

B.Sc. Botany

June 2023-2024

Programme : B.Sc. Botany - 2023 onwards

Sem .	Part	Course	Course Title	Course Code	Hours / week	Credits	Marks		
							CIA	ESE	Total
I	I	Language I	பொதுத்தமிழ் I	U23TM1L1	6	3	25	75	100
	II	English I	Prose and Short Stories	U23EG1L1	6	3	25	75	100
	III	Core I	Plant Diversity-I (Algae)	U23BY101	5	5	25	75	100
		Core Prac. I	Plant Diversity-I (Algae) Practical	U23BY1P1	3	3	40	60	100
		Allied I	Allied Zoology	U23ZY1Y1	3	3	25	75	100
		Allied Prac. I	Allied Zoology Practical	U23ZYYP1	3	2	40	60	100
	IV	SEC I	Nursery and Landscaping	U23BY1E1	2	2	25	75	100
		FC	Basics of Botany	U23BY1N1	2	2	100	--	100
					30	23			
II	I	Language II	பொதுத்தமிழ் II	U23TM2L2	6	3	25	75	100
	II	English II	Poetry and Shakespeare	U23EG2L2	6	3	25	75	100
	III	Core II	Plant Diversity-II (Fungi, Bacteria, Viruses, Pathology and Lichens)	U23BY202	5	5	25	75	100
		Core Prac. II	Plant Diversity-II (Fungi, Bacteria, Viruses, Pathology and Lichens Practical- II)	U23BY2P2	3	3	40	60	100
		Allied II	Zoology Paper- II	U23ZY2Y2	3	3	25	75	100
		Allied Prac. II	Allied Zoology Practical	U23ZYYP2	3	2	40	60	100
	IV	SEC II	Mushroom Cultivation	U23BY2E2	2	2	25	75	100
		SEC III	Botanical Garden and Landscaping	U23BY2S3	2	2	25	75	100
					30	23			
III	I	Language III	பொதுத்தமிழ் III	U23TM3L3	6	3	25	75	100
	II	English III	One Act Plays and Abridged Novel	U23EG3L3	6	3	25	75	100
	III	Core III	Plant Diversity – III – Bryophytes and Pteridophytes	U23BY303	5	5	25	75	100

		Core Prac. III	Plant Diversity – III – Bryophytes and Pteridophytes Practical- III	U23BY3P3	3	3	40	60	100
		Allied III	Allied Chemistry - I	U23CH3Y3	3	3	25	75	100
		Allied Prac. III	Allied Chemistry Practical - I	U23CHYP3	3	2	40	60	100
	IV	SEC IV	Herbal Technology	U23BY3S4	1	1	25	75	100
		SEC V	Entrepreneurial Opportunities in Botany	U23BY3S5	2	2	25	75	100
		EVS	Environmental Studies	U23EST41	1	--	--	--	--
					30	22			
IV	I	Language IV	பொதுத்தமிழ் IV	U23TM4L4	6	3	25	75	100
	II	English IV	Language through Literature	U23EG4L4	6	3	25	75	100
	III	Core IV	Plant Diversity – IV – Gymnosperms, Paleobotany, and Evolution	U23BY404	5	5	25	75	100
		Core Prac. IV	Plant Diversity – IV – Gymnosperms, Paleobotany and Evolution Practical- IV	U23BY4P4	3	3	40	60	100
		Allied IV	Allied Chemistry - II	U23CH4Y4	3	3	25	75	100
		Allied Prac. IV	Allied Chemistry Practical - II	U23CHYP4	2	2	40	60	100
	IV	SEC VI	Fermentation Technology	U23BY4S6	2	2	25	75	100
		SEC VII	Environmental Impact Analysis	U23BY4S7	2	2	25	75	100
		EVS	Environmental Studies	U23EST41	1	2	25	75	100
						30	25		

V	III	Core V	Plant Morphology, Taxonomy and Economic Botany	U23BY505	5	4	25	75	100
		Core VI	Plant Anatomy and Embryology	U23BY506	4	4	25	75	100
		Core VII	Cell Biology, Genetics, and Plant Breeding	U23BY507	4	4	25	75	100
		Core Prac. V	Plant Morphology, Taxonomy, and Economic Botany Practical - V	U23BY5P5	3	2	40	60	100

		Core Prac. VI	Plant Anatomy, Embryology, Cell Biology, Genetics and Plant Breeding Practical – VI	U23BY5P6	3	2	40	60	100
		Core Project	Core Project with Viva voce	U23BY5PJ	3	2	20	80	100
		Elective I	Bio Analytical Techniques	U23BY5:A	3	3	25	75	100
			Aquatic Botany	U23BY5:B					
			Entrepreneurial Botany	U23BY5:C					
		Elective II	Plant Bioresources	U23BY5:D	3	3	25	75	100
			Seed Biology	U23BY5:E					
			Pomology	U23BY5:F					
	IV	VLO	Abundant Life	U23VLO5 1	2	2	25	75	100
				Human Values					
					30	26			
VI	III	Core VIII	Plant Ecology and Phytogeography	U23BY608	6	4	25	75	100
		Core IX	Plant Biotechnology and Molecular Biology	U23BY609	6	3	25	75	100
		Core X	Plant Physiology and Plant Biochemistry	U23BY610	5	3	25	75	100
		Core Prac. VII	Plant Ecology, Phytogeography, Plant Biotechnology, Molecular Biology, Plant Physiology, and Plant Biochemistry Practical – VII	U23BY6P7	3	2	40	60	100
		Elective III	Horticulture	U23BY6:A	4	3	25	75	100
			Natural Resource Management	U23BY6:B					
			Forestry	U23BY6:C					
		Elective IV	Bionanotechnology	U23BY6:D	4	3	25	75	100
			Computer Application in Botany	U23BY6:E					
			Forensic Botany	U23BY6:F					
		V	PCS	Botany for Competitive Examinations	U23BY6G 1	2	2	25	75
VI	Extension Activity	Extension Activities	U23ETA61	--	1	--	--	--	
					30	21			

	Total Credits :	140			
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Programme: B.Sc. Botany	
Programme Code:	
Duration: 3 years	
Programme Out comes (PO)	
The B.Sc. Botany program is designed to achieve the following objectives	
PO1	Apply the knowledge of science and technology fundamentals for findings solution for complex problems.
PO2	To provide up to date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
PO3	To comprehend and interpret various facets of Botany including the importance and judicious utilization of plant sources.
PO4	Exploration of diverse plant life-forms and to nature the conservation of biodiversity.
PO5	To understand the principles and applications of various traditional and modern techniques used in Botany.
PO6	To disseminate knowledge on the design and execution of experiments in Botany with emphasis on the operation of relevant sophisticated instruments.
PO7	To impart knowledge on the economic importance of plant/microbial resources and their products and to promote entrepreneurship skill.
PO8	To promote proficiency in designing the research problems, review of literature, laboratory experiments, data analyses and preparation of reports with professional ethics.
PO9	To motivate the students to take up innovative and cutting-edge research in frontier areas of Botany and related biology subjects.
PO10	To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.
Program specific Outcomes (PSO)	
On successful completion of the B.Sc. Botany program, the students are expected to	
PSO1	Implement the concept of science and technology to foster the traditional and modern techniques for solving the complex problems in Plant Biology.
PSO2	Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany
PSO3	Develop the scientific problem solving skills during experimentation, research projects, analysis and interpretation of data
PSO4	Design scientific experiments independently and to generate useful information to address various issues in Botany.
PSO5	Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings
PSO6	Design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations
PSO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PSO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.

