship Program** 1. The Internship Programme Coordinator should give proper procedures to the intern before and after the Internship. 2. The Internship Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the internship. 3. The weekly report submitted by the student should be reviewed and reported to the Internship Programme coordinator.	
UNIT IV	Academic Industrial Activity- Programme **Internal:** 25 marks Presentation -25 marks **External:** 75 marks Completion certificate - 40 marks Internship report - 35 marks	
UNIT V	**CONTENTS OF THE REPORT** Title page Page for supervisory committee Table of Acknowledgement Academic Industrial Activity- Programme Certificate **Executive Summary** Introduction of the Report Overview of the Organization What I have Learned Analyses Summary Recommendations and Conclusion References Appendices	

Course outcomes: CO	On completion of this course, the students will be able to:	Programme outcomes
CO 1	1. For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.	K1
CO 2	2. Compile data and familiarize yourself with techniques for pl anning an carrying out tests.	K2
CO 3	3. Collect data and educate yourself on how to analyze the results of you scientific studies.	K3 & K5
CO 4	4. This in-the-moment industrial exposure helps them become knowledgeble and skilled in the latest technology.	K4
CO 5	5. Improving communication skills and coming up with creative id crucial components of training that help someone become an entrepre	K5 & K6

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 Text:

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	1	3	3	3	3	3	2
CO 2	3	3	3	3	3	3	2	1	3	3
CO 3	3	3	3	3	3	3	2	1	3	3
CO 4	3	2	3	3	3	3	3	2	3	3
CO 5	3	3	3	3	3	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**	4	**Course Code** **23BBO6C1**
		Semester	VI			
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**
	3		1		-	4
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:CO	On completion of this course, the students will be able to: CO	**Programme outcomes**
CO1	1. Relate to the significance of the biotic and abiotic componentsof the ecosystems and energy flow.	K1
CO 2	2. Summarizethe phytogeographical division of India.	K2
CO 3	3. Explain theimplication of pollution on the environment.	K3
CO 4	4. Analyzethe implications of functionaland behavioral ecology innatural and man-made areas, biodiversity and conservation.	K4
CO 5	5. Developmitigations for the effective conservation of biodiversity and disastermanagement.	K5

	CONTENTS
Unit I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. 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.
Unit 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.
Unit III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*).

Unit 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.
Unit V	**Phytogeography Introduction**, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance. 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 Professional Component (is a part ofinternal component only, Not to be included inthe External Examinationquestion paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired fromthis course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

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 IndiaPvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An EarthSystems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas PublishingHouse Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between aircontaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. Melchias, G., 2001. Biodiversity and Conservation, Science PublishersInc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmentalstudies. 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.
8. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBSPublishers 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 andDiversity)
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**	4	**Course Code**	**23BBO6C2**
		Semester	VI				

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

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:CO	On completion of this course, the students will be able to: CO	**Programme outcomes**
CO1	1.Recognize the fundament als concepts ofplant biotechnology and genetic engineering.	K1
CO 2	2.Explain various steps intranscription, proteinsynthesis and protein modification.	K2
CO 3	3. Elucidate gene cloning andevaluate different methods of gene transfer.	K3
CO 4	4. Analyze the majorconcerns and applications of transgenic technology.	K4
CO 5	5. Developtheir competency on different types of plant tissue culture.	K5

	CONTENTS
UNIT 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*).
UNIT 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. Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method,
UNIT III	*Agrobacterium* mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros andcons of GM food.

UNIT 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.
UNIT 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 (isa part ofinternal component only, Not to beincluded in theExternal Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, 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, NewDelhi.
4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier IndiaPvt. 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

ReferenceBooks

1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principlesand applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.
2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, NewDelhi.
3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to genetechnology, VCR Pub., Weintein.
4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freemanand Co., New York.
5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III,Coldspring Harbor Laboratory Press, New York.
6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.
7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum,New York.
8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondarymetabolism of plant cell cultures – Springer – Verlag, Berlin.
9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin.
10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac million,New York.
11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, SpringerVerlag. 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 theCourse	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**						
Paper Number	CORE XVI						
Category	Core	**Year**	III	**Credits**	4	**Course Code**	23BBO6C3
		Semester	VI				

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

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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to water relation of plants with respect to various physiological phenomenon.	K1
CO 2	2. Explain the process and significance of photosynthesis and respiration.	K2
CO 3	3. Elucidate properties of nutrients and their deficiency symptoms inplants.	K3
CO 4	4. Analyze the biological role of plantgrowth regulators, carbohydrates, proteins, lipids, nucleic acids andenzymes.	K4
CO 5	5. Decipher the phenomenon of seed dormancy and germination inplants.	K5

