KUNTHAVAI NAACCHIYAAR GOVERNMENT ARTS COLLEGE FOR WOMEN
An Autonomous College Affiliated to Bharathidasan University
Re-Accredited by NAAC with 'B' Grade
Thanjavur-613 007, Tamil Nadu, India.

Scheme of Instruction and Syllabus for

B.Sc., BOTANY

PG & RESEARCH DEPARTMENT OF BOTANY

LEARNING OUTCOMES-BASED CURRICULUM FRAMEWORK GUIDELINES BASED REGULATIONS FOR UNDER GRADUATE PROGRAMME

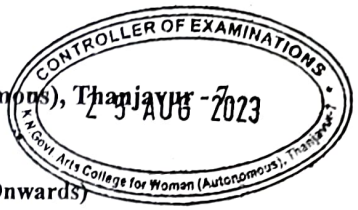
Programme:	**B.Sc. BOTANY**
Duration:	**3 Years (UG)**
Programme Outcomes:	**PO1: Disciplinary knowledge:** Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate Programme of study **PO2: Communication Skills:** Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups. **PO3: Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development. **PO4: Problem solving: Capacity** to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations. **PO5: Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints. **PO6: Research-related skills**: A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesising and articulating; Ability to recognise cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyse, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation **PO7: Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act together as a group or a team in the interests of a common cause and work efficiently as a member of a team **PO8: Scientific reasoning**: Ability to analyse, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective. **PO9: Reflective thinking**: Critical sensibility to lived experiences, with self awareness and reflexivity of both self and society. **PO10 Information/digital literacy:** Capability to use ICT in a variety of learning situations, demonstrate ability to access, evaluate, and use a variety of relevant information sources; and use appropriate software for analysis of data. **PO 11 Self-directed learning**: Ability to work independently, identify appropriate resources required for a project, and manage a project through to completion. **PO 12 Multicultural competence:** Possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups. **PO 13: Moral and ethical awareness/reasoning**: Ability 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.
Programme Specific Outcomes:	On successful completion of Bachelor of Physics with Computer Applications programme, the student should be able to: **PSO1: Disciplinary Knowledge:** Understand the fundamental principles, concepts, and theories related to physics and computer science. Also, exhibit proficiency in performing experiments in the laboratory. **PSO2: Critical Thinking:** Analyse complex problems, evaluate information, synthesize information, apply theoretical concepts to practical situations, identify assumptions and biases, make informed decisions and communicate effectively **PSO3: Problem Solving:** Employ theoretical concepts and critical reasoning ability with physical, mathematical and technical skills to solve problems, acquire data, analyze their physical significance and explore new design possibilities. **PSO4: Analytical & Scientific Reasoning:** Apply scientific methods, collect and analyse data, test hypotheses, evaluate evidence, apply statistical techniques and use computational models. **PSO5: Research related skills:** Formulate research questions, conduct literature reviews, design and execute research studies, communicate research findings and collaborate in research projects. **PSO6: Self-directed & Lifelong Learning:** Set learning goals, manage their own learning, reflect on their learning, adapt to new contexts, seek out new knowledge, collaborate with others and to continuously improve their skills and knowledge, through ongoing learning and professional development, and contribute to the growth and development of their field.

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

Kunthavai Naacchiyaar Govt. Arts College for Women (Autonomous), Thanjavur - 7

B.Sc., BOTANY Course Structure under CBCS



(For the candidates admitted from the academic year 2023 - 2024 Onwards)

Semester	Part	Course	Subject Code	Title of the Paper	Inst. Hrs.	Credit	Exam Hrs.	Marks		Total
								Int.	Ext.	
I	Part I	LC I	23K1T1	Language –Tamil Paper I	6	3	3	25	75	100
	Part II	ELC I	23K1E1	English– Paper I	6	3	3	25	75	100
	Part III	CC I	23K1B01	Plant Diversity I –Algae	5	5	3	25	75	100
		CCII (P)	23K1B02P	Practical - I Covering Core Course I	3	3	3	25	75	100
		EC 1	23K1B/CHECZ1:1	Elective Zoology I	4	4	3	25	75	100
			23K1B/CHECZ1:2	Radiation Biology						
		EC 2 (P)		Elective Zoology Lab	2	-	-	-	-	-
	Part - IV	SEC 1	23K1BSEC1	Nursery and Landscaping	2	2	3	25	75	100
		Foundation Course FC	23K1BFC	Basics of Botany	2	2	3	25	75	100
	Total				30	22				700
II	Part I	LC 2	23K2T2	Language –Tamil Paper II	6	3	3	25	75	100
	Part II	ELC 2	23K2E2	English– Paper II	6	3	3	25	75	100
	Part III	CC III	23K2B03	Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	5	5	3	25	75	100
		CCIV (P)	23K2B04P	Practical - II Covering Core Course III	3	3	3	25	75	100
		EC 2 (P)	23K2B/CHECZ2P	Elective Zoology Practicals	2	2	3	25	75	100
		EC 3	23K2B/CHECZ3:1	Allied: Zoology Paper II	4	3	3	25	75	100
			23K2B/CHECZ3:2	Agricultural Entomology						
	Part IV	SEC 2	23K2BSEC2	Mushroom cultivation	2	2	3	25	75	100
		SEC 3	23K2BSEC3	Botanical garden and landscaping	2	2	3	25	75	100
	Total				30	23				800

III	Part I	LC 3	23K3T3	Language –Tamil – Paper III	6	3	3	25	75	100
	Part II	ELC 3	23K3E3	English– Paper III	6	3	3	25	75	100
	Part III	CCV	23K3B05	Plant Diversity III - Bryophytes and Pteridophytes	5	5	3	25	75	100
		CC VI (P)	23K3B06P	Practical - III Covering Core Course V	3	3	3	25	75	100
		EC 4	23K3B/P/ZECCH4:1	Elective Chemistry - I	4	4	3	25	75	100
			23K3B/P/ZECCH4:2	Chemistry for Physical and Biological Sciences - I						
		EC 5 (P)		Volumetric and Organic Analysis Practicals	2	-	-	-	-	-
	Part IV	SEC 4 (Entrepreneurial Skill)	23K3BSEC4	*Entrepreneurial Skill Entrepreneurial Opportunities in Botany	1	1	3	25	75	100
		SEC 5	23K3BSEC5	Herbal Technology	2	2	3	25	75	100
		EVS		Environmental studies	1	-	-	-	-	-
		ECC 1	23K3BECC1:1	Biofertilizers and Biopesticides	-	3	3	-	-	100
			23K3BECC1:2	MOOC						
		ECC 2	23K3BECC2	Add on course*	-	4	-	-	-	-
	Total				30	21				700
IV	Part I	LC 4	23K4T4	Language –Tamil – Paper IV	6	3	3	25	75	100
	Part II	ELC 4	23K4E4	English– Paper IV	6	3	3	25	75	100
	Part III	CCVII	23K4B07	Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	4	4	3	25	75	100
		CC VIII (P)	23K4B08P	Practical - IV Covering Core Course VII	3	3	3	25	75	100
		EC 5 (P)	23K4B/P/ZECCH5P	Volumetric and Organic Analysis Practical	2	2	3	25	75	100
		EC 6	23K4B/P/ZECCH6:1	Elective Chemistry - II	4	3	3	25	75	100
			23K4B/P/ZECCH6:2	Chemistry for Physical and Biological Sciences - II						
	Part IV	SEC 6	23K4BSEC6	Fermentation technology	2	2	3	25	75	100
		SEC 7	23K4BSEC7	Environmental impact analysis	2	2	3	25	75	100
		EVS	23K4EVS	Environmental Studies	1	2	3	25	75	100
		ECC 3	23K4BECC3:1	Seaweed Technology	-	3	3	-	-	100
			23K4BECC3:2	MOOC						
	Total				30	24				900