PSO9	Follow the concept of professional ethics and bioethics norms for practicing the value of plant kingdom.
PSO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively

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	40 Marks
	Attendance and Class Participation	
External Evaluation	End Semester Examination	60 Marks
	Record	
	Total	100 Marks
Methods of Assessment		
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions	
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or overview	
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain	
Analyze (K4)	Problem-solving questions, Finish a procedure in many steps, Differentiate between various ideas, Map knowledge	
Evaluate (K5)	Longer essay/ Evaluation essay, Critique or justify with pros and cons	
Create (K6)	Check knowledge in specific or offbeat situations, Discussion, Debating or Presentations	

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

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

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

CBCS - COURSE PATTERN AND SYLLABUS

UG - BOTANY

(For students who join the programme from 2022-2023 onwards)

CORE-I PLANT DIVERSITY I ALGAE

ALLIED		PLANT DIVERSITY I ALGAE							
Paper Number		CORE I							
Category	Core	Year	I	Credits	3	CourseCode: U23BY101			
		Semester	I						
Instructional Hours per week		Lecture	4	Tutorial	2	Lab Practice	--	Total	6
		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;								
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- <i>Chlorella</i> , Diatoms, colonial- <i>Volvox</i> , filamentous- <i>Anabaena</i> , <i>Oedogonium</i> , siphonous- <i>Caulerpa</i> , parenchymatous- <i>Sargassum</i> , <i>Gracilaria</i>).								
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, <i>Oedogonium</i> and <i>Chara</i> , diplontic-Diatoms and <i>Sargassum</i> , diplohaplontic- <i>Ulva</i> and diplobiontic- <i>Gracilaria</i>) (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.
Recommended Texts:	
1	Dehradun. Edwardlee, R. 2018. Phycology, 5 th Ed., Cambridge University Press, London.
2	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4	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 PRACTICAL -IPLANT DIVERSITY I ALGAE - PRACTICAL-I

Title of the Course	PLANT DIVERSITY – I: ALGAE Practical I						
Paper Number	CORE PRACTICAL -I						
Category	Core	Year	I	Credits	3	CourseCode	U23BY1P1
		Semester	I				
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total
			-		3		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 CO	Programme outcomes						
CO1 Recall and identify algae using key identification characters.	K1						
CO2 Demonstrate practical skills in	K2						

preparation of fresh mount and identification of algal forms from algal mixture.	
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	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 1. Nancy Sere diak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 2. Chapman, V.J and Chapaman, D.J. 1960. The Algae, ELBS & MacMillan, London. 3. Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York. 4. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
Web resources:	<ol style="list-style-type: none"> 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)

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

Title of the Course		PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS					
Paper Number		CORE II					
Category	Core II	Year	I	Credits	5	Course Code	U23BY202
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		
Pre-requisite		Students should be familiar with the basics of fungi, bacteria, viruses and lichens.					
Learning Objectives							
C1	To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.						
C2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles						
C3	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.						
C4	To identify the main groups of plant pathogens, their symptoms.						
C5	To understand the various types of plant diseases.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme outcomes						
1. Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1						
2. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural	K2						

organization.	
3. Identify the common plant diseases, according to geographical locations and device control measures.	K3
4. Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
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, each with one suitable example: Zygomycotina (<i>Pilobolus</i> , <i>Mucor</i> , <i>Rhizopus</i>), Ascomycotina (<i>Aspergillus</i> , <i>Saccharomyces</i> <i>Peziza</i>), Basidiomycotina (<i>Agaricus</i> , <i>Pleurotus</i> , <i>Puccinia</i>) and Deuteromycotina (<i>Cercospora</i> , <i>Alternaria</i>). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association.
II	ECONOMIC IMPORTANCE OF FUNGI: Cultivation of mushroom – <i>Pleurotus</i> (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins
III	BACTERIA, VIRUS: Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.
	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

<p>IV</p>	<p>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</p>
<p>V</p>	<p>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 <i>Usnea</i>. 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,</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 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.
<p>Reference Books</p>	<ol style="list-style-type: none"> 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

	<p>companies, New Delhi.</p> <p>4. Burnett, J.H. 1971. The fundamentals of Mycology. ELBS Publication, London.</p> <p>5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.</p> <p>6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.</p> <p>7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.</p> <p>8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.</p> <p>9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.</p> <p>10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company</p>
Web Resources	<p>1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE</p> <p>2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html</p> <p>3. http://www.freebookcentre.net/Biology/Mycology-Books.html</p> <p>4. https://www.kobo.com/us/en/ebook/introduction-to-fungi</p> <p>5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html</p> <p>6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html</p>

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

Title of the Course		PLANT DIVERSITY – I: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II					
Paper Number		CORE PRACTICAL -II					
Category	Core	Year	I	Credits	3	Course Code	U23BY2P2
		Semester	II				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
			-	3	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: CO	Programme Outcomes						
1. Identify microbes, fungi and lichens using key identifying characters	K1						
2. Develop practical skills for culturing and cultivation of fungi.	K2						
3. Identify and select suitable control measures for the common plant diseases.	K3						
4. Analyze the characteristics of	K4						

microbes, fungi and plant pathogens	
5. Access the useful role of fungi in agriculture and pharmaceutical industry.	K5
<p>EXPERIMENTS</p> <ol style="list-style-type: none"> 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 (<i>Trichoderma</i>), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins. 6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs) 7. Visit to fungal biotechnology laboratories. 8. Ultra structure of bacteria. 9. Structure of bacteriophage. 10. Micro-preparation of <i>Usnea</i> 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. 	
<p>Recommended Texts:</p> <ol style="list-style-type: none"> 1. Chmielewski, J.G and Kravesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA. 2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India. 3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge. 4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 	
<p>Reference Books:</p> <ol style="list-style-type: none"> 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/itmefsn6dyhfh9b>
4. https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y
5. <https://www.kobo.com/us/en/ebook/introduction-to-fungi>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE-III PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES

Title of the Course	PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES						
Paper Number	CORE III						
Category	Core	Year	II	Credits	5	Course Code	U23BY303
		Semester	III				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		
Pre-requisite		Students should be familiar with the basics of Bryophytes and Pteridophytes.					
Learning Objectives							
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.						
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.						
C3	To know the evolution of Bryophytes and Pteridophytes.						
C4	To understand the economic importance of the Bryophytes and Pteridophytes.						
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Recognize morphological variations of Bryophytes and Pteridophytes.	K1						
2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2						
3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and	K3						

Pteridophytes.	
4. Decipher the stages of plant evolution and their transition to land habitat.	K4
5. Access the useful role of Bryophytes and Pteridophytes.	K5
UNIT	EXPERIMENTS
I	BRYOPHYTES General characters of Bryophytes, classification (Watson, 1971) (up to family). Economic importance of Bryophytes – Ecological importance (Pollution indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (<i>Riccia/Marchantia</i>); Anthocerotopsida (<i>Anthoceros</i>) and Bryopsida (<i>Funaria/Polytrichum</i>). (Examples may be changed according to the availability of the specimens). Evolution of Bryophytes
III	PTERIDOPHYTES General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homosporous and heterosporous.
IV	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (<i>Psilotum</i>), Lycopsida (<i>Lycopodium/Selaginella</i>), Sphenopsida (<i>Equisetum</i>), Pteropsida (<i>Adiantum/Marsilea</i>). (Examples may be changed according to the availability of the specimens).
V	Origin and evolution of Pteridophytes. Stellar 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	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Course	
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai. 2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteridophyta, 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:	<ol style="list-style-type: none"> 1. http://www.bryoecol.mtu.edu/ 2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NFWQK 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. http://www.bsiervis.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 PRACTICAL -III PLANT DIVERSITY III BRYOPHYTES AND
PTERIDOPHYTES –
PRACTICAL-III**

Title of the Course	PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III						
Paper Number	CORE PRACTICAL -III						
Category	Core	Year	II	Credits	3	Course Code	U23BY303
		Semester	III				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
			-	3	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: CO	Programme Outcomes						
1. Recognize the major groups of Non-vascular and Vascular cryptogams	K1						
2. Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2						
3. Identify and	K3						

illustrate the morphological and anatomical features of bryophytes and Pteridophytes.	
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5

EXPERIMENTS

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.
2. Hepaticopsida (*Riccia/Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria/Polytrichum*) (Examples may be changed according to the availability of the specimens) (need not study developmental aspects).