	CONTENTS
UNIT 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.
UNIT 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

UNIT III	**RESPIRATION** Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient. **NITROGEN METABOLISM** Biological nitrogen fixation, nitrogen cycle.
UNIT 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).
UNIT 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 ProfessionalComponent (is a part ofinternal component only, Not to be included in the (External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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

RecommendedTexts

1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, NewDelhi.
2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing HouseLtd., 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 ofBiochemistry, Chand & Co. Ltd., New Delhi.
5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and CompanyLtd., New Delhi.
6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley EasdternLtd., 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.

ReferenceBooks

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 andMolecular 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 (secondedition).

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. NarosaPublishing House, New Delhi.
10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). SinauerAssociates, Inc., Publishers, Massachusetts, USA.
11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (secondedition). 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 XIII, XIV AND XV - PRACTICAL-VI

Title of the Course	**PRACTICAL-VI - PLANT ECOLOGY AND PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY AND PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**					
Paper Number	CORE XVI					
Category	Core	**Year**	III	**Credits**	4	**CourseCode: 23BBO6P1**
		Semester	VI			

Instructional Hoursper 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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to the distribution and adaptions of plants pertaining to their habitat	K1
CO 2	2. Demonstrate skills in green planningand callus culture.	K2
CO 3	3. Elucidate the basic principlesinvolved in the plant physiology and biochemistry experiments.	K3
CO 4	4. Appreciate the structure and functions of DNA and RNA.	K4
CO 5	5. Estimate the biochemical components and determine the factorscontrolling 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).

6. 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*
7. Map of the phytogeographical regions of India.
8. Quadrate study and line transect.
9. Plan for a green building.
10. 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.
10. 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 fromthis 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 PlantPhysiology andBiochemistry. Scientific Publisher.

Web resources

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

Mapping with Programme Outcomes:

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

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

III YEAR- VI SEMESTER COURSE CODE:

CORE – XVI - PLANT ECOLOGY AND PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY AND PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

INTERNAL

Time: 3hrs **Max. Marks: 25**

1.	**A** Taking a lot, ask for requirement, write the procedure, setup and perform the experiment as indicated, collect data/ measurements, present them and interpret the result. **(Requirements-1, Procedure-1, Result-1, Interpretation-1)**	1x4=04
2.	Identify and write notes on **B** **(Identication-1, Notes-1)**	1x2=02
3.	**C** -Analyze the vegetation in already constructed quadrate/transect. Tabulate the observed data and calculate frequency density and abundance. Express the result through the graph. **(Procedure-1, Tabulation-1, Result-1,Interpretation-1)**	1x4=04
4.	**D** - Identify and write notes on adaptations of given material **(Identification-1, Notes-1)**	1x2=02
5.	**E-** Taking a lot, ask for requirement, write the procedure, setup and perform the experiment, tabulate the data and interpret the result **(Procedure-2, Tabulation-1, Result-1)**	1x4=04
6.	**F-** Identify, write down the flow chart **(Identification-1, Flow chart -1)**	1x2=02
7.	**G** Identify and write notes on the given spotter **(Identification-1, Notes-1)**	1X2=02
	Continuous assessment	5
	Total	**25**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 25**

1.	**A** – Physiology Major experiments to be given **(Requirements-1, Procedure-1, Result-1, Interpretation-1)**	1x4=04
2.	**B** Physiology Minor Experiments to be given **(Identication-1, Notes-1)**	1x2=02
3.	**C** Analyze the vegetation in the already constructed quadrate/transect. **(Procedure-1, Tabulation-1, Result-1,Interpretation-1)**	1x4=04
4.	**D-** Hydrophyte/ Mesophyte/ Xerophyte/Halophyte/Epiphyte to be given **(Identification-1, Notes-1)**	1x2=02
4.	**E** – pH of the any two soil /Carbohydrate, Lipid and Protein **(Procedure-2, Tabulation-1, Result-1)**	1x4=04
5.	**F-** Biotechnology (Sterilization technique/MS medium preparation) **(Identification-1, Flow chart -1)**	1x2=02
6.	**G** Biotechnolgy/molecular biology photographs/models to be given **(Identification-1, Notes-1)**	1X2=02
	Submission of Record Note Book	5
	Total	**25**

III YEAR- VI SEMESTER COURSE CODE:

PLANT ECOLOGY AND PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY AND PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