***Road map for SEC4:** Workshop on Entrepreneurship with hands-on training special lectures by experts/industrialists on entrepreneurial schemes and funding available from Central/State Government

V	Part III	CC IX	23K5B09	Plant Morphology, Taxonomy and Economic Botany	6	5	3	25	75	100
		CC X	23K5B10	Plant Anatomy and Embryology	6	5	3	25	75	100
		CC XI (P)	23K5B11P	Practical - V Covering Core Courses IX, X and XII	6	5	3	25	75	100
		CC XII	23K5B12	Cell Biology, Genetics and Plant Breeding	6	4	3	25	75	100
		Elective course EC 7	23K5BECB7:1	Bio-Analytical Techniques	4	3	3	25	75	100
			23K5BECB7:2	Computer Application in Botany						
	Part IV	VE	23K5VE	Value Education	2	2	3	25	75	100
			23K5I	Summer Internship/Industrial Training	-	2	-	-	-	-
	Total				30	26				600
VI	Part III	CC XIII	23K6B13	Plant Ecology and Phytogeography	7	6	3	25	75	100
		CC XIV	23K6B14	Plant Physiology and Biochemistry	7	6	3	25	75	100
		CC XV (P)	23K6B15P	Practical – VI Covering Core Courses XIII and XIV	7	6	3	25	75	100
		Elective Course EC 8	23K6BECB8:1	Horticulture	7	3	3	25	75	100
			23K6BECB8:2	Entrepreneurial Botany						
	Part IV	SEC 8 Professional Competency Skill	23K6BSEC8	Botany for Competitive examinations	2	2	3	25	75	100
	Part V		23K6EA	Extension activity	-	1	-			
	Total				30	24				500
	Grand Total				180	140				4200

CONTROLLER OF EXAMINATIONS
25 AUG 2023
K.N.Govt. Arts College for Women (Autonomous), Thanjavur

*Add on course III : Microbial Inoculant Technology

ALLIED BOTANY

Elective Course 1 – 23K1ZECB1:1 : Elective Botany I

23K1ZECB1:2 : Fundamentals of Botany I

Elective Course 2 – 23K2ZECB2P : Elective Botany Practicals

Elective Course 3 – 23K2ZECB3:1 : Elective Botany II

23K2ZECB3:2 : Fundamentals of Botany II

2. Highlights of the Revamped Curriculum:

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

Value additions in the Revamped Curriculum:

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

II year Vacation activity	Internship / Industrial Training	• Practical training at the Industry/ Banking Sector / Private/ Public sector organizations / Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	Tour Program	• As per the part of Botany Degree Courses, Every III year students shall undertaken a tour and field study of Vegetation under the guidance of the staff (less than Seven Days within India). They should submit minimum number of 20 herbarium sheets along with field note and tour report.
VI Semester	Introduction of Professional Competency component	• Curriculum design accommodates all category of learners; 'Statistics for Advanced Explain' component will comprise of advanced topics in Statistics and allied fields, for those in the peer group / aspiring researchers; • 'Training for Competitive Examinations' –caters to the needs of the aspirants towards most sought - after services of the nation viz, UPSC, ISS, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners / Honors degree		• To cater to the needs of peer learners / research aspirants

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

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – \CC IX	4	5	6.1 Core Course – CC XIII	4	6
Part.2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X	4	5	6.2 Core Course – CC XIV	4	6
1.3 Core Course – CC I	5	5	2..3 Core Course – CC III	5	5	3.3 Core Course – CC V	5	5	4.3 Core Course – CC VII Core Industry Module	5	5	5. 3.Core Course CC -XI	4	5	6.3 Core Course – CC XV	4	6
1.4 Core Course – CC II	5	5	2.4 Core Course – CC IV	5	5	3.4 Core Course – CC VI	5	5	4.4 Core Course – CC VIII	5	5	5. 4.Core Course –/ Project with viva-voce CC -XII	4	5	6.4 Elective -VII Generic/ Discipline Specific	3	5
1.5 Elective I Generic/ Discipline Specific	3	4	2.5 Elective II Generic/ Discipline Specific	3	4	3.5 Elective III Generic/ Discipline Specific	3	4	4.5 Elective IV Generic/ Discipline Specific	3	3	5.5 Elective V Generic/ Discipline Specific	3	4	6.5 Elective VIII Generic/ Discipline Specific	3	5
1.6 Skill Enhancement Course SEC-1	2	2	2.6 Skill Enhancement Course SEC-2	2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	1	4.6 Skill Enhancement Course SEC-6	2	2	5.6 Elective VI Generic/ Discipline Specific	3	4	6.6 Extension Activity	1	-
1.7 Skill Enhancement -(Foundation Course)	2	2	2.7 Skill Enhancement Course –SEC-3	2	2	3.7 Skill Enhancement Course SEC-5	2	2	4.7 Skill Enhancement Course SEC-7	2	2	5.7 Value Education	2	2	6.7 Professional Competency Skill	2	2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship /Industrial Training	2				
	23	**30**		**23**	**30**		**22**	**30**		**25**	**30**		**26**	**30**		**21**	**30**

Total – 140 Credits

CONTROLLER OF EXAMINATIONS
25 AUG 2023
P.G. & Govt. Arts College for Women (Autonomous), Thanjavur-7

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

First Year – Semester-I

Part	List of Courses	Credit	No. of Hours
Part-1	Language – Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses [in Total]	12	14
Part-4	Skill Enhancement Course SEC-1	2	2
	Foundation Course	2	2
		22	**30**

Semester-II

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

Second Year – Semester-III

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	12	14
Part-4	Skill Enhancement Course -SEC-4 (Entrepreneurial Based)	1	1
	Skill Enhancement Course -SEC-5 (Discipline / Subject Specific)	2	2
	E.V.S	-	1
		21	**30**

CONTROLLER OF EXAMINATIONS
25 AUG 2023
K.N. Govt. Arts College for Women (Autonomous), Thanjavur-7

Semester-IV

Part	List of Courses	Credit	No. of Hours
Part-1	Language - Tamil	3	6
Part-2	English	3	6
Part-3	Core Courses & Elective Courses including laboratory [in Total]	12	13
Part-4	Skill Enhancement Course -SEC-6 (Discipline / Subject Specific)	2	2
	Skill Enhancement Course -SEC-7 (Discipline / Subject Specific)	2	2
	E.V.S	2	1
		24	**30**

Third Year
Semester-V

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project Viva voce / Elective Based	22	28
Part-4	Value Education	2	2
	Internship / Industrial Visit / Field Visit	2	-
		26	**30**

Semester-VI

Part	List of Courses	Credit	No. of Hours
Part-3	Core Courses including Project / Elective Based & LAB	21	28
Part-4	Extension Activity	1	-
	Professional Competency Skill	2	2
		24	**30**

CONTROLLER OF EXAMINATIONS
25 AUG 2023
K.N.Govt. Arts College for Women (Autonomous), Thanjavur-7

Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	12	13	12	12	22	21	92
Part IV	4	4	3	6	4	02	23
Part V	-	-	-	-	-	1	1
Total	22	23	21	24	26	24	**140**

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

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

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations

In order to avoid pull the score down of each PO, it is suggested that the usage L-Low (1) to the minimum.