Pteridophytes

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

Extended Professional Component (is a part of internal	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)
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component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication. 4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India. 5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4 2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html 4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual 5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

**CORE-IV PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AN
EVOLUTION**

Title of the Course	PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION						
Paper Number	CORE IV						
Category	Core	Year	II	Credits	5	Course Code	U23BY404
		Semester	IV				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	3		2		-	5	
Pre-requisite	Students should know about the fundamentals 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 paleobotany, types of fossils and geological time scale.						
C5	Understand the various fossil genera representing different fossil groups.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Relate to the general characteristics of Gymnosperms and fossil forms	K1						
2. Explain about the morphology and anatomy Gymnosperms.	K2						
3. Compare and contrast the reproductive structures of	K3						

Gymnosperms & fossil forms.	
4. Analyze the anatomy and reproduction of Gymnosperms along with their ecological and economical importance.	K4
5. Determine the various fossilization methods and their significance in paleobotany.	K5
UNIT	CONTENTS
I	GYMNOSPERMS Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
II	GYMNOSPERMS Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (<i>Cycas</i>), Coniferales (<i>Pinus</i>). Gnetales (<i>Gnetum</i>).
III	PALEOBOTANY Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni
IV	PALEOBOTANY Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	EVOLUTION Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
Extended Professional Component	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)

(is a part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 PRACTICAL –IV PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY
AND EVOLUTION - PRACTICAL-IV**

Title of the Course	PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV						
Paper Number	CORE PRACTICAL -IV						
Category	Core	Year	II	Credits	3	CourseCode	U23BY4 P4
		Semester	IV				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
			-	3	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:	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Analyze and observe and record the morphological features of selected species of Gymnosperms..	K1						
2. Describe the structure of fossil forms prescribed in the syllabus.	K2						

3. Identify and Illustrate the morphological and anatomical features of gymnosperms.	K3
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in gymnosperms.	K5
EXPERIMENTS	
<p>1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of <i>Cycas</i>, <i>Pinus</i> and <i>Gnetum</i>.</p> <p>2. Identifying the micro slides relevant to the syllabus.</p> <p>3. Field visit to study the habitat (Hill station).</p> <p>Study the following fossil members: <i>Rhynia</i>, <i>Lepidodendron</i>, <i>Lepidocarpon</i>, <i>Calamites</i> and <i>Williamsonia seawardiana</i> through permanent slides.</p> <p>2. Photograph of evolution scientists.</p>	
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	<p>1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.</p> <p>2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.</p>

	<ol style="list-style-type: none"> 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover 2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721 3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ 4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE V PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Title of the Course	PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY						
Paper Number	CORE V						
Category	Core	Year	III	Credits	5	CourseCode	U23BY505
		Semester	V				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	3		-		2	5	
Pre-requisite	Prior knowledge on morphological, anatomical characteristics and uses of plants.						
Learning Objectives							
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.						
C2	Students will know about the basic concepts of classification of plants.						
C3	Understand major evolutionary trends in Angiospermic plants.						
C4	To know the characteristic features of the selected families.						
C5	To know the economic importance of plants.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to:							
CO							
1. Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1						
2. Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2						

3. Describe the core concepts of economic Botany and relate its applications in human life.	K3
4. Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
5. Assess terms and concepts related to Phylogenetic Systematics.	K5

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

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London. 4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Wesley Publishing Co. Ind USA. 5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. 6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey. 7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.

Reference Books	<ol style="list-style-type: none"> 1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London. 2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta 3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh. 4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York. 5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London. 6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA. 7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
Web Resources	<ol style="list-style-type: none"> 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=Roi0lwSXFnuUC&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 PRACTICAL -V PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-
BOTANY-PRACTICAL-V**

Title of the Course	PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-PRACTICAL-V						
Paper Number	CORE PRACTICAL -V						
Category	Core	Year	III	Credits	3	CourseCode	U23BY5P5
		Semester	V				
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
			-	3	3		
Pre-requisite		Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.					
Learning Objectives							
C1	To study morphological characters of the families.						
C2	Able to describe the plant technically using the floral characteristics.						
C3	To preserve the plants and prepare herbarium sheets.						
C4	To be able to identify the local flora.						
C5	To understand the economic importance of the plants.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Recognize the distinguishing plant morphological characters.	K1						
2. Identify locally available plants to their respective families.	K2						
3. Develop comprehensive skills in field identification, collection of specimens,	K3						

writing technical description, botanical drawings and herbaria preparation.	
4. Construct floral diagram and write floral formula for a given flower.	K4
5. Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.	K5

EXPERIMENTS

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

Extended Professional Component (is a part of internal component only, Not	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)
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to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062. 3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education. 4. Pandely, B.P. 1987. Taxonomy of Angiosperms. 5. Nordenstam, B., El Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.
Reference Books	<ol style="list-style-type: none"> 1. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne. 1994. <i>Natural Products</i>. Longman Scientific and Technical Essex. 2. Gopalan, C., B.V. Ramasastry and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad. 3. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London. 4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London. 5. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.
Web resources	<ol style="list-style-type: none"> 1. https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210 2. https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html 3. https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8 4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C 5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592 6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook.

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE VI PLANT ANATOMY AND EMBRYOLOGY

Title of the Course	PLANT ANATOMY AND EMBRYOLOGY						
Paper Number	CORE VI						
Category	Core	Year	III	Credits	4	Course Code	U23 BY5 06
		Semester	V				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	4				-	4	
Pre-requisite	To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.						
Learning Objectives							
C1	To know fundamental concepts of plant anatomy and embryology.						
C2	To understand the internal tissue organization of various plant organs.						
C3	To differentiate normal and abnormal secondary growth.						
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.						
C5	To know embryology of plants.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1						
2. Describe the internal tissue organization of various plant organs.	K2						
3. Elucidate the stages of normal and abnormal	K3						

secondary growth.	
4. Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
5. Access the various anatomical adaptations in plants.	K5
UNIT	CONTENTS
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in oot and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- <i>Boerhaavia</i> , <i>Nyctanthes</i> and <i>Dracaena</i> . Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule, types of ovules; female gametophyte–megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (<i>Polygonum</i> 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	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)

(is a part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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. Fahh, A. 1974. Plant Anatomy. Pergmon Press, USA. 7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA. 8. Evert, R.F. 2006. Esau’s Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John

	<p>Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.</p> <p>9. Swamy, B.G.L and Krishnamurthy, K.V. 1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi</p>
Web Resources	<ol style="list-style-type: none"> 1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2 2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811 6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE VII CELL BIOLOGY, GENETICS AND PLANT BREEDING

Title of the Course	CELL BIOLOGY, GENETICS AND PLANT BREEDING					
Paper Number	CORE VII					
Category	Core	Year	III	Credits	4	CourseCode U23BY507
		Semester	V			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	4				-	4
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:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Enumerate the structure and functions of cells, cellular structures and organelles.	K1					
2. Explain about cell cycle, cell division and laws of inheritance with suitable examples.	K2					
3. Elucidate	K3					

concepts of sex determination and sex linked inheritance.	
4. Analyze the importance of genes interactions at population and evolutionary levels.	K4
5. Develop conceptual understanding of plant genetic resources, plant breeding, gene bank and gene pool.	K5
UNIT	CONTENTS
I	Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.
II	Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes-, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.
III	Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel, Reciprocal cross - Back cross and Test cross. Incomplete dominance - <i>Mirabilis jalapa</i> . Interaction of factors – Complementary genes, Supplementary genes, inhibitory genes, epistasis (dominant and recessive), duplicate genes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory of linkage, crossing over, recombinations and mapping of genes on chromosomes. Sex determination in plants.

IV	Sex linked inheritance – Haemophilia and colour blindness. Polyploidy origin, types and significance. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation . Extra nuclear inheritance and its significance - Male sterility in corn , Maternal inheritance – Plastid Inheritance in <i>Mirabilis jalapa</i> . Genetics of <i>Neurospora</i> . 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	<ol style="list-style-type: none"> 1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55. 2. Sinnott, E.W., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi. 3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co. 4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA. 5. Singh, R.J. 2017. Practical Manual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
Reference Books	<ol style="list-style-type: none"> 1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York. 3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California. 4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach.