EXTERNAL QUESTION

Time: 3hrs **Max. Marks: 75**

1.	**A** Taking a lot, ask for requirement, write the procedure, setup and perform the experiment as indicated, collect data/ measurements, present them and interpret the results **(Requirements-2, Procedure-4, Result-2, Interpretation-2)**	1x10 =10
2.	Identify and write notes on **B** **(Identication-1, Procedure/Notes-4)**	1x5=05
3.	**C** -Analyze the vegetation in already constructed quadrate/transect. Tabulate the observed data and calculate frequency density and abundance. Express the result through the graph. **(Requirements-2, Procedure-2, Tabulation-2, Result-2, Interpretation-2)**	1x10=10
4.	**D-** Hydrophyte/ Mesophyte/ Xerophyte/Halophyte/Epiphyte to be given **(Identification-1, Sketches-2, Notes-2)**	1x5=5
5.	**E&F-** Taking a lot, ask for requirement, write the procedure, setup and perform the experiment, tabulate the data and interpret the result **(Identification- 1 , Procedure-2, Result-2)**	2x5=10
6.	**G** -Identify, write down the flow chart **(Identification-1, Flow chart -4)**	1x5=05
7.	**H, I&J-** Identify and write notes on given spotters **(Identification-1, sketches-2, Notes-2)**	3x5=15
	Field trip to any one Wetland/Pond	5
	Submission of Record Note Book	10
	Total	**75**

KEY AND SCHEME OF VALUATION

Time: 3hrs **Max. Marks: 75**

1.	**A** – Physiology Major experiments to be given **(Requirements-2, Procedure-4, Result-2, Interpretation-2)**	1x10 =10
2.	**B** Physiology Minor Experiments to be given **(Identication-1, Procedure/Notes-4)**	1x5=05
3.	**C** Analyze the vegetation in already constructed quadrate/transect. **(Requirements – 2, Procedure-2, Tabulation-2, Result-2, Interpretation-2)**	1x10=10
4.	**D-** Hydrophyte/ Mesophyte/ Xerophyte/Halophyte/Epiphyte to be given **(Identification-1, Sketches-2, Notes-2)**	1x5=5

5.	**E**-pH of the any two soil & **F-** Carbohydrate, Lipid and Protein **(Identification- 1, Notes-2, Demo-2)**	2x5=10
6.	**G-** Biotechnology (Sterilization technique/MS medium preparation) **(Identification-1, Flow chart -4)**	1x5=05
7..	**H-** Biotechnology, **I-** Molecular Biology & **J-** Phytogeographical regions of India models/photographs/ Maps to be given **(Identification-1, Sketches-2, Notes-2)**	3X5=15
11.	Field trip to any one wetland	5
12.	Submission of Record Note Book	10
	Total	**75**

DISSERTATION/ PROJECT WITH VIVA-VOCE (GROUP PROJECT)

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PROJECT: GROUP PROJECT</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">Skill Enhancement</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Skill Enhancement</td><td>Year</td><td>III</td><td rowspan="2">Credits</td><td rowspan="2">3</td><td rowspan="2">Course Code</td><td rowspan="2">23BBO6D/ 23BBO6PR</td></tr>
<tr><td>Semester</td><td>VI</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td></td><td colspan="2">3</td><td colspan="2">3</td><td>6</td></tr>
<tr><td colspan="2">Pre-requisite</td><td colspan="6">To allow students to demonstrate the personal abilities and skills required to produce and present an extended piece of work and as well as to practice writing thesis</td></tr>
<tr><td colspan="2">Learning Objectives</td><td colspan="6">1.To recognize the concept of research and its various forms in the context of botany.</td></tr>
<tr><td colspan="2"></td><td colspan="6">2.To improve abilities relating to scientific experiments.</td></tr>
<tr><td colspan="2"></td><td colspan="6">3.To become proficient in data collection and the documentation of scientific findings.</td></tr>
<tr><td colspan="2"></td><td colspan="6">4.To prepare students for entry-level positions or professional training programmes in any field of Botany.</td></tr>
<tr><td colspan="2"></td><td colspan="6">5.Compare the various reporting and writing styles used in science.</td></tr>
<tr><td colspan="2"></td><td colspan="6">CONTENTS</td></tr>
<tr><td colspan="2">UNIT I</td><td colspan="6">1. Each student will be allotted a Project Guide from the faculty of the department concerned by lot method.
2. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester.
3. After the completion of the project work, the student has to submit four copies of dissertation with report carrying his/her project report for evaluation by examiners. After evaluation, one copy is to be retained in the College Library.
4. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each.
5. Viva-voce will be conducted by the panel comprising, External examiner</td></tr>
<tr><td colspan="2"></td><td colspan="6">All the candidates of M.Sc (Botany) are required to undergo a major project and submit the following:
1. Dissertation/Thesis based on the work done by the student.
2. Soft copy of the project on VD.</td></tr>
</table>