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

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

CORE COURSE I - PLANT DIVERSITY I - ALGAE

Category - Core	Year - I	Semester - I	Credits - 5	Course Code – 23K1B01
Instructional Hours per week	Lecture – 3 + Tutorial – 2 = Total - 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	On completion of this course, students will;	**Programme outcomes**
CO1	Relate to the structural organization, reproduction and 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

UNIT	CONTENTS
I	Classification (Fritsch-1935-1945), criteria for classification, algal distribution.
II	Thallus organization (unicellular-*Chlorella*, Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum*, *Gracilaria*).
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*) (Examples may be changed according to the availability of the specimens).
IV	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.
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 as indicator of water pollution, algal bioinoculants, Bioluminescence.
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	Knowledge, Problem Solving, Analytical ability,

Course	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, Rastogi Publication, Meerut.
4	Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
5	Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.

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

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

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 COURSE II – PRACTICAL – I COVERING CORE COURSE I

Category – Core Course	Year - I	Semester - I	Credits - 3	CourseCode – 23K1B02P
Instructional Hours per week	**Lab Practice – 3 = Total – 3**			

Pre-requisite	Students should be familiar with the basics of algae.	
Learning Objectives		
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.	
C2	To identify microalgae in a mixture.	
C3	To develop skills to prepare the microslides of algae.	
C4	To study the economic importance of few species.	
C5	To understand importance of algae to animals and humans	
Course Outcomes: On completion of this course, the students will be able to		**Programme outcomes**
CO1	Recall and identify algae using key identification characters.	K1
CO2	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	K2
CO3	Describe the internal structure of algae prescribed in the syllabus	K3
CO4	Decipher the algal diversity in fresh/marine water and their economic significance.	K4
CO5	Evaluate the various techniques used to culture algae for commercial purposes	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 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.	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 (10th 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 food Canada publisher.
3.	Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London.
4.	Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
5.	Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., 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)**

ELECTIVE COURSE 1 - ALLIED BOTANY I

Category - Core	Year - I	Semester - I	Credits - 4	CourseCode – 23K1ZECB1:1
Instructional Hours per week	**Lecture – 3 + Tutorial – 1 = Total - 4**			

Pre-requisite : To study the basics of botany.		
Learning Objectives		
C1	To study morphological and anatomical adaptations of plants of various habitats.	
C2	To demonstrate techniques of plant tissue culture.	
C3	To familiarize with the structure of DNA, RNA.	
C4	To study the structure of cells.	
C5	To carry out experiments in mono and dihybrid cross.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Understand the structure of various organelles of cells.	K4
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	CONTENTS
I	**Algae:** General characters of Algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.
II	**Fungi:** General characters of Fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi.
III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application in biotechnology.
Extended Professional Component (is a part of internal component only, Not to be	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC

included in the External Examination question paper)	– 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.	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 1 – FUNDAMENTALS OF BOTANY I

Category - Core	Year - I	Semester - I	Credits - 4	CourseCode – 23K1ZECB1:2
Instructional Hours per week	Lecture – 3 + Tutorial – 1 = Total - 4			

Pre-requisite : To study the basics of botany.		
Learning Objectives		
C1	To relate the skill and methods in thallophytes and non-flowering plant groups.	
C2	To employ knowledge in understanding the structural and functional diversity of Lower group of plants.	
C3	To know about Bryophytes	
C4	To categorize the Pteridophytes by their characteristic features.	
C5	To state the gymnosperms.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Knowledge to understanding the diversity of plant forms	K1
CO2	Examine the importance of structural diversity in the evolution of plant forms.	K2
CO3	Compare the structural organization of gametophytes and sporophytes in different classes of Bryophytes.	K3
CO4	Develop critical understanding on morphology, reproduction and life cycle of Pteridophytes.	K4
CO5	To appraise the significance and importance of plant diversity.	K5

UNIT	CONTENTS
I	**Algae:** Classification of Algae by Fritsch (1935-45) - Structure, Reproduction and Life cycle of following genera- *Chlamydomonas*, *Chlorella* and *Ulva.*
II	**Fungi:** Classification of Fungi by Alexopoulos (1979) - Structure, Reproduction and Life cycle of the following genera – *Saccharomyces* (Yeast), *Aspergillus* and *Polyporus*.
III	**Bryophytes:** General characters of Bryophytes, Structure, Reproduction and Life cycle of the following genera – *Marchantia* and *Anthoceros.*
IV	**Pteridophytes:** General characters of Pteridophytes, Structure, Reproduction and Life cycle of the following genera – *Psilotum* and *Selaginella*.
V	**Gymnosperms:** General characters of Gymnosperms, Structure (Morphology), Reproduction and Life cycle of the following genera – *Pinus* and *Gnetum*
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.	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference books:	
1.	Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2.	Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3.	Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4.	Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5.	Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6.	Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
7.	.Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.
Web Resources	
1.	https://www.kobo.com/us/en/ebook/the-algae-world
2.	http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3.	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4.	https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5.	https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6.	https://www.us.elsevierhealth.com/medicine/cell-biology
7.	https://www.us.elsevierhealth.com/medicine/genetics
8.	https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

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

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

SEC I - NURSERY AND LANDSCAPING

Category - Skill Enhancement Course	Year - I	Semester - I	Credits - 2	Course Code – 23K1BSEC1
Instructional Hours per week	Lecture – 2 = Total - 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:		Programme Outcomes
CO1	Recognize the basic principles and components of gardening.	K1
CO2	Explain about bio-aesthetic planning and conceptualize flower arrangement.	K2
CO3	Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3 & K6
CO4	. Compare and contrast different garden styles and landscaping patterns.	K4
CO5	Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6

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

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 - BASICS OF BOTANY

Category - Foundation Course	Year - I	Semester - I	Credits - 2	Course Code – 23K1BFC
Instructional Hours per week	Lecture – 2 = Total - 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**
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Compare the structure and function of cells and explain the development of cells.	K4
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	CONTENTS
I	**BIODIVERSITY** Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.
II	**CELL BIOLOGY** Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane Plastids, Ribosomes.
III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance.
V	**PLANT PHYSIOLOGY** Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition

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

Recommended Texts	
1.	Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2.	Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3.	Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4.	Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5.	Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi.
6.	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference books	
1.	Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2.	Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3.	Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4.	Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5.	Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6.	Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
Web Resources	
1.	https://www.kobo.com/us/en/ebook/the-algae-world
2.	http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3.	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4.	https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5.	https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf
6.	https://www.us.elsevierhealth.com/medicine/cell-biology
7.	https://www.us.elsevierhealth.com/medicine/genetics
8.	https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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 COURSE III - PLANT DIVERSITY II - FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Category – Core Course	**Year - I**	**Semester - II**	**Credits - 5**	**CourseCode : 23K2B03**
Instructional Hours per week		**Lecture – 3 + Tutorial – 2 = Total – 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO 1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
CO 2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.	K2
CO 3	Identify the common plant diseases, according to geographical locations and device control measures.	K3
CO 4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
CO 5	Determine the economic importance of microbes, fungi and lichens.	K5

UNIT	**EXPERIMENTS**
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 Zygomycotina (*Rhizopus*), Ascomycotina (*Aspergillus*), Basidiomycotina (*Agaricus*) and Deuteromycotina (*Cercospora).*
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), Vitamins (Vitamin B-complex) - applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi - Agriculture (Biofertilizers) – Mycotoxins - Harmful effects of Fungi.
III	**BACTERIA, VIRUS:** Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.

IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; 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 and Tikka disease
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, 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 ProfessionalComponent (is a part of internal component only,Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	
1.	Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2.	Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3.	Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4.	Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
5.	Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
6.	Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
7.	Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	
1.	Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2.	Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
3.	Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
4.	Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London.
5.	Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
6.	Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
7.	Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.
8.	Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria,

	Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
9.	Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.
10.	Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company
Web Resources	
1.	https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
2.	http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html
3.	http://www.freebookcentre.net/Biology/Mycology-Books.html
4.	https://www.kobo.com/us/en/ebook/introduction-to-fungi
5.	http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html
6.	http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

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 COURSE IV - PRACTICAL – II COVERING CORE COURSE III

Category – Core Course	Year - I	Semester - II	Credits - 3	Course Code : 23K2B04P
Instructional Hours per week		Lab Practice – 3 = Total – 3		

Pre-requisite	Students should be familiar with the basics of fungi and lichens.	
Learning Objectives		
C1	To enable students to identify microscopic and macroscopic fungi.	
C2	To 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Developpractical skills for culturing and cultivation of fungi.	K1
CO 2	Identify andselect suitable control measures for the common plant diseases.	K2
CO 3	Analyze the characteristics of microbes, fungi and plant pathogens	K3
CO 4	Access the useful role of fungi in agriculture and pharmaceutical industry.	K4
CO 5	Access the useful role of fungi in 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.
3. Protocol for mushroom cultivation.
4. Inoculation techniques for fungal culture (Demonstration only).
5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
7. Visit to fungal biotechnology laboratories.
8. Ultra sturcture of bacteria.
9. 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 Potential Applications, IK International.

Web resources:

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

Mapping with Programme Outcomes:

COs	COs	PO1	PO2	PO3	PO4	PO5	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)

ELECTIVE COURSE 2 - ELECTIVE BOTANY PRACTICALS

Category- Elective Course	Year-I	Semester-II	Credits-2	Course Code : 23K2ZECB2P
Instructional Hours per week	**Lab Practice – 2 = Total - 2**			

Pre-requisite	A practical pertaining to above subjects is important to get knowledge on various aspects of plants.

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

Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO 1	To study the internal organization of Algae and Fungi.	**K1**
CO 2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	**K2**
CO 3	To study the classical Taxonomy with reference to different parameters.	**K3**
CO 4	Understand the fundamental concepts of plant anatomy and embryology.	**K4**
CO 5	To study the effect of various physical factors on photosynthesis.	**K5**

EXPERIMENTS

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

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

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

Recommended Texts

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

Reference Books

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

Web sources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 3 - ELECTIVE BOTANY-II

Category - Elective Course	Year - I	Semester - II	Credits - 3	Course Code - 23K2ZECB3:1
Instructional Hours per week	**Lecture – 3 + Tutorial – 1 = Total - 4**			

Pre-requisite	To study basics of botany.	
Learning Objectives		
C1	To be familiar with the basic concepts and principles of plant systematics.	
C2	Learn the importance of plant anatomy in plant production systems.	
C3	Understand the mechanism underling the shift from vegetative to reproductive phase.	
C4	To learn about the physiological processes that underlie plant metabolism.	
C5	To know the energy production and its utilization in plants.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Understand the fundamental concepts of plant anatomy and embryology	**K1**
CO 2	Analyze and recognize the different organs of plants and secondary growth.	**K2**
CO 3	Understand water relation of plants with respect to various physiological processes.	**K3**
CO 4	Classify aerobic and anaerobic respiration.	**K4**
CO 5	Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	**K5**

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

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

Recommended Texts

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

Reference Books

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 3 – FUNDAMENTALS OF BOTANY-II

Category - Elective Course	Year - I	Semester - II	Credits - 3	Course Code - 23K2ZECB3:2
Instructional Hours per week	**Lecture – 3 + Tutorial – 1 = Total - 4**			

Pre-requisite	To study basics of botany.	
Learning Objectives		
C1	To state the basic system of classification and salient features of few families.	
C2	To be familiar with the basic concepts and principles of plant systematics.	
C3	To familiarize with the adaptation in hydrophytes and xerophytes.	
C4	To illustrate the structure, types and development of endosperm and embryo.	
C5	To recall the basic principles of ecology.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Understand the fundamental concepts of plant taxonomy.	**K1**
CO 2	Classify plant systematics and recognize the economic importance of plants	**K2**
CO 3	Understand water relation of plants with respect to various anatomical adaptations.	**K3**
CO 4	Understand the concept of endosperm and embryo.	**K4**
CO 5	Analyze and recognize the various components of ecosystem.	**K5**

UNIT	CONTENTS
I	**Taxonomy:** General characters and Economic importance of following families – Meliaceae, Fabaceae, Cucurbitaceae, Rubiaceae and Solanaceae.
II	General characters and Economic importance of following families – Amaranthaceae, Euphorbiaceae, Liliaceae, Poaceae and Cyperaceae.
III	**Anatomy:** General account of adaptations in Hydrophytes – *Hydrilla* and *Nymphaea*; Xerophytes – *Nerium* and *Opuntia.*
IV	**Embryology:** Endosperm types – Nuclear, Cellular and Helobial. Cytology and Physiology of endosperm, functions of endosperm. Development of Embryo – Dicot and Monocot.
V	**Ecology:** Definition, components of ecology (Biotic and Abiotic factors), Dynamics of Ecosystem – Energy, primary and secondary production, food chain and food web.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.

Recommended Texts

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

Reference Books

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

SEC 2 - MUSHROOM CULTIVATION

Category – Skill Enhancement Course	Year-I	Semester –II	Credits-2	Course Code : 23K2BSEC2
Instructional Hours per week	Lecture – 2 = Total - 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO 1	Recall various types and categories of mushroom.	K1
CO 2	Explain about various types of food technologies associated with mushroom industry.	K2
CO 3	Apply techniques studied for cultivation of various types of mushroom.	K3
CO 4	Analyze and decipher the environmental factors and economic value associated with mushroom cultivation	K4
CO 5	Develop new methods and strategies to contribute to mushroom production.	K5 & K6

UNIT	CONTENTS
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
III	Life cycle of *Pleurotus spp* and *Agaricus spp.*
IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.
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. Handbook of Mushroom Cultivation. 1999. TNAU publication.
2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.

Reference Books

1. Handbook of Mushroom Cultivation. 1999. TNAU publication.
4. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
5. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
6. 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.
7. 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)

SEC 3 - BOTANICAL GARDEN AND LANDSCAPING

Category - Skill Enhancement Course	Year - I	Semester - II	Credits -2	CourseCode : 23K2BSEC3
Instructional Hours per week	Lecture – 2 = Total -2			

Pre-requisite	Students should know about the fundamental concepts of gardening and landscaping.	
Learning Objectives		
C1	To know about the fundamental concepts of gardening and landscaping.	
C2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	
C3	To illustrate the significance of garden adornments and propagation structures.	
C4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.	
C5	To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Recognize fundamental concepts of gardening and landscaping.	K1
CO 2	Explain about significance of garden adornments and propagation structures.	K2
CO 3	Apply techniques of landscaping for aesthetic purposes and gardening for recreation.	K3 & K6
CO 4	Distinguish between formal, informal and free style gardens and their applications.	K4
CO 5	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping	K5 & K6

UNIT	CONTENTS
I	Principles of gardening, garden components, lawn making, methods of 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.
II	Flower arrangement: importance, Bio-aesthetic 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.
III	Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, dam sites, IT parks, corporate.
IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeri scaping, hardscaping.
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	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved

Examination question paper)	(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 Millan India Ltd.
3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency
4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.