	<p>5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA.</p> <p>5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.</p> <p>6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.</p> <p>7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.</p> <p>8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.</p>
Web Resources	<p>1. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html</p> <p>2. https://www.us.elsevierhealth.com/medicine/cell-biology</p> <p>3. https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A</p> <p>4. http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html</p> <p>5. https://www.us.elsevierhealth.com/medicine/genetics</p> <p>6. https://libguides.uthsc.edu/genetics/ebooks</p> <p>7. https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding</p> <p>8. http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson</p>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

**CORE PRACTICAL -VI- PLANT ANATOMY, EMBRYOLOGY, CELL BIOLOGY,
GENETICS AND PLANT BREEDING-VI**

Title of the Course	PRACTICAL-VI PLANT ANATOMY, EMBRYOLOGY, CELL BIOLOGY, GENETICS AND PLANT BREEDING-VI						
Paper Number	CORE PRACTICAL VI						
Category	Core	Year	III	Credits	3	Course Code	U23BY5P6
		Semester	V				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
			-		3	3	
Pre-requisite	Theoretical understanding of anatomy, embryology, cell biology, genetics and plant breeding as well as basic laboratory skills for the relevant core course.						
Learning Objectives							
C1	To study the anatomy of the plant organs using various techniques.						
C2	To study the embryology of the plant.						
C3	To identify the structure of various cell organelles.						
C4	To understand genetics through problem solving.						
C5	To study various plant breeding techniques.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to:							
CO							
1. Identify the structure of cell organelles and stages of cell division.	K1						
2. Classify the types of stomata and ovules.	K2						
3. Compare the functions of various ergastic substances	K3						

present in plant tissues.	
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K4
5. Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	K5
EXPERIMENTS	
Anatomy	
<ol style="list-style-type: none"> 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 <i>Boerhaavia</i>, <i>Nyctanthes</i> and <i>Dracaena</i>. 4. T.S of dicot and monocot leaves. 5. Study of stomatal types. 	
Embryology	
<ol style="list-style-type: none"> 1. T.S of (young and mature) anther (section from <i>Datura</i> or <i>Cassia</i> 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. <p>Dissection and display of any two stages of embryo in <i>Tridax</i></p>	
Cell biology	
<ol style="list-style-type: none"> 1. Study of the photomicrographs of cell organelles. 2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide. 3. Study the polytene and lamp brush chromosome structure through photograph. 4. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip. 	

Genetics	
<ol style="list-style-type: none"> 1. Genetic problems – test cross, back cross and allelic interaction. 2. Construction of chromosome map – three point test cross 3. Multiple alleles problems. 	
Plant Breeding	
<ol style="list-style-type: none"> 1. Emasculation technique. 2. To test the viability of seeds using Tetrazolium chloride. 3. Genetic models of heterosis. 4. Phenotype of heterosis (Maize). 	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various 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	<ol style="list-style-type: none"> 1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi. 2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company. 3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691. 4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications, Meerut. 5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES XII (12thed.). Jones & Bartlett Learning. 6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
Reference Books	<ol style="list-style-type: none"> 1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668. 2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley and Sons. 3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall. 4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, John

	<p>Wiley & Sons, New York.</p> <p>5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (8thed.) (South Asian Edition), Lea and Febiger, Philadelphia, USA.</p> <p>6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.</p>
Web resources	<p>1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509</p> <p>2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&redir_esc=y</p> <p>3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219</p> <p>4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X</p> <p>5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498</p>

Mapping with Programme Outcomes:

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

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

CORE VIII PLANT ECOLOGY AND PHYTOGEOGRAPHY

Title of the Course	PLANT ECOLOGY AND PHYTOGEOGRAPHY						
Paper Number	CORE VIII						
Category	Core	Year	III	Credits	4	Course Code	U23BY608
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		4		2		-	6
Pre-requisite		Understanding the environmental factors impacting biodiversity is crucial after taking this course.					
Learning Objectives							
C1	To relate to the significance of the biotic and abiotic components of the ecosystems.						
C2	To understand the energy flow in ecosystem.						
C3	To conceptualize the biodiversity.						
C4	To know implication of pollution on the environment.						
C5	To familiarize with the phytogeography.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1						
2. Summarize the phytogeographical division of India.	K2						
3. Explain the implication of pollution on the environment.	K3						

4. Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.	K4
5. Develop mitigations for the effective conservation of biodiversity and disaster management.	K5
Unit	CONTENTS
I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (<i>In situ</i> and <i>ex situ</i>).
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, Vegetational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance. Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes

	and conservation (<i>In situ</i> and <i>ex situ</i> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd., 4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems. 5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons. 6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA. 7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.

	8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK. 9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland. 10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.
Web Resources	1. https://www.kobo.com/us/en/ebook/plant-ecology-3 . 2. https://www.worldcat.org/title/plant-ecology/oclc/613206385 3. https://books.google.co.in/books/about/Plant_Ecology.html? 4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP 5. http://www.freebookcentre.net/Biology/Ecology-Books.html 6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X 7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity) 8. https://link.springer.com/journal/11258 (Plant Ecology)

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE IX- PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Title of the Course	PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY					
Paper Number	CORE IX					
Category	Core	Year	III	Credits	3	CourseCode U23BY609
		Semester	VI			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	3		3		-	6
Pre-requisite	To empower students recognize and appreciate the basic principles that sustain biotechnology as an interdisciplinary domain of learning and research.					
Learning Objectives						
C1	To know various aspects of biotechnology					
C2	To know the concept and techniques of plant tissue culture.					
C3	To familiarize with the gene transfer techniques.					
C4	To know about DNA replication and repair.					
C5	To familiarize with gene regulation.					
Course outcomes: On the completion of the course the students will be able to: CO:	Programme Outcomes					
1. Recognize the fundamental concepts of plant biotechnology and genetic engineering.	K1					
2. Explain various steps in transcription, protein	K2					

synthesis and protein modification .	
3. Elucidate gene cloning and evaluate different methods of gene transfer.	K3
4. Analyze the major concerns and applications of transgenic technology.	K4
5. Develop their competency on different types of plant tissue culture.	K5
UNIT	CONTENTS
I	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (<i>Aspergillus niger</i>) and Proteases production (<i>Bacillus sps</i>).
II	Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropagation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, <i>Agrobacterium</i> mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.
IV	Nature and function of genetic materials, Nucleic acid – base paring – Chargaff’s rule, DNA – structure. Types, denaturation - renaturation. Replication of DNA in prokaryotes. RNA structure and types. DNA repair mechanism.

V	Transcription – Enzymology – RNA polymerase – classes of RNA molecules – transcription in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Gene regulation in Prokaryotes – <i>lac</i> operon and <i>trp</i> operon
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice. 2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers. 3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi. 4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. 5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur. 6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag
Reference Books	<ol style="list-style-type: none"> 1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C. 2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi. 3. Ernst L. Winnacker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein. 4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York. 5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York. 6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York. 7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York. 8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin. 9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin. 10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac millon, New York.

	11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.
Web Resources	<ol style="list-style-type: none"> 1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html 2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C 3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183 6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html 7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVWT3

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE X -PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Title of the Course	PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY						
Paper Number	CORE X						
Category	Core	Year	III	Credits	3	Course Code	U23BY610
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	3		2		-	5	
Pre-requisite	Basic knowledge on physiological processes in plants and primary and secondary plant metabolites and enzymes.						
Learning Objectives							
C1	To relate to water relation of plants with respect to various physiological phenomenon.						
C2	To know the pathways of photosynthesis.						
C3	To familiarize with respiration and nitrogen metabolism.						
C4	To know about plant growth regulators.						
C5	To familiarize with plant biochemistry.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Relate to water relation of plants with respect to various physiological phenomenon.	K1						
2. Explain the process and significance of photosynthesis and respiration.	K2						
3. Elucidate properties of nutrients and their deficiency symptoms in plants.	K3						

4. Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	K4
5. Decipher the phenomenon of seed dormancy and germination in plants.	K5
UNIT	CONTENTS
I	<p>WATER RELATIONS:</p> <p>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.</p>
II	<p>PHOTOSYNTHESIS:</p> <p>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</p>
III	<p>RESPIRATION</p> <p>Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient.</p> <p>NITROGEN METABOLISM</p> <p>Biological nitrogen fixation, nitrogen cycle.</p>

IV	<p>GROWTH:</p> <p>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).</p>
V	<p>PLANT BIOCHEMISTRY:</p> <p>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.</p>
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	<p>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)</p>
Skills acquired from this course	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
Recommended Texts	<ol style="list-style-type: none"> 1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi. 2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi. 3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi. 4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi. 5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi. 6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi. 7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay. 8. Verma, V. 2008. Textbook of plant Physiology, Ane's student edition, New

	Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA. 2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant Metabolism (second edition). Longman Essex, England. 3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA. 4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands. 5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA. 6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA. 7. Nobel, P.S. 1999. Physicochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA. 8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA. 9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi. 10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA. 11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.
Web Resources	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants 2. https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6 3. https://www.kobo.com/us/en/ebook/plant-biochemistry 4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1 5. https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA 6. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692 7. https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

CORE PRACTICAL - VII PLANT ECOLOGY, PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY, MOLECULAR BIOLOGY, PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY PRACTICAL -VII

Title of the Course	PLANT ECOLOGY, PHYTOGEOGRAPHY, PLANT BIOTECHNOLOGY, MOLECULAR BIOLOGY, PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY PRACTICAL-VII						
Paper Number	CORE PRACTICAL VII						
Category	Core	Year	III	Credits	2	Course Code	U23BY6P7
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
			-		3	3	
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants.						
Learning Objectives							
C1	To study morphological and anatomical adaptations of plants of various habitats.						
C2	To demonstrate techniques of plant tissue culture.						
C3	To familiarize with the structure of DNA, RNA.						
C4	To carryout experiments related with plant physiology.						
C5	To perform biochemistry experiments.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Relate to the distribution and adaptions of plants pertaining to their habitat	K1						
2. Demonstrate skills in green planning and callus culture.	K2						
3. Elucidate the basic principles involved in the plant physiology and biochemistry experiments.	K3						
4. Appreciate the structure and functions	K4						

of DNA and RNA.	
5. Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.	K5
EXPERIMENTS	
Plant Ecology and Phytogeography	
<p>1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.</p> <p style="padding-left: 40px;">Hydrophytes : <i>Nymphaea, Hydrilla</i></p> <p style="padding-left: 40px;">Xerophytes : <i>Nerium, Casuarina</i></p> <p style="padding-left: 40px;">Mesophytes : <i>Tridax, Vernonia</i></p> <p style="padding-left: 40px;">Halophytes : <i>Avicennia, Rhizophora</i></p> <p style="padding-left: 40px;">Epiphytes : <i>Vanda</i></p> <p>2. Map of the phytogeographical regions of India.</p> <p>3. Quadrature study and line transect.</p> <p>4. Plan for a green building.</p> <p>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).</p>	
Plant Biotechnology - Demonstration	
<p>1. Sterilization techniques in plant tissue culture.</p> <p>2. MS - Media preparation.</p> <p>3. Explant sterilization, Callus induction, Plantlet, hardening.</p>	

Molecular Biology – Photographs	
<ol style="list-style-type: none"> 1. DNA Structure 2. tRNA 3. DNA – Replication 4. DNA – Repair 5. Genetic code 	
Plant Physiology and Plant Biochemistry	
<ol style="list-style-type: none"> 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	
<ol style="list-style-type: none"> 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)	<p>Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved</p> <p>(To be discussed during the Tutorial hour)</p>

question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut. 2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. 3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York. 4. Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw–Hill Publishing Company Ltd., New Delhi. 5. Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai. 6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Wiley Eastern Limited, New Delhi. 7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
Reference Books	<ol style="list-style-type: none"> 1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell. 2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual. 3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida. 4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India). 5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge. 6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition. 7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
Web resources	<ol style="list-style-type: none"> 1. https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK 2. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009 3. https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9 4. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9386102633 5. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE ALLIED BOTANY-I

Title of the Course	ALLIED BOTANY-I						
Paper Number	Allied-I						
Category	Core	Year	I	Credits	2	Course Code	U23ZYBY1
		Semester	I				
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total	
		3		1	-	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 carryout experiments related with plant physiology.					
C5		To perform biochemistry experiments.					
Course outcomes: On completion of this course, the students will be able to: CO		Programme Outcomes					
1. Increase the awareness and appreciation of human friendly algae and their economic importance.		K1					
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies		K2					
3. Develop critical understanding on morphology, anatomy and reproduction of		K3					

Bryophytes, Pteridophytes and Gymnosperms.	
4. Compare the structure and function of cells and explain the development of cells.	K4
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5
UNIT	CONTENTS
I	Algae: General characters of algae - Structure, reproduction and life cycle of the following genera - <i>Anabaena</i> and <i>Sargassum</i> and economic importance of algae.
II	Fungi, Bacteria and Virus: General characters of fungi, structure, reproduction and life cycle of the following genera - <i>Penicillium</i> and <i>Agaricus</i> and economic importance of fungi. Bacteria - general characters, structure and reproduction of <i>Escherichia coli</i> and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.
III	Bryophytes, Pteridophytes and Gymnosperms: General characters of Bryophytes, Structure and life cycle of <i>Funaria</i> . General characters of Pteridophytes, Structure and life cycle of <i>Lycopodium</i> . General characters of Gymnosperms, Structure and life cycle of <i>Cycas</i> .
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 - <i>In vitro</i> culture methods. Plant tissue culture and its application in biotechnology.
Extended Professional Component (is a part of internal	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)

component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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:	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/the-algae-world 2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/ 5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 6. https://www.us.elsevierhealth.com/medicine/cell-biology 7. https://www.us.elsevierhealth.com/medicine/genetics 8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

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

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

ELECTIVE ALLIED BOTANY-II

Title of the Course	ALLIED BOTANY-II					
Paper Number	Allied-II					
Category	Core	Year	I	Credits	2	CourseCode U23BYY22
		Semester	II			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	3		1		-	4
Pre-requisite	To study basics of botany.					
Learning Objectives						
C1	To be familiar with the basic concepts and principles of plant systematics.					
C2	Learn the importance of plant anatomy in plant production systems.					
C3	Understand the mechanism underling the shift from vegetative to reproductive phase.					
C4	To learn about the physiological processes that underlie plant metabolism.					
C5	To know the energy production and its utilization in plants.					
Course outcomes :	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Understand the fundamental concepts of plant anatomy and embryology.	K1					
2.	K2					

Analyze and recognize the different organs of plants and secondary growth.	
3. Understand water relation of plants with respect to various physiological processes.	K3
4. Classify aerobic and anaerobic respiration.	K4
5. Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	K5
UNIT	CONTENTS
	MORPHOLOGY OF FLOWERING PLANTS: Plant and its parts. Structure and function of root and stem. Leaf and its parts.

I	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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

Mapping with Programme Outcomes:

Cos	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	3	3	3	3	3	3
CO 2	3	3	3	3	3	3	3	3	3	3
CO 3	2	3	3	3	3	1	3	3	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 ALLIED BOTANY PRACTICALS

Title of the Course	ALLIED BOTANY PRACTICALS						
Paper Number	Core-Allied Practicals-I						
Category	Core	Year	I	Credits	2	CourseCode	U23BYYP1
		Semester	II				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	1		-		3	4	
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various 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.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. To study the internal organization of algae and fungi.	K1						
2. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K2						

EXPERIMENTS	
<p>1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.</p> <p>2. Micro photographs of the cell organelles ultra structure.</p> <p>3. Simple genetic problems.</p> <p>4. To make suitable micro preparations of anatomy materials prescribed in the syllabus.</p> <p>5. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy, Embryology, Cell biology and Biotechnology.</p>	
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<p>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.</p>
<p>Reference Books</p>	<p>1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 2. Nancy Sereidiak 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.</p>

	<p>4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.</p> <p>5. Steward, F.C. 2012. Plant Physiology Academic Press, US</p>
Web sources	<p>1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883</p> <p>2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover</p> <p>3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ</p> <p>4. https://medlineplus.gov/genetocs/understanding/basics/cell/</p> <p>5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf</p> <p>6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf</p> <p>7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4</p>

ELECTIVE ALLIED BOTANY PRACTICALS

Title of the Course	ALLIED BOTANY PRACTICALS					
Paper Number	Core-Allied Practical-I					
Category	Core	Year	I	Credits	2	CourseCode U23BYYP2
		Semester	II			
Instructional Hours per week	Lecture	Tutorial		Lab Practice	Total	
	1	-		3	4	
Pre-requisite	Practicals pertaining to above subjects is important to get knowledge on various aspects of plants.					
Learning Objectives						
C1	To be familiar with the basic concepts and principles of plant systematics.					
C2	Understanding of laws of inheritance, genetic basis of loci and alleles.					
C3	To learn about the physiological processes that underlie plant metabolism.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. To study the classical taxonomy with reference to different parameters.	K3					
2. Understand the fundamental concepts of plant anatomy and embryology	K4					
3. To study the effect of various physical factors on photosynthesis	K5					

EXPERIMENTS	
<ol style="list-style-type: none"> 1. To describe in technical terms, plants belonging to any of the family prescribes and to identify the family. 2. To dissect a flower, construct floral diagram and write floral formula. 3. Demonstration experiments <ol style="list-style-type: none"> 1. Ganong's Light screen 2. Ganong's respiroscope 4. To make suitable micro preparations of anatomy materials prescribed in the syllabus. 5. Spotters - Angiosperm. 	
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 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.
<p>Reference Books</p>	<ol style="list-style-type: none"> 6. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 7. Nancy Sereidiak and M. Huynh. 2011. Algae identification lab Guide.