	PROJECT EVALUATION GUIDELINES: **The project is evaluated on the basis of following heads:** For Viva-Voce maximum is 60 marks which will be conducted by both the internal and external examiners during end semester university practical examinations **Internal:** 25 marks I Review – Selection of the field of study, topic and literature collection - 05marks II Review – Research design and data collection - 10 marks III Review – Analysis and conclusion, preparation of rough draft - 10 marks **External:** 75 marks Thesis/ Dissertation - 40 marks Presentation - 20 marks Viva-voce - 15 marks
UNIT III	**Suggested areas of work:** Algae,fungi, microbiology, biocontrol agents, plant tissue culture, plant physiology, phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, sustainable agriculture, herbal formulations, cytogenetics, molecular biology, biotechnology, bioinformatics, nanotechnology and applied botany.
UNIT IV	**Methodology:** **Each project should contain the following details:** 1. Brief introduction on the topic 2. Review of Literature 3. Materials and Methods 4. Results and Discussion – evidences in the form of figures, tables and photographs 5. Summary 6. Bibliography

Extended Professional Component (is a part of internal component only, Not to be included in the External 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
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional, Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of PracticalBiochemistry (4th Edition) Cambridge University Press, Cambridge.
2. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.
3. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
4. Wilson, K and J. Walker. 2005. Principles and Techniques of Practical Biochemistry, 5th Edition. Cambridge University press, New York.

Reference Books:

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

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

ELECTIVE-II
HORTICULTURE

Title of the Course		**HORTICULTURE**					
Paper Number		Elective-II					
Category	DSE-III A	**Year**	III	**Credits**	3	**CourseCode 23BBO6E1**	
		Semester	VI				
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		2		1		-	3
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: CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Enumeratethe concepts in horticulture andnursery management.	K1
CO 2	2. Demonstrate a working knowledge onbiology of soil,compost making, designing and planning of garden, pest,diseases andnutrient management practices.	K2
CO 3	3. Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
CO 4	4. Analyzedifferent methods ofweed control in horticulturalcrops.	K4
CO 5	5. Developtheir competency onpre and post-harvest technology in horticulturalcrops.	K5 & K6

	CONTENTS
UNIT 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.
UNIT II	Hydroponic culture-types of container. Use of manures and fertilizers inHorticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.
UNIT 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.

UNIT IV	A brief account of annual, biennials and perennials with reference to ornamentalgardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.
UNIT 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 ProfessionalComponent (is a part ofinternal component only, Not tobe includedin the External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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 – principlesand practices. Half of India. New Delhi.
2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical andsubtropical 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, KrishiBhavan, New Delhi.
5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBHPub., Co., Calcutta.
6. Gopalswamy Iyyangar. 1970. Complete gardening in India, KalyanPrinters, Bangalore.
7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants inIndia (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi

Reference Books

1. Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca.
2. Bailey, S. 1971. Perpectual flowering carnation, Fabner and Fabner,London.
3. Laurie, A., Kiplingr, D.D and Nelson, K.S. 1968. Commercial flowerforcing. 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 HallLtd., 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.
8. Helleyer, A. 1976. The Collingridge Encyclopedia of gardeningChartwell Book, Inc., New Jercy.

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE-II
NATURAL RESOURCE MANAGEMENT

Title of theCourse		**NATURAL RESOURCE MANAGEMENT**					
PaperNumber		Elective-II					
Category	DSE-III B	**Year**	III	**Credits**	3	**CourseCode**	**23BBO6E2**
		Semester	VI				
InstructionalHours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		2		1		-	3
Pre-requisite		To understand the concept of different natural resources and their utilization.					

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

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate tosignificance ofnatural resources pertaining to economy and environment	K1
CO 2	2. Understandthe concept of different natural resources and their utilization.	K2
CO 3	3. Evaluate themanagement strategies of different natural resources.	K3
CO 4	4. Criticallyanalyze the sustainable utilization land, water,forest and energy resources.	K4
CO 5	5. Design new models of natural resource conservation and maintenance.	K5 & K6

	CONTENTS
UNIT I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among differenttypes of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.
UNIT 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.