Reference Books

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

Web resources

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

Mapping with Programme Outcomes:

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

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

CORE COURSE V - PLANT DIVERSITY III - BRYOPHYTES AND PTERIDOPHYTES

Category - Core Course	Year - II	Semester - III	Credits - 5	Course Code : 23K3B05
Instructional Hours per week	Lecture – 3 + Tutorial – 2 = Total - 5			

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.	
Learning Objectives		
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.	
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.	
C3	To know the evolution of Bryophytes and Pteridophytes.	
C4	To understand the economic importance of the Bryophytes and Pteridophytes.	
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Recognize morphological variations of Bryophytes and Pteridophytes.	K1
CO 2	Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2
CO 3	Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	K3
CO 4	Decipher the stages of plant evolution and their transition to land habitat.	K4
CO 5	Access the useful role of Bryophytes and Pteridophytes.	K5

UNIT	EXPERIMENTS
I	**BRYOPHYTES** General characters of Bryophytes, classification (Watson, 1971) (up to family). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Riccia*.); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*). Evolution of Bryophytes.
III	**PTERIDOPHYTES** General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and Apospory, Homospory and Heterospory.
IV	Morphology, Anatomy and Reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium*), Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*).
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 examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional, Competency, Professional Communication and Transferrable Skill.

Recommended Texts

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

Reference Books

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

Web Resources:

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

Category – Core Course	Year - II	Semester - III	Credits - 3	Course Code : 23K3B06P
Instructional Hours per week	Lab Practice – 3 = Total - 3			

Pre-requisite	Students should be familiar with the basics of Bryophytes and Pteridophytes.	
Learning Objectives		
C1	To enable students gain expertise in hand sectioning technique.	
C2	To study diversity of Bryophytes and Pteridophytes.	
C3	To understand the anatomical structure of the Bryophytes and Pteridophytes.	
C4	Develop comprehensive skills in sectioning and micro preparation.	
C5	Describe the structure of fossil forms prescribed in the syllabus.	
Course Outcomes: On successful completion of this course the student will be able to:		**Programme Outcomes**
CO1	Recognize the major groups of Non-vascular and Vascular cryptogams	K1
CO 2	Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2
CO 3	Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes	K3
CO 4	Develop comprehensive skills in sectioning and micro preparation.	K4
CO 5	Interpret the significance of reproductive structures in Bryophytes and Pteridophytes	K5

EXPERIMENTS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida (*Riccia*), Anthocerotopsida (*Anthoceros*) and Bryopsida (*Polytrichum*) (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.*), Sphenopsida (*Equisetum*), Pteropsida (*Marsilea*).
4. Identifying the micro slides relevant to the syllabus.

Botanical excursion.

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

Recommended Texts

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. 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.
5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
6. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.

Reference Books

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

Web resources

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

Mapping with Programme Outcomes:

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

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

SEC 4 - *ENTREPRENEURIAL SKILL

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Category - Skill Enhancement Course	**Year - II**	**Semester - III**	**Credits - 1**	**CourseCode : 23K3BSEC4**
Instructional Hours per week	**Lecture – 1 = Total - 1**			

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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach.	K1
CO 2	Explain the concept of Entrepreneurial Opportunities in Botany.	K2
CO 3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	K3
CO 4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
CO 5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	K5 & K6

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

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

Reference books

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

Web sources

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

SEC 5 - HERBAL TECHNOLOGY

Category - Skill Enhancement Courses	Year - II	Semester - III	Credits - 2	CourseCode: 23K3BSEC5
Instructional Hours per week	Lecture – 2 = Total - 2			

Pre-requisite	To understand the importance of herbal technology.	
Learning Objectives		
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.	
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.	
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.	
C4	To apply the knowledge to cultivate medical plants.	
C5	To know the pharmacological importance of medicinal plants.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Define and describe the principle of cultivation of herbal products.	K1
CO 2	List the major herbs, their botanical name and chemical constituents.	K2
CO 3	Apply techniques for monitoring drug adulteration through the biological testing.	K3
CO 4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
CO 5	Develop the skills for cultivation of plants and their value added processing / storage	K5 & K6

UNIT	CONTENTS
I	Herbal Technology: Definition and scope; Herbal medicines: History and Scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine).
II	Cultivation - harvesting - processing - storage of herbs and herbal products. Value added plant products: Herbs and herbal products recognized in India;
III	Pharmacognosy - Systematic position, the plant parts used for the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, *Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera*.
IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs.
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved

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

Recommended Texts

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

Reference Books

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

Web resources

1. https://www.kopykitab.com/Herbal-Science
2. https://kadampa.org/books/free-ebook-download howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7 iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_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)**

CC 1 BIOFERTILIZERS AND BIOPESTICIDES

Category – Extra Credit Course	Year - II	Semester - III	Credits - 3	CourseCode : 23K3BECC1:1

Pre-requisite	To study the fundamental concepts of Bio-fertilizer and Bio-pesticides.	
C1	To describe the importance of biofertilizers and their cultivation.	
C2	To learn mass cultivation of different bio fertilizers.	
C3	To identify the types of mycorrhiza and its advantages.	
C4	To assess the knowledge about the types of biopesticides and its advantages.	
C5	To understand the mechanism and action of biopesticides.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Classify the various fertilizer types, importance and how they are used.	K1
CO 2	Knowledge of bio-fertilizer mass production techniques.	K2
CO 3	Explain the advantages of fungus-based fertilizer.	K3
CO 4	Analyze the value of manufacturing bio-pesticides in large quantities and quality control methods.	K4
CO 5	Examine the applications, importance and mechanisms of bio-pesticides as well as their methods of application.	K5 & K6

UNIT	CONTENTS
I	**BIOFERTILIZERS:** Definition, Classification of fertilizers (Synthetic and Natural fertilizer), organic fertilizers, Biofertilizers – General account and importance, Fertilizers application method (Foliar, seed dressing, soil drenching), Dry and wet formulation.
II	**MASS CULTIVATION**: Mass cultivation: Bacterial biofertilizers Azospirillum, Azotobacter and Rhizobium and Cyanobacterial biofertilizers – Anabaena and nostoc.
III	**FUNGAL BIOFERTILIZERS**: Fungal biofertilizers, Mycorrhizal Classification, isolation and its importance, VAM- Inoculum production and its field applications.
IV	**BIOPESTICIDES**: Biopesticides – Definition, types and mass production of biopesticides, methods and application of biopesticides. Methods of quality control and Techniques of biopesticides. Advantages of biopesticides and commercialization.
V	**BIOPESTICIDES**: Mechanism of action and application of biopesticides – viral origin (NPV) – fungal origin (Trichoderma) – bacterial origin (Pseudomonas and Bacillus).
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. Biofertilizers Advances in Bio- Inoculants (volume I) 1 st edition 2021 by Amitava Rakshit, Vijay Meena, Manoj Parihar, H.B. Singh, A.K Singh.
2. Biopesticides Advances in Bio- Inoculants (volume II) 2021, by Amitava Rakshit, Vijay Meena, P.C.Abhilash, B.K Sarma, H B Singh, Anand kumar.
3. The complete technology book on Biofertilizer and organic farming (2nd revised edition) NIIR Board.
4. Biofertilizers and biopesticides by Technoscience Publications, 1998 A.M Deshmukh.

Reference Books

1. Joshi, S.R. (2018). Biopesticides: A Biotechnological Approach. New Age International (P) Ltd., Publishers.
2. Koul, O. and Dhaliwal, G.S. 2012. Biopesticides and Pest Management. Cumpus Books International.
3. Subba Rao, N.S. (2000). Soil Microbiology. Oxford and IBH Publishing Co.Pvt. Ltd., New Delhi.
4. Varma, A. and Hock, B. (1995). Mycorrhiza Springer – Varlag, Berlin.
5. Yaaco Vokan (1994). Azospirillum / Plant Associations. CRC Press, Boca Raton, FL.
6. Biofertilizers Technology by Kannaiyan, S., Kumar, K., Govindarajan, K. – 2010.