	<p>Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.</p> <p>8. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.</p> <p>9. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications.</p> <p>10. Steward, F.C. 2012. Plant Physiology Academic Press, US</p>
Web sources	<p>8. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883</p> <p>9. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy+mnosperms&printsec=frontcover</p> <p>10. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ</p> <p>11. https://medlineplus.gov/genetocs/understanding/basics/cell/</p> <p>12. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf</p> <p>13. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf</p> <p>14. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4</p>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

NON-MAJOR ELECTIVE-I

SEC-I

NURSERY AND LANDSCAPING

Title of the Course		NURSERY AND LANDSCAPING					
Paper Number		SEC- I					
Category	Elective	Year	I	Credits	2	Course Code	U23BY1E1
		Semester	I				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		2		-		-	2
Pre-requisite		Students should know about the fundamental concepts of nursery and landscaping.					
Learning Objectives							
C1		To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.					
C2		To be able to design gardens and become entrepreneur in Horticulture.					
C3		To study the methods of propagation.					
C4		To know about nursery structure.					
C5		To learn about gardening.					
Course outcomes:		Programme Outcomes					
On completion of this course, the students will be able to: CO							
1. Recognize the basic principles and components of gardening.		K1					
2. Explain about bio-aesthetic planning and conceptualize flower arrangement.		K2					
3. Apply techniques for design various types of gardens according to the culture and art of bonsai.		K3 & K6					

4. Compare and contrast different garden styles and landscaping patterns.	K4
5. Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6
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	<ol style="list-style-type: none"> 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. (3 rd Ed.), W.H. Freeman and Co., San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788 3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

SEC-II

MUSHROOM CULTIVATION

Title of the Course	MUSHROOM CULTIVATION					
Paper Number	SEC-II					
Category	Elective	Year	I	Credits	2	CourseCode U23BY2E2
		Semester	II			
Instructional Hours per week		Lecture		Tutorial		Lab Practice
		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:		Programme Outcomes				
On completion of this course, the students will be able to: CO						
1. Recall various types and categories of mushroom.		K1				
2. Explain about various types of food technologies associated with mushroom industry.		K2				
3. Apply techniques studied for cultivation of various types of		K3				

mushroom.	
4. Analyze and decipher the environmental factors and economic value associated with mushroom cultivation	K4
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 <i>Pleurotus spp</i> and <i>Agaricus spp</i> .
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.

	<p>1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.</p> <p>3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.</p> <p>4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.</p> <p>5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovement with their marketing. Daya Publishing House.</p>
Reference Books	<p>1. Handbook of Mushroom Cultivation. 1999. TNAU publication.</p> <p>2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.</p> <p>3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.</p> <p>4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.</p> <p>5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.</p>
Web Resources	<p>1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X</p> <p>2. http://nrcmushroom.org/book-cultivation-merged.pdf</p> <p>3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf</p> <p>4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/</p> <p>5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y</p>

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)

ELECTIVE COURSE I
1. BIO-ANALYTICAL TECHNIQUES

Title of the Course	BIO-ANALYTICAL TECHNIQUES					
Paper Number	Elective-I					
Category	Elective	Year	III	Credits	3	CourseCode U23BY5:A
		Semester	V			
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total
		3			-	3
Pre-requisite		To impart expertise about analysis and research.				
Learning Objectives						
C1	To understand the principle, operation and maintenance of various tools/equipment in the laboratory.					
C2	Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.					
C3	To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.					
C4	To give an exposure to various forms of field research and data analysis techniques.					
C5	To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Relate to the various biological techniques and its importance.	K1					
2. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and	K2					

electron microscopy.	
3. Apply suitable strategies in data collections and disseminating research findings.	K3 & K6
4. Compare and contrast the significance of different types of chromatography techniques.	K4
5. Develop methodologies for extraction and analysis of biochemical compounds.	K5
UNIT	CONTENTS
I	I MICROSCOPY: Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.
II	CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS: Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).
III	ELECTROPHORESIS AND PH METER: Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	IV SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE: Principle and law of absorption, construction, operation and uses of colorimeter and UV-Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	BIostatistics: Data collection methods, population, samples, parameters; Representation of Data: Tabular, Graphical– Histogram – frequency curve – Bar diagram–measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t–test.
Extended Professional Component	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)

ent (is a part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 Jersey.
Web Resources	<ol style="list-style-type: none"> 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_EGf73exaWpY8D9JNpJZsOcXQCQ4pZlRzTrYH2lopaVP1xxoCIPgQAvD_BwE 5. https://www.kobo.com/us/en/ebooks/biostatistics 6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG
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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 I
2. AQUATIC BOTANY

Title of the Course	AQUATIC BOTANY					
Paper Number	Elective-I					
Category	Elective	Year	III	Credits	3	CourseCode U23BY5:B
		Semester	V			
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	
		3		-	3	
Pre-requisite		To understand ecological functions and economic uses of aquatic plants.				
Learning Objectives						
C1	To give an overview of the distribution of lower plants forms and its ecological significance.					
C2	To enable students to understand the ecological functions and economic uses of aquatic plants.					
C3	To equip students to collect, analyze and identify the planktons.					
C4	To give an exposure to various forms seaweeds.					
C5	To know about the values and uses of aquatic plants..					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Recognize aquatic plants and their ecological importance.	K1					
2. Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2					
3. Apply techniques for conservation of	K3					

aquatic plants for value addition.	
4. Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
5. Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.	K5 & K6
UNIT	CONTENTS
I	MARINE AND LIMNETIC MACRO ALGAE: Common seaweeds of Indian subcontinent: <i>Ulva</i> , <i>Caulerpa</i> , <i>Sargassum</i> , <i>Gracilaria</i> , etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: <i>Anabaena</i> , <i>Chlorella</i> , <i>Scenedesmus</i> .
II	MANGROVES: Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including <i>Avicennia</i> , <i>Rhizophora</i> , <i>Acanthus</i> and <i>Aegiceras</i> . Ecological significance of mangroves.
III	PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS: Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.
IV	AQUATIC ANGIOSPERMS: Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
V	VALUES AND USES OF AQUATIC PLANTS: Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.
Extended	Questions related to the above topics, from various competitive examinations

Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	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	<ol style="list-style-type: none"> 1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge. 2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott's Microbiology. 9th Edition. Mc Graw Hill International. 3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press. 5. Daubenmire, R.F.1973. Plant and Environment. John Willey. 6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi. 7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 ISSN: 0971-8044.
Reference Books	<ol style="list-style-type: none"> 1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited. 2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands. 3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp. 4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp. 5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp. 6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	<ol style="list-style-type: none"> 1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf 2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf 3. https://www.springer.com/gp/book/9788132221777 4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-

	science.pdf 5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN
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Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE I

3. ENTREPRENEURIAL BOTANY

Title of the Course	ENTREPRENEURIAL BOTANY					
Paper Number	Elective-I					
Category	Elective	Year	III	Credits	3	CourseCode U23BY5:C
		Semester	V			
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	
		3		-	3	
Pre-requisite		To develop innovative ideas to exploit the economically useful plant products for commercial purposes.				
Learning Objectives						
C1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.					
C2	To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.					
C3	To comprehend the molecular processes.					
C4	To expose the students a fundamental of the various value added products.					
C5	To introduce the entrepreneurial opportunities.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Recognize the significance of government agencies for entrepreneurship development.	K1					
2. Explain about entrepreneurial values, risk assessment and solutions	K2					
3. Make use of entrepreneurial	K3					

opportunities.	
4. Analyze and decipher the significance of bioventure and value added products.	K4
5. Devise innovative methods for making value added products.	K5 & K6
UNIT	CONTENTS
I	INTRODUCTION: Need - definition and concept - Types and characterization - entrepreneurial values- motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.
II	BIOVENTURE: Industry - overview of <i>Spirulina</i> , <i>Pleurotus</i> , Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	VALUE ADDED PRODUCTS: Canning of fruits - process and equipment, fruit and vegetable based products (squash) - ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies), Palmyrah Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based products-virgin coconut oil, jasmine oil production, nutraceuticals, standards and quality management.
IV	ORGANIZATIONS AND AGENCIES: TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO – Micro Small and Medium Enterprises – support structure for promoting entrepreneurship – various government schemes.
V	ENTREPRENEURIAL OPPORTUNITIES: Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), steps in filing patents, trademarks and copyright, Intellectual Property Rights, export and import license.
Extended Professional Component (is a part of internal component only, Not to be included in the	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)