UNIT III	Landscape impact analysis, wetland ecology & management. Waterresources: 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.
UNIT 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.
UNIT 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 Professional Component (is a part of internal component only,Notto 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 fromthis course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa PublishingHouse, New Delhi.
2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and ResourceConservation. Anamaya Publications, New Delhi.
3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to SustainableDevelopment. Prentice Hall of India Private Limited, New Delhi.
4. United States Government Accountability Office.2008. Natural ResourceManagement. 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 forSustainable Development. Daya Publishing House, New Delhi.

ReferenceBooks

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, BlackwellScience.
8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.
3. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.

Web resources

1. https://books.google.co.in/books/about/Natural_Resource_Management.html ?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Man agement.html?id=Tz9iDM6crLIC&redir_esc=y
2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and _Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
4. https://www.kobo.com/us/en/ebooks/natural-resources
5. https://www.igi-global.com/chapter/natural-resources-management/195183
6. 6crLIC&redir_esc=y
7. https://books.google.co.in/books/about/Natural_Resource_Conservation_and _Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
8. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE
9. https://www.kobo.com/us/en/ebooks/natural-resources
10. https://www.igi-global.com/chapter/natural-resources-management/195183

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-II
FORESTRY

Title of the Course		**FORESTRY**				
Paper Number		Elective-II				
Category	DSE-III C	**Year**	II	**Credits**	3	**CourseCode 23BBO6E3**
		Semester	VI			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	1		-	3
Pre-requisite		Prior knowledge on trees, forests and their importance.				

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

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to the basic concepts related to forest distribution, degradation,protection, managementand resource utilization.	K1
CO 2	2. Understand complex interactions of humans and forest ecosystems in a global context.	K2
CO 3	3.Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
CO 4	4.Examine and decipher the factorsinfluencing forest vegetation, forest degradation and methods of wood preservation	K4
CO 5	5.Developnew strategiesand apply theknowledge gained forproblem-solving analysis in theconservation and management Of forest ecosystems.	K5

CONTENTS

UNIT I	**SILVICULTURE:** Forests - definition. Extent of forests in India and other countries. Forest typesof 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 andmethods - macro and micro propagation techniques.

UNIT 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.
UNIT 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.
UNIT 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.
UNIT 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 andnecessity - 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 (isa part ofinternal component only, Not to beincluded in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

Recommended Texts

1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthroughapproach to forest service. Jain Bros.
2. Roger Sands. 2013. Forestry in a global context, CAB international.
3. Balakathiresan. S.1986. Essentials of Forest Management. NatrajPublishers, Dehradun.
4. Agarwala, V.P. 1990. Forests in India, Environmental and ProtectionFrontiers. 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, DehraDun.
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. OxfordIBH Publishing Co., New Delhi.
5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from thebamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia.
6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. 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/WDSContentServ er/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-III
1. BIONANOTECHNOLOGY

Title of the Course	BIONANOTECHNOLOGY						
Paper Number	Elective-III						
Category	DSE-IV A	**Year**	III	**Credits**	3	**CourseCode**	**23BBO6E4**
		Semester	VI				

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

Pre-requisite	To provide an insight into the principles of nanotechnolgoy in biological and medical research.

Learning Objectives

C1	To provide students with comprehensive knowledge of basics in nanotechnology.
C2	To enable the students understand and appreciate the various applications of nanoparticles.
C3	To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications inmedicine.
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:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Relate to theessential features of biology and nanotechnology that are converging to create the new area of bionanotechnology	K1
CO 2	2. Explain the synthesis ofnanomaterials and their applications.	K2
CO 3	3. Apply the knowledge gained to develop nanomaterials	K3
CO 4	4. Compare the advantages and disadvantageof nanoparticles in health, medicine andenvironment.	K4
CO 5	5. Construct various types of nanomaterial for application and evaluate the impacton environment.	K5 & K6

	CONTENTS
UNIT 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.
UNIT 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 plantextracts, bacteria and fungi.

UNIT III	**FOREST UTILIZATION AND WOOD TECHNOLOGY: PROPERTIES & CHARACTERIZATION OF NANOPARTICLES:** Nano size effects - optical, electrical, mechanical, magnetic and catalyticactivity. Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, Atomic force microscopy, Scanning tunnel microscopy, NMR, X-rayCrystallography and Photoluminescence.
UNIT IV	**NANOCARRIERS:** Introduction. Nanocarriers for drug delivery (DDS) – Polimeric nanotubes and solid lipid nanoparticles (SLN) as carriers, controlled release, site specifictargeting. Magnetic nanoparticles as drug carriers and its applications.
UNIT V	**APPLICATIONS OF NANOPARTICLES:** Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, woundhealing and dressing; Environment – green manufacturing. Agriculture -nanofertilizers and nanopesticides. Smart biosensors – Components and itsapplication.