Web resources

1. https://microbialcellfactories.biomedcentral.com/articles/10.1186/1475-2859-13-66
2. https://www.toppr.com/guides/biology/microbes-in-humanwelfare/biofertilizers/
3. https://www.vedantu.com/biology/biofertilizers
4. https://www.peptechbio.com/blog-biofertilizers/
5. https://www.onlinebiologynotes.com/biofertilizer-advantages-typesmethods-of-application-and-disadvantages/
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8230470/
7. https://www.researchgate.net/publication/347427936_Benefits_and_limitat ions_in_ using_ biopesticides
8. https://gacbe.ac.in/pdf/ematerial/18BBO35S-U4.pdf

Mapping with Programme Outcomes:

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

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

CORE COURSE VII - PLANT DIVERSITY IV - GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Category – Core Course	Year - II	Semester - IV	Credits - 4	Course Code : 23K4B07
Instructional Hours per week	**Lecture – 2 + Tutorial-2 = Total - 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to the general characteristics of Gymnosperms and fossil forms	K1
CO 2	Explain about the morphology and anatomy Gymnosperms.	K2
CO 3	Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3
CO 4	Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	K4
CO 5	Determine the various fossilization methods and their significance in Paleobotany.	K5

UNIT	CONTENTS
I	**GYMNOSPERMS** Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
II	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*) and Gnetales (*Gnetum*).
III	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni.
IV	P**ALEOBOTANY** Study of the following fossils: *Rhynia, Lepidodendron, Lepidocarpon, Calamites* and *Williamsonia*.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and Sympatric.

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

Recommended Texts

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

Reference Books

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

CORE CORSE VIII - PRACTICAL – IV COVERING CORE COURSE VII

Category – Core Course	Year - II	Semester - IV	Credits - 3	CourseCode : 23K4B08P
Instructional Hours per week	Lab Practice - 3 = Total - 3			

Pre-requisite	Students should be familiar with the fundamentals of Gymnosperms, Paleobotany.	
Learning Objectives		
C1	To enable students observe and record the morphological features of selected species of Gymnosperms.	
C2	To enable students observe and record the anatomical features of selected species of Gymnosperms.	
C3	To develop the skill of preparation of microslides of the gymnosperm samples.	
C4	To enable students to gain insights into the basics of paleobotany and methods of fossilization.	
C5	To understand the anatomy of the fossil plants through microscopy.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Analyze and observe and record the morphological features of selected species of Gymnosperms..	K1
CO 2	Describe the structure of fossil forms prescribed in the syllabus.	K2
CO 3	Identify and Illustrate the morphological and anatomical features of gymnosperms.	K3
CO 4	Develop comprehensive skills in sectioning and micro preparation.	K4
CO 5	Interpret the significance of reproductive structures in gymnosperms.	K5

EXPERIMENTS

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

2. Identifying the micro slides relevant to the syllabus.

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

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

4. Photograph of evolution scientists.

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

Recommended Texts
Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan. 1. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand. 2. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 3. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 4. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
Reference Books
1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi. 2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.
Web resources
1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv =1&dq=gymnosperms&printsec=frontcover 2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721 3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ 4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

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

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

SEC 6 - FERMENTATION TECHNOLOGY

Category - Skill Enhancement Course	Year - II	Semester - IV	Credits - 2	Course Code :23K4BSEC6
Instructional Hours per week	**Lecture – 2 = Total - 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Enumerate the significance of industrially useful microbes.	K1
CO 2	Explain the design and operation of industrial practices in mass production of fermented products.	K2
CO 3	Explain the process of maintenance and preservation of microorganisms.	K3
CO 4	Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
CO 5	Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6

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

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

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

Recommended Texts

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

Reference Books

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

Web resources

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

Mapping with Programme Outcomes:

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

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

SEC 7 - ENVIRONMENTAL IMPACT ANALYSIS

Category - Skill Enhancement Course	Year - II	Semester - IV	Credits - 2	Course Code : 23K4BSEC7
Instructional Hours per week	Lecture – 2 = Total - 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Enumerate the fundamental concepts and significance of environmental impact assessment.	K1
CO 2	Explain the important steps of EIA process.	K2
CO 3	Interpret the environmental appraisal and procedures in India.	K3
CO 4	Decipher how to prepare the various documents required by state and federal regulations.	K4
CO 5	Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6

UNIT	CONTENTS
I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.
II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,
III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document.
IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.
V	Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.

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

Recommended Texts

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

Reference Books

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

Web resources

1. https://www.amazon.in/Environmental-Impact-Assessment-Gajbhiye-Khandeshwar-ebook/dp/B06XTNQ5PW
2. https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-assessment/9789382332930/
3. https://www.elsevier.com/books/environmental-impact-assessment/mareddy/978-0-12-811139-0
4. https://link.springer.com/book/10.1007/978-3-030-80942-3
5. https://onlinelibrary.wiley.com/doi/book/10.1002/0471722022

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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)**

ECC 3 - SEAWEED TECHNOLOGY

Category – Extra Credit Course	Year - II	Semester - III	Credits - 3	CourseCode : 23K4BECC3:1

Pre-requisite	To study the importance of Seaweed Technology.
C1	To describe the importance of seaweed cultivation and the strategies involved.
C2	To understand different seaweeds and their importance.
C3	To gain knowledge on seaweed farming and quality assurance.
C4	To understand seaweed ecology and management.
C5	To understand the mechanism and action of biopesticides.

Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	A complete understanding of sustainable seaweed farming.	K1
CO 2	Development of practical knowledge about seaweed breeding.	K2
CO 3	Understand the importance of seaweeds.	K3
CO 4	Knowledge on seaweed farming related issues.	K4
CO 5	Understand the seaweed ecosystem management.	K5 & K6

UNIT	CONTENTS
I	**INTRODUCTION:** Seaweed – Definition – Significance – Benefits – Marine algae – Major bioactive compounds – Classification – Brown algae (Phaeophyta), Green algae (Chlorophyta), Red algae (Rhodophyta) – Characteristic features.
II	**STRUCTURE OF SEAWEEDS:** (Thallus, Lamina, Sorus, Air bladders, Stipe, Holdfast, Haptera). Seaweed Reproduction (Asexual and Sexual). Economic importance of seaweeds.
III	**SEAWEED FARMING:** Seaweed farming - bioreactors – methods of breeding seaweeds – collection and preservation techniques of seaweeds. Seaweed quality assurance, seaweed safety – illness associated with consumption – toxins, allergies and intolerances – health risks and threats.
IV	**AQUATIC ECOLOGY:** Aquatic ecology – Biodiversity – Disaster management – Coastal zone management – Ecosystem – Services of seaweed farming.
V	**SEAWEEDS AND SOCIETY:** Seaweeds and society – farming seaweeds for food and fuel by entrepreneurs – sustainable aquaculture – potential disadvantages of growing seaweed.
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. Fritsch, F.E. 2009. The Structure and Reproduction of the Algae. Cambridge University Press. 2. Sambamurthy, A.V.S.S. 2013. A Textbook of Algae, IK International Publishing House Pvt. Ltd. 3. Biotechnological Application of seaweeds.
Reference Books
1. Maria, H.A., Rui, P. and Jean, F.S. 2014. Marine Algae, CRC Press. 2. Pereira and Joao, M.N. 2020. Marine Algae: Biodiversity Taxonomy Environmental Assessment And Biotechnology, T&F Publishers, India. 3. Sustainable seaweed Technologies: cultivation, Biorefinery, and applications (Advance in green and sustainable chemistry) Kindle Edition.
Web resources
1. http://en.wikipedia.org/wiki/Seaweed 2. http://www.oilgae.com/algae/types/marine_algae/marine_algae.html 3. https://en.wikipedia.org/wiki/Brown_algae 4. https://en.wikipedia.org/wiki/Red_algae 5. https://en.wikipedia.org/wiki/Green_algae 6. https://www.seaweed.ie/algae/chlorophyta.php

Mapping with Programme Outcomes:

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

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

CORE IX - PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Category – Core Course	Year - III	Semester - V	Credits - 5	CourseCode : 23K5B09
Instructional Hours per week	Lecture – 4 + Tutorial – 2 = Total - 6			

Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.
Learning Objectives	
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
C2	Students will know about the basic concepts of classification of plants.
C3	Understand major evolutionary trends in Angiospermic plants.
C4	To know the characteristic features of the selected families.
C5	To know the economic importance of plants.

Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1
CO 2	Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2
CO 3	Describe the core concepts of economic Botany and relate its applications in human life.	K3
CO 4	Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
CO 5	Assess terms and concepts related to Phylogenetic Systematics.	K5

UNIT	CONTENTS
I	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.
II	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, an overview of APG Classification. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.
III	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
V	Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).

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

Recommended Texts

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

Reference Books

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

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 COURSE X - PLANT ANATOMY AND EMBRYOLOGY

Category – Core Course	Year - III	Semester - V	Credits - 5	Course Code : 23K5B10
Instructional Hours per week	Lecture – 4 + Tutorial – 2 = Total - 6			

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

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

Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to the fundamental concepts of plant anatomy and embryology.	K1
CO 2	Describe the internal tissue organization of various plant organs.	K2
CO 3	Elucidate the stages of normal and abnormal secondary growth.	K3
CO 4	Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
CO 5	Access the various anatomical adaptations in plants.	K5

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

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

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

Recommended Texts

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

Reference Books

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA.
8. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi

Web Resources

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

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO 5
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 COURSE XI – PRACTICAL – V COVERING CORE COURSES IX, X AND XII

Category – Core Course	Year - III	Semester - V	Credits - 5	CourseCode : 23K5B11P
Instructional Hours per week	Lecture – 2 + Lab Practice – 4 = Total - 6			

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 characteristics of the families.	
C2	To preserve the plants, prepare herbarium sheets and to identify the local flora.	
C3	To understand the economic importance of the plants.	
C4	To study the anatomy of the plant organs using various techniques.	
C5	To study the embryology of the plant.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Identify locally available plants and recognize their distinguishing plant morphological characters.	K1
CO 2	Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.	K2
CO 3	Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K3
CO 4	Recognize the types of ovules and anther.	K4
CO 5	Validate the plant endosperm by dissecting the seed.	K5

EXPERIMENTS

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

Anatomy

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

Embryology

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

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

Recommended Texts

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Pandey, B.P. 1987. Taxonomy of Angiosperms.
3. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
4. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan. ISBN-8173199698, 9788173199691

Reference Books

1. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. NutritiveValue of Indian Foods. National Institute of Nutrition, Hyderabad.
2. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
3. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
4. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons.

Web resources

1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210
2. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C
3. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.
4. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509
5. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id =Cq1KPwAACAAJ&redir_esc=y

Mapping with Programme Outcomes:

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

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

CORE COURSE XII - CELL BIOLOGY, GENETICS AND PLANT BREEDING

Category – Core Course	Year - III	Semester - V	Credits - 4	Course Code : 23K5B12
Instructional Hours per week	Lecture – 4 + Tutorial – 2 = Total - 6			

Pre-requisite	To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.	
Learning Objectives		
C1	To enable students to gain insights into cell wall organization and its functions.	
C2	To familiarize with various cell organelles and their functions.	
C3	To gain knowledge in classical genetics.	
C4	To know about sex linked inheritance.	
C5	To have knowledge about plant breeding techniques for crop improvement.	
Course Outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Enumerate the structure and functions of cells, cellular structures and organelles.	K1
CO 2	Explain about cell cycle, cell division and laws of inheritance with suitable examples.	K2
CO 3	Elucidate concepts of sex determination and sex linked inheritance.	K3
CO 4	Analyze the importance of genes interactions at population and evolutionary levels.	K4
CO 5	Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.	K5

UNIT	CONTENTS
I	Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin.
II	Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes. Cell division, Mitosis and Meiosis - their significance.
III	Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilis jalaba.* Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over.

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*. . Population genetics – Hardy – Weinberg principle.
V	Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (Mass, Pure line and Clonal), hybridization techniques. Heterosis – Interspecific and intergeneric causes and effects. Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.

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

Recommended Texts

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

Reference Books

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.
4. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.
5. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 7 - BIO-ANALYTICAL TECHNIQUES

Category – Elective Course	Year - III	Semester - V	Credits - 3	Course Code : 23K5BECB7:1
Instructional Hours per week	**Lecture – 3 + Tutorial – 1 = Total - 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: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to the various biological techniques and its importance.	K1
CO 2	Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	K2
CO 3	Apply suitable strategies in data collections and disseminating research findings.	K3 & K6
CO 4	Compare and contrast the significance of different types of chromatography techniques.	K4
CO 5	Develop methodologies for extraction and analysis of biochemical compounds.	K5

UNIT	CONTENTS
I	**MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.
II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
III	**ELECTROPHORESIS AND PH METER:** Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	**SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE:** Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	**BIOSTATISTICS:** Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.

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

Recommended Texts

1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishing House.
3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi.
5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.

Reference Books

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 7 - COMPUTER APPLICATIONS IN BOTANY

Category – Elective Course	Year - III	Semester - V	Credits - 3	Course Code : 23K5BECB7:2
Instructional Hours per week	Lecture – 3 + Tutorial – 1 = Total - 4			

Pre-requisite	To equip students with computational skills for drug design.	
Learning Objectives		
C1	To familiarize the student with the fundamentals concepts of bioinformatics.	
C2	To equip students with computational skills for drug design.	
C3	To learn about the bioinformatics database, data format and data retrieval from online sources.	
C4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.	
C5	Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Recognize advanced resources for accessing scholarly literature from the internet.	K1
CO 2	Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.	K2
CO 3	Apply various software resources with advanced functions to carry out analysis of data procured through research.	K3 & K6
CO 4	Decipher the effective utilization of bibliography management software while typing and downloading citations.	K4
CO 5	Determine how the knowledge gained can be used for designing experiments and data interpretation.	K5

UNIT	CONTENTS
I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media
II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.
III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence

	alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.
V	**Applications:** Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS.Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).

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

Recommended Texts

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

Reference Books

1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun.
4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press.
5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.

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

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)

CORE COURSE XIII - PLANT ECOLOGY AND PHYTOGEOGRAPHY

Category – Core Course	Year - III	Semester - VI	Credits - 6	CourseCode : 23K6B13
Instructional Hours per week	Lecture – 4 + Tutorial – 3 = Total - 7			

Pre-requisite	Understanding the environmental factors impacting biodiversity is crucial after taking this course.
Learning Objectives	
C1	To relate to the significance of the biotic and abiotic components of the ecosystems.
C2	To understand the energy flow in ecosystem.
C3	To conceptualize the biodiversity.
C4	To know implication of pollution on the environment.
C5	To familiarize with the phytogeography.

Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1
CO 2	Summarize the phytogeographical division of India.	K2
CO 3	Explain the implication of pollution on the environment.	K3
CO 4	Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.	K4
CO 5	Develop mitigations for the effective conservation of biodiversity and disaster management.	K5

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

V	**Phytogeography Introduction**, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators. 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 of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional, Competency, Professional Communication and Transferrable Skill

Recommended Texts

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

Reference Books

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.

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

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 COUESE XIV - PLANT PHYSIOLOGY AND BIOCHEMISTRY

Category – Core Course	Year - III	Semester - VI	Credits - 6	Course Code : 23K6B14
Instructional Hours per week	Lecture – 4 + Tutorial – 3 = Total - 7			

Pre- requisite	Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.	
Learning Objectives		
C1	To relate to water relation of plants with respect to various physiological phenomenon.	
C2	To know the pathways of photosynthesis.	
C3	To familiarize with respiration and nitrogen metabolism.	
C4	To know about plant growth regulators.	
C5	To familiarize with plant biochemistry.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Relate to water relation of plants with respect to various physiological phenomenon.	K1
CO 2	Explain the process and significance of photosynthesis and respiration.	K2
CO 3	Elucidate properties of nutrients and their deficiency symptoms in plants.	K3
CO 4	Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	K4
CO 5	Decipher the phenomenon of seed dormancy and germination in plants.	K5

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

V	**BIOCHEMISTRY:** Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.

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

Recommended Texts

1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi.
2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi.
3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.
4. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
5. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay.
6. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.

Reference Books

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

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 COURSE XV – PRACTICAL VI COVERING CORE COURSES XIII AND XIV

Category - Core Course	Year - III	Semester - VI	Credits - 6	CourseCode : 23K6B15P
Instructional Hours per week	Lecture – 3 + Lab Practice – 4 = Total - 7			

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

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

Course Outcomes: On completion of this course, the students will be able to		Programme Outcomes
CO1	Relate to the distribution and adaptions of plants pertaining to their habitat	K1
CO 2	Demonstrate skills in green planning and callus culture.	K2
CO 3	Elucidate the basic principles involved in the plant physiology and biochemistry experiments.	K3
CO 4	Appreciate the structure and functions of DNA and RNA.	K4
CO 5	Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.	K5

EXPERIMENTS

Plant Ecology and Phytogeography

1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.
   - Hydrophytes : *Nymphaea, Hydrilla*
   - Xerophytes : *Nerium, Casuarina*
   - Mesophytes : *Tridax, Vernonia*
   - Halophytes : *Avicennia, Rhizophora*
   - Epiphytes : *Vanda*
2. Map of the phytogeographical regions of India.
3. Quadrate study and line transect.
4. Plan for a green building.
5. Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub jungle/Pallikaranai Marsh/Siruthavur Scrub/Vedanthangal Bird Sanctuary/Kelampakkam Marsh/Adyar Poonga).

Plant Physiology and Plant Biochemistry

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

Biochemical test for carbohydrates, proteins and lipids

Demonstration – Experiments

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

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

Recommended Texts

1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands.
3 Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi.
4 Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
5. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited,New Delhi.
6. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi

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. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
4. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4^{th} Edition) Cambridge University Press, Cambridge.
5. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9^{th} Edition.
6. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.

Web resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 8 - HORTICULTURE

Category – Elective Course	Year - III	Semester - VI	Credits - 3	CourseCode : 23K6BECB8:1
Instructional Hours per week	Lecture – 4 + Tutorial – 3 = Total - 7			

Pre-requisite	Students should know fundamental knowledge on horticulture applications.	
Learning Objectives		
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.	
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.	
C3	To know about hydroponic culture.	
C4	To develop the various horticultural crop protection.	
C5	To impart the knowledge on market preparation.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Enumerate the concepts in horticulture and nursery management.	K1
CO 2	Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.	K2
CO 3	Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
CO 4	Analyze different methods of weed control in horticultural crops.	K4
CO 5	Develop their competency on pre and post-harvest technology in horticultural crops.	K5 & K6

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

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

Reference Books

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

Web Resources

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

Mapping with Programme Outcomes:

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

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

ELECTIVE COURSE 8 - ENTREPRENEURIAL BOTANY

Category – Elective Course	Year - III	Semester - VI	Credits - 3	CourseCode : 23K6BECB8:2
Instructional Hours per week	Lecture – 4 + Tutorial – 3 = Total - 7			

Pre-requisite	To develop innovative ideas to exploit the economically useful plant products for commercial purposes.	
Learning Objectives		
C1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.	
C2	To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.	
C3	To comprehend the molecular processes.	
C4	To expose the students a fundamental of the various value added products.	
C5	To introduce the entrepreneurial opportunities.	
Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Recognize the significance of government agencies for entrepreneurship development.	K1
CO 2	Explain about entrepreneurial values, risk assessment and solutions	K2
CO 3	Make use of entrepreneurial opportunities.	K3
CO 4	Analyze and decipher the significance of bioventure and value added products.	K4
CO 5	Devise innovative methods for making value added products.	K5 & K6

UNIT	CONTENTS
I	**INTRODUCTION:** Need - definition and concept - Types and characterization - entrepreneurial values-motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
II	**BIOVENTURE:** Industry - overview of *Spirulina*, *Pleurotus*, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	**VALUE ADDED PRODUCTS:** Canning of fruits - process and equipment, fruit and vegetable based products (squash) - ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.
IV	**ORGANIZATIONS AND AGENCIES:** TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurshoip – various government schemes.
V	**ENTREPRENEURIAL OPPORTUNITIES:** Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), steps in filing patents, trademarks and copyright, Intellectual Property Rights, export and import license.

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

Reference Books

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

Web Resources

1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entrepreneurship/
2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/value-added-products-microalgae-faizal-bux
3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3
4. https://www.elsevier.com/books/value-addition-in-food-products-and-processing-through-enzyme-technology/kuddus/978-0-323-89929-1

Mapping with Programme Outcomes:

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

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

SEC 8 – TRAINING FOR COMPETITIVE EXAMINATIONS
BOTANY FOR COMPETITIVE EXAMINATIONS (2 hours)

Category - Skill Enhancement Course	**Year - III**	**Semester - VI**	**Credits - 2**	**Course Code : 23K6BSEC8**
Instructional Hours per week	**Lecture – 2 = Total - 2**			

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

Course outcomes: On completion of this course, the students will be able to:		**Programme Outcomes**
CO1	Identify and define different groups of plants with their taxonomic position Compare the different groups of plants and evaluate their economic importance	K1, K2 & K5
CO 2	List down the general characters of Bryophytes, Pteridophytes and Gymnosperms Classify the types of fossils and recognize the fossil beds of Tamil Nadu Analyse and trace the origin of different plant groups using Geological Time scale	K1,K3 & K5
CO 3	Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.	K3 & K5
CO 4	Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked inheritance. Tabulate the different cell organelles with their functions.	K2, K3 & K5
CO 5	Define and appreciates biodiversity. Identify the cause and solve environmental related issues. Design eco friendly approaches to protect earth and generate new conservation strategies.	K1, K5 & K6

GENERAL STUDIES FOR COMPETITIVE EXAMINATIONS (2 hours)

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

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

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

Recommended Texts

1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany for Competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams.) Astral Cracker.
2. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers.
3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House.
4.Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.
5. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies Taxonomy: Nair Datta
6. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.

Reference Books

1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.
2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York.
3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi.
6. Power, C.B and Daginawa, H.F. 2010. General Microbiology : Himalaya Publishing House Pvt Ltd,
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
9. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.

Web resources

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

Mapping with Programme Outcomes:

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

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