External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New venture creation, Galgeha publication company, New Delhi.ISSN: 2321-8916. 2. Desai,V.,2015. Entrepreneurship development, First edition.Himalaya publication house, Mumbai. ISBN:9789350973837. 3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand company limited, New Delhi.ISBN:9788121918015. 4. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10th ed).Rastogi Publications, Meerut. 5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entrepreneurship/ 2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/value-added-products-microalgae-faizal-bux 3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Products-ebook/dp/B0845QXPY3 4. https://www.elsevier.com/books/value-addition-in-food-products-and-processing-through-enzyme-technology/kuddus/978-0-323-89929-1 5. https://www.oreilly.com/library/view/selling-today-partnering/9780134477404/xhtml/fileP7001011940000000000000000000000001DEB.xhtml

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE-III

1. HORTICULTURE

Title of the Course	HORTICULTURE					
Paper Number	Elective-III					
Category	Elective	Year	III	Credits	3	CourseCode U23BY6:A
		Semester	VI			
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	
		3		-	3	
Pre-requisite		Students should know fundamental knowledge on horticulture applications.				
Learning Objectives						
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.					
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.					
C3	To know about hydroponic culture.					
C4	To develop the various horticultural crop protection.					
C5	To impart the knowledge on market preparation.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Enumerate the concepts in horticulture and nursery management.	K1					
2. Demonstrate a working knowledge on biology of soil, compost making, designing and planning of	K2					

garden, pest, diseases and nutrient management practices.	
3. Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
4. Analyze different methods of weed control in horticultural crops.	K4
5. Develop their competency on pre and post-harvest technology in horticultural crops.	K5 & K6
UNIT	CONTENTS
I	Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (greenhouses), environment controls.
II	Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.
III	Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation - cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
IV	A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.
V	Technology of horticultural crops - market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and

	canning, drying and chemical preservation.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Arditti, A. 1977. Orchid biology, Cornell Univ., Press. Ithaca. 2. Bailey, S. 1971. Perpetual flowering carnation, Fabner and Fabner, London. 3. Laurie, A., Kiplinger, 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 Jercoy.
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-III

2. NATURAL RESOURCE MANAGEMENT

Title of the Course	NATURAL RESOURCE MANAGEMENT					
Paper Number	Elective-III					
Category	Elective	Year	III	Credits	3	CourseCode U23BY6:B
		Semester	VI			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	3				-	3
Pre-requisite	To understand the concept of different natural resources and their utilization.					
Learning Objectives						
C1	To develop an appreciation for the natural resources and their ecological and economic impact.					
C2	To gain an understanding of various strategies of natural resource management.					
C3	To understand the concept of different natural resources and their utilization.					
C4	To create the models of natural resource conservation and maintenance.					
C5	To study the significance of natural resources pertaining to economy and environment.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Relate to significance of natural resources pertaining to economy and environment	K1					
2. Understand the concept of different natural	K2					

resources and their utilization.	
3. Evaluate the management strategies of different natural resources.	K3
4. Critically analyze the sustainable utilization land, water, forest and energy resources.	K4
5. Design new models of natural resource conservation and maintenance.	K5 & K6
UNIT	CONTENTS
I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.
II	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification.
III	Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish

	resource, unsustainable harvesting, issues and challenges for resource supply, new prospects.
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
Extended 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	<ol style="list-style-type: none"> 1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi. 2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. 3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 4. United States Government Accountability Office. 2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition 5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House 6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition). Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303. 2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.

	<p>3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.</p> <p>4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.</p> <p>5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.</p> <p>6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).</p> <p>7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.</p> <p>8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.</p> <p>9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.</p>
Web resources	<p>1. https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&redir_esc=y</p> <p>2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y</p> <p>3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE</p> <p>4. https://www.kobo.com/us/en/ebooks/natural-resources</p> <p>5. https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&redir_esc=y</p> <p>6. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y</p> <p>7. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE</p> <p>8. https://www.kobo.com/us/en/ebooks/natural-resources</p> <p>9. https://www.igi-global.com/chapter/natural-resources-management/195183</p> <p>10. https://www.igi-global.com/chapter/natural-resources-management/195183</p>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE-III

3. FORESTRY

Title of the Course	FORESTRY					
Paper Number	Elective-III					
Category	Elective	Year	II	Credits	3	CourseCode U23BY6:C
		Semester	VI			
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total
		3			-	3
Pre-requisite		Prior knowledge on trees, forests and their importance.				
Learning Objectives						
C1	To study the distribution pattern, composition and diversity of forest ecosystem					
C2	To understand the method of forest management principles and conservation.					
C3	To enable them to meaningfully contribute in the forest conservation.					
C4	To raise student awareness of the need to create a sustainable way of living and the current global issues with forestry caused by human interference.					
C5	To provide a platform to appreciate biodiversity and the importance.					
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes					
1. Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	K1					
2. Understand complex interactions of humans and	K2					

forest ecosystems in a global context.	
3. Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
4. Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation	K4
5. Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	K5 & K6
UNIT	CONTENTS
I	<p>SILVICULTURE:</p> <p>Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu - revised classification - pure and mixed stands - even and uneven aged stands. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural</p>

	and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.
II	<p>FOREST MENSURATION AND MANAGEMENT:</p> <p>Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees - methods and principles - tree stem form - form factor. Volume estimation of stand - age - basal area determinations Stem and Stump Analysis. Forest inventory - sampling techniques and methods - measurement of crops - sample plots. Yield calculation - CAI and MAI - volume, yield and stand tables preparation.</p>
III	<p>FOREST UTILIZATION AND WOOD TECHNOLOGY:</p> <p>Logging - extraction of timber - felling rules and methods - conversion methods - conversion season. Implements used - cross cutting system - sawing - different types - extraction methods. Grading of timbers. Transportation of timbers - major and minor transportation methods Storage and sales of logs - sales depot - management of depots. Recent trends in logging - Ergonomics and RIL. Forest products - Timber - timber, fuel, pulp, paper, rayon and match. Wood Composites - plywood, particle board, fiber boards, MDF, hardboard, insulation boards - production technology. Non timber forest products (NTFP) - collection - processing and storage of NTFP - fibres and flosses - bamboos and canes - katha and bidi leaves - essential oils and oil seeds - gums and resins - tans and dyes - drugs - insecticides - lac and shellac - tassar silk - role of tribal co-operative societies.</p>
IV	<p>FOREST BIOLOGY AND BOTANY:</p> <p>Forest ecology - definition - biotic and abiotic components - forest ecosystem - forest community - concepts - succession - primary productivity - nutrient cycling. Composition of forest types in India - classification of India's forests - species composition - association and diversity. Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation. Biodiversity - Definition, origin, types - factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book. Biodiversity assessments - principles and methods.</p>
V	<p>FOREST BOTANY:</p> <p>Importance of botany - taxonomic classification of plant species - identification of species - composition and association. Dendrology - principles and establishment of herbaria and arboreta. Tree Improvement - Forest Genetics and Tree Breeding - Definition and concepts - Steps in tree improvement - Variation and selection - Progeny Evaluation Test (PET) - Candidate Tree, Plus Tree, Elite trees - use of provenances and seed sources - heritability and genetic gains - hybrids in tree improvement - heterosis exploitation. Seed production Area and seed orchards - types and</p>