Extended ProfessionalComponent (is a part ofinternal component only, Not to be included in the External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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

RecommendedTexts

1. Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction toNanotechnology, A John Wiley & Sons, INC., Publication.
2. George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. CRCPress.
3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscienceand
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, TaylorFrancis Group.
7. Sharma P.K. 2008. Understanding Nanotechnology. Vista InternationalPublishing House, Delhi.

Viswanathan B. 2009. Nano Materials. Narosa Publishing House, NewDelhi.

Reference Books

1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd,
2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience.
3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory.
4. European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.
5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.ofQueensland.
6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication.

Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.

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1. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453
2. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4
3. https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti- Kaushik/p/book/9781774635179
4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php
5. https://phys.org/news/2014-10-endless-possibilities-bio- nanotechnology.html
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/
7. https://phys.org/news/2014-10-endless-possibilities-bio- nanotechnology.html
8. http://www.particle-works.com/applications/controlled-drug-release/Applications

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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-III

2. COMPUTER APPLICATIONS IN BOTANY

Title of the Course		**COMPUTER APPLICATIONS IN BOTANY**				
Paper Number		Elective-III				
Category	DSE-IV B	**Year**	III	**Credits**	3	**CourseCode 23BBO6E5**
		Semester	VI			
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**
		2	1		-	3
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 andfunctional genomics of plants.

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Recognizeadvanced resources foraccessing scholarly literature from the internet.	K1
CO 2	2. Explain the concept of databases and Use of different public domain for DNA and proteins sequence retrieval.	K2
CO 3	3. Applyvarious software resources with advanced functions to carry out analysis of data procuredthrough research.	K3
CO 4	4. Decipher the effective utilization of bibliography management software while typing and downloading citations.	K4
CO 5	5. Determinehow theknowledge gained can beused for designing experiments and data interpretation.	K5 & K6

	CONTENTS
UNIT 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
UNIT II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.

UNIT 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.
UNIT 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.
UNIT 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 ofinternal component only, Not to be included inthe ExternalExamination question paper)	Questions related to the above topics, from various competitive examinationsUPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. RastogiPublications, 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.
3. Xiong J. 2006. Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.

ReferenceBooks

1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun.
4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press.
5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.
6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition.
7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Molecular Biologists. Volume III 2nd Edn. Horizontal Scientific Press, Norwich,UK.

Web Resources:

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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	DSE-IV C	**Year**	III	**Credits**	3	**CourseCode 23BBO6E6**
		Semester	VI			

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

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 couldserve as leads in crime spots.
C3	To learn classification of plants from forensic point of view.
C4	To understand forensic importance of different parts of plants.
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Recognizemorphologicaland anatomical feature of plants, which could be useful for forensic investigations.	K1
CO 2	2. Summarize the forensic importance of different parts of plants.	K2
CO 3	3. Apply techniques for the collection and preserve of botanical evidences of crime.	K3
CO 4	4. Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
CO 5	5. Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6

	CONTENTS
UNIT 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.
UNIT 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.

UNIT 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.
UNIT IV	Collection and preservation of botanical evidences: Botanical samples,outdoor crime scene consideration.
UNIT V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensicbotany 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 apart of internalcomponent only,Not to be included in theExternal 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 acquiredfrom this course	Knowledge, Problem Solving, Analytical ability, ProfessionalCompetency, Professional Communication and Transferrable Skill

RecommendedTexts

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, AcademicPress.
3. Nicholas Marquez Grant, John Wiley. 2012. Forensic EcologyHandbook. 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
4. http://docshare02.docshare.tips/files/25818/258183613.pdf

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 8 –TRAININGFOR COMPETITIVE EXAMINATIONS.

BOTANY FOR COMPETITIVE EXAMINATIONS (2 hours)

Title of the Course	**BOTANY FOR COMPETITIVE EXAMINATIONS**					
Paper Number	Skill Enhancement					
Category	PCS	**Year**	III	**Credits**	1	**CourseCode 23BBO6S1**
		Semester	VI			
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: CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1. Identify and define differentgroups of plantswith their taxonomic position Compare the different groupsof plants and evaluate their economic importance	K1,K2&K5
CO 2	2.List down thegeneral characters of Bryophytes, Pteridophytes and Gymnosperms Classify the types of fossils an recognizethe fossil beds ofTamil Nadu Analyseand trace the originof different plantgroups usingGeological Time scale	K1,K3&K5
CO 3	3. Appreciates themorphology of plant and analysedifferent modifications ofplant organs. Explore themajor Herbariaof the world and recognize theimportance.	K3&K5
CO 4	4. Differentiate Prokaryotic andEukaryotic cell. Evaluate the significance ofcell division. Justify the cause for the sex linkedinheritance. Tabulate the different cellorganelles with their functions.	K2,K3&K5
CO 5	5. Define and appreciates biodiversity. Identify thecause and solveenvironmental related issues. Design ecofriendly approaches toprotect earth andgenerate newconservation strategies.	K1,K5 & K6

GENERAL STUDIES FOR COMPETITIVE EXAMINATIONS (2hours)

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

	CONTENTS
UNIT 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.
UNIT 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.
UNIT 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.
UNIT 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
UNIT 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 ProfessionalComponent (is a part ofinternal component only, Not tobe included in the External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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, Academ 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 ofGenetics, John Wiley Sons Inc., 8th Edn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. WassworthPub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- RastogiPublication, 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.
6. 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/

https://www.amazon.in/Botany-Entrance-Examination-Anupam- Rajak-ebook/dp/B089S1GLMP

Mapping with Programme Outcomes:

Os	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)

BOTANY FOR ADVANCED STUDIES (4 hours)

Title of theCourse	**BOTANY FOR ADVANCED STUDIES**					
Paper Number	Skill Enhancement					
Category	Elective	**Year**	III	**Credits**	1	**CourseCode 23BBO6S2**
		Semester	VI			
Instructional Hours per week	**Lecture**		**Tutorial**		**Lab Practice**	**Total**
	2		-		-	2
Pre-requisite	To develop the botany students for preparing advanced studies.					

Learning Objectives	
C1	To be familiar with the basic concepts and principles of plant systematics.
C2	Learn the importance of plant anatomy in plant production systems.
C3	To expose the students a fundamental of the various techniques used inmolecular studies.
C4	To learn about the physiological processes that underlie plant metabolism.
C5	To know the energy production and its utilization in plants.

Course outcomes:CO	On completion of this course, the students will be able to:	**Programme outcomes**
CO1	1.Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data	K1,K2&K5
CO 2	2. Learn thestructures, functions and roles of apical *vs* lateral meristemsin monocot and dicot plant growth.	K1,K3 &K5
CO 3	3. Understand the organizationof nuclear genome	K3&K5
CO 4	4. Understand the various steps involved in the basic functioningof plant growth and the nutritive value of food.	K2,K4&K5
CO 5	5.Gain awareness about the variousprocesses involved in the energy production in plants and metabolic pathways.	K1, K5 &K6

	CONTENTS
UNIT I	**MOLECULAR GENETICS** Molecular Biology of gene expression: Brief overview of the Central Dogma and Teminism. Transcription in prokaryotes and eukaryotes. Types and structure of RNA polymerase, Different types of RNA, Regulatory sequences and transcription factors involved. Mechanism: Initiation, elongation and termination. Split genes and RNA splicing in eukaryotes. Translation in prokaryotes and eukaryotes. Salient features, exceptions, tRNA-suppressor mutations. Mechanism of translation: Chain initiation, elongation and termination, proteins involved, factors affecting translation accuracy. Molecular mechanism of mutation, cancer biology, human cytogentics Molecular mechanism of Gene Regulation: Regulation in prokaryotes, Regulation in Eukaryotes, Epigenetic mechanisms: methylation and transcriptional inactivation, cosuppression through transcriptional silencing, genome imprinting. RNA processing->alternative splicing, RNA stability, RNA interference. Translational regulation: Gene amplification, mating type interconversion. Genomics: Structural genomics, Genetic and physical mapping (RFLP), microsatellite maps, cyotogenetic maps, physical maps, positional cloning,

	chromosome walks and jumps, Genome sequencing, genome databases, human genome sequencing project. Functional genomics. transcriptome, proteome and metabolome, Microarrays and gene-chips. Comparative genomics. Functional and evolutionary relationships prokaryotes, organelles and eukaryotes, orthologues and paralogues. Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing.
UNIT II	**ADVANCED TRENDS IN SYSTEMATICS** **(i) Basic concepts of:** a. Morphology - History, general morphology, types of data, methods of gathering data, b. Anatomy - History, general anatomy, types of data, methods of gathering data, c. Embryology – History, types of data, methods of gathering data; d. Palynology: History, general palynological characters, types of data, methods of gathering data; e. Cytology and Cytogenetics: History, general cytological and cytogenetic characters, types of data, methods of gathering data; f. Ecology, History, general ecology, types of data, methods of gathering data (At least two examples from each section should be studied to substantiate the taxonomic significance) **(ii) Chemotaxonomy:** a. History, general chemical and chemotaxonomic characters, types of data, methods of gathering data. b. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources 8 (phenolics, steroids, terpenoids glycosides and alkaloids). c. Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention, biotechnology in the production of phytochemicals. Phytochemical databases (iii) Molecular trends in Biosystematics a. Molecules and genomes in plant systematics, techniques used in molecular taxonomy, molecular systematics in crop evolution b. Serology in relation to plant taxonomy- Methods, role of serology in taxonomy. c. Cladistics and Phenetics (iv) Molecular trends in Reproductive Biology: (i) Apomixis – Types, cytogenetic basis and induction of apomixes, applications.) Biochemistry and genetics of incompatibility, methods to overcome incompatibility, pollen viability tests, molecular basis of incompatibility) Sterility – Male sterility, CMS, GMS, CGMS, temperature sensitive and photosensitive male sterility, transgenic male sterility, female sterility and zygotic sterility.

UNIT III	**PLANT PHYSIOLOGY** (i) Modern concepts Photosynthesis – Environmental and agricultural relevance; Respiration – Biochemical control of respiration Photomorphogenesis Phytochrome genes and their expression, control of photo-morphogenic responses. Dose-response relations in photomorphogenesis, light induced chloroplast differentiation, effect of photoreceptors. (iii) Biological clock: Circadian rhythms, rhythm responses to environment ,clock mechanism (iv) Photoperiodism General principles , florigen concept (ii) Plant growth and development Patterns of growth and differentiation; Gene expression and mutations regulating meristem function, embryogenesis, seedling, root, leaf and flower development. Homeotic genes, ABCD model in Arabidopsis flower, hormonal control of plant tissue development, effect of auxins on root and root formation, gibberellin promoted growth of plants, ethylene and triple response mutants, brassinosteroids and photomorphogenesis.
UNIT IV	**PLANT PHYSIOLOGY** **(i)** Enzymes: General account: Importance and properties of enzymes in biological sciences, the classification and nomenclature of enzymes with examples, Mechanism of enzyme action role of enzyme in chemical action, various factors affecting the enzyme activity.Molecular genetics in plant physiology, Environmental plant physiology, Stress physiology .
UNIT V	**ECONOMC BOTANY** Economic importance of Cereals, Tuber Crops, Fibre yielding plants, Plantation Crops, Sugar yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Beverages

Extended ProfessionalComponent (is a part ofinternal component only, Not to be includedin the External Examinationquestion paper)	Questions related to the above topics, from various competitive examinationsUPSC / 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. Plant Taxonomy. (II Edition).The McGraw HillCompanies.
2. Maheshwari, P. 1963. Recent Advances in Embryology ofAngiosperms. Intl. Soc. Plant Morphologists, New Delhi.
3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun PublishingHouse, New Delhi.
4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. NewDelhi.
5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018.Fundamentals of Plant Physiology. Sinauer Associates Inc., US.
6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of theCell (6th edition). Benjamin/Cummings Pub. Co. New York.
7. Brooker, R. J. 1999. Genetics Analysis and Principles. AddisonWesley Longman Inc., New York.
4. Bruce, A. et. al. 2002. Molecular Biology of the Cell. GarlandPublishing. New York.

Reference books

1. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media,Germany.
4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy:An Applied Approach. Blackwell Publishing, Malden, USA.
5. Steward, F.C. 2012. Plant Physiology Academic Press, US.
6. Hopkins, W.G and Huner, N.P. 2009. Introduction to PlantPhysiology (4th ed.). John Wiley & Sons. U.S.A.
7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
8. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
9. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
10. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
12. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
13. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.
14. Mabberley, J.D. 2014. Mebberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp.
15. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.
16. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media,Germany.
17. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
18. Steward, F.C. 2012. Plant Physiology Academic Press, US.
19. Hopkins, W.G and Huner, N.P. 2009. Introduction to PlantPhysiology (4th ed.). John Wiley & Sons. U.S.A.
20. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
21. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.
22. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.
23. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.
24. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.
25. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.
18. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.

Web resources

1. http:// www.ornl.gov.
2. http:// ash. gene. ncl. ac .nk..
3. http://tor. cshl. org. http:www. gdb. org.
4. http: //www. neg r. org.
5. http: // www. genetics. wustl. edu.
6. http: // genome. imb- jena. dc.

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

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