	<p>establishment. In situ and ex situ gene conservation. Exotics - role of exotic forest trees in India - application of biotechnological methods in forestry.</p> <p>AGRO FORESTRY AND SOCIAL FORESTRY:</p> <p>Agro forestry - definition, concept and objectives. Classification of agro forestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of agro forestry - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros. 2. Roger Sands. 2013. Forestry in a global context, CAB international. 3. Balakathiresan. S.1986. Essentials of Forest Management. Nataraj Publishers, Dehradun. 4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi. 5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi. 6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat. 7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun. 8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun. 9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert

	<p>Book Agency, New Delhi.</p> <p>10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.</p>
Reference Books	<ol style="list-style-type: none"> 1. Donald L. Grebner, Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press 2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland. 3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York. 4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford IBH Publishing Co., New Delhi. 5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia. 6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. Wertz Kanounnikoff. 2007. Incentives and constraints shape forest outcomes. In: At loggerheads? Agricultural expansion, poverty reduction and environment in tropical forests. The World Bank, Washington, DC. 7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
Web resources	<ol style="list-style-type: none"> 1. http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_20061019150049/Rendered/PDF/367890Loggerheads0Report.pdf 2. https://www.britannica.com/science/forestry 3. https://en.wikipedia.org/wiki/Forestry. 4. https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119 5. https://academic.oop.com 6. https://www.cbd.int/development/doc. 7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE-IV

1. BIONANOTECHNOLOGY

Title of the Course	BIONANOTECHNOLOGY					
Paper Number	Elective-IV					
Category	Elective	Year	III	Credits	3	Course Code U23BY6:D
		Semester	VI			
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total
		3			-	3
Pre-requisite		To provide an insight into the principles of nanotechnology in biological and medical research.				
Learning Objectives						
C1	To provide students with comprehensive knowledge of basics in nanotechnology.					
C2	To enable the students understand and appreciate the various applications of nanoparticles.					
C3	To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.					
C4	To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.					
C5	To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.					
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes					
1. Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology	K1					
2. Explain the synthesis of nanomaterials and their applications.	K2					

3. Apply the knowledge gained to develop nanomaterials	K3
4. Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.	K4
5. Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6
UNIT	CONTENTS
I	INTRODUCTION TO NANOTECHNOLOGY: History, Concepts, Prospects and Challenges. Scope of nanotechnology in Indian and global perspectives. Definition - Nanoscience, Nanotechnology. Classification based on the dimensionality- basic understanding of 1D, 2D and 3D nanostructures. Overview of nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biotemplates – DNA to build nanocubes and hinges – smart glue, DNA as wire template.
II	SYNTHESIS OF NANOPARTICLES: Synthesis of nanoparticles - Top down and bottom up approach. Methods of synthesis: Physical, Chemical reduction – reducing agents, capping agents, stabilizing of nanoparticles and Biological – Novel synthetic methods using plant extracts, bacteria and fungi.
III	FOREST UTILIZATION AND WOOD TECHNOLOGY: PROPERTIES & CHARACTERIZATION OF NANOPARTICLES: Nano size effects - optical, electrical, mechanical, magnetic and catalytic activity. Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, Atomic force microscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography and Photoluminescence.
IV	NANOCARRIERS: Introduction. Nanocarriers for drug delivery (DDS) – Polimeric nanotubes and solid lipid nanoparticles (SLN) as carriers, controlled release, site specific targeting. Magnetic nanoparticles as drug carriers and its applications.
V	APPLICATIONS OF NANOPARTICLES: Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, wound healing and dressing; Environment – green manufacturing. Agriculture - nanofertilizers and nanopesticides. Smart biosensors – Components and its application.

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction to Nanotechnology, A John Wiley & Sons, INC., Publication. 2. George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. CRC Press. 3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscience and 4. Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Practices. Capital 5. Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers. 6. Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylor Francis Group. 7. Sharma P.K. 2008. Understanding Nanotechnology. Vista International Publishing House, Delhi. 8. Viswanathan B. 2009. Nano Materials. Narosa Publishing House, New Delhi.
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd, 2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience. 3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory. 4. European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union.

	<ol style="list-style-type: none"> 5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland. 6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Spirnger Publication. 7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery Systems for Lung Cancer. Academic Press. An imprint of Elsevier.
Web resources	<ol style="list-style-type: none"> 1. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453 2. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4 3. https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179 4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php 5. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html 6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/ 7. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html 8. http://www.particle-works.com/applications/controlled-drug-release/Applications

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE-IV

2. COMPUTER APPLICATIONS IN BOTANY

Title of the Course	COMPUTER APPLICATIONS IN BOTANY					
Paper Number	Elective-IV					
Category	Elective	Year	III	Credits	3	CourseCode U23BY6:E
		Semester	VI			
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total
	3				-	3
Pre-requisite	To equip students with computational skills for drug design.					
Learning Objectives						
C1	To familiarize the student with the fundamentals concepts of bioinformatics.					
C2	To equip students with computational skills for drug design.					
C3	To learn about the bioinformatics database, data format and data retrieval from online sources.					
C4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.					
C5	Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.					
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes					
1. Recognize advanced resources for accessing scholarly literature from the internet.	K1					
2. Explain the concept of databases and use of	K2					

different public domain for DNA and proteins sequence retrieval.	
3. Apply various software resources with advanced functions to carry out analysis of data procured through research.	K3
4. Decipher the effective utilization of bibliography management software while typing and downloading citations.	K4
5. Determine how the knowledge gained can be used for designing experiments and data interpretation.	K5 & K6
UNIT	CONTENTS
I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media

II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.
III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees.
V	Applications: Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS. Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 1. P.K. Gupta. Biotechnology and Genomics. 2016-2017. Rastogi Publications, 7th Reprint (1st Edition). 2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications,

	<p>1st edition. New Delhi, Delhi: Oxford University Press.</p> <ol style="list-style-type: none"> 3. Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc. 4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House. 5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons. 6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd edition. New Jersey, U.S.: Wiley Blackwell. 7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Cambridge, U.K.: Cambridge University Press.
Reference Books	<ol style="list-style-type: none"> 1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US. 2. David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US. 3. Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun. 4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press. 5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg. 6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practical Guide to Design and Analysis. Chapman and Hall/CRC; 1st edition. 7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Molecular Biologists. Volume III 2nd Edn. Horizontal Scientific Press, Norwich, UK.
Web Resources:	<ol style="list-style-type: none"> 1. http://www.agrimoon.com/introduction-to-computer-applications-pdf-book/ 2. https://www.ebooks.com/en-us/subjects/computers/ 3. https://it.careers360.com/download/ebooks 4. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformatics22.23-4-2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20Amira.pdf 5. http://www.freebookcentre.net/Biology/BioInformatics-Books.html 6. https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE-IV
3. FORENSIC BOTANY

Title of the Course	FORENSIC BOTANY						
Paper Number	Elective-IV						
Category	Elective	Year	III	Credits	3	Course Code	U23BY6 :F
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		3		1		-	4
Pre-requisite		The course will provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.					
Learning Objectives							
C1	To provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.						
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.						
C3	To learn classification of plants from forensic point of view.						
C4	To understand forensic importance of different parts of plants.						
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1						
2. Summarize the forensic	K2						

importance of different parts of plants.	
3. Apply techniques for the collection and preserve of botanical evidences of crime.	K3
4. Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
5. Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6
UNIT	CONTENTS
I	General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.
II	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man-made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
III	Various types of poisonous plants: <i>Abrus precatorius</i> , <i>Aconitum napellus</i> , <i>Anacardium occidentale</i> , <i>Argemone mexicana</i> , <i>Cannabis sativa</i> , <i>Claviceps purpuria</i> , <i>Croton tiglium</i> , <i>Atropa belladonna</i> , <i>Gloriosa superba</i> , <i>Jatropha curcas</i> , <i>Lathyrus sativus</i> , <i>Nerium indicum</i> , <i>Nicotiana tabacum</i> , <i>Strychnos nux vomica</i> , <i>Thevetia nerifolia</i> . Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, <i>Psilocybin</i> mushrooms.
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.

V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.
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	<ol style="list-style-type: none"> 1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press. 2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition. 3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom. 4. Jane H Bock, David Norris.2015. Forensic Plant Science. Elsevier. 5. Patricia E. J. Wiltshire.2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation. Criminal and Environmental Soil Forensics pp 129–149
Reference Books	<ol style="list-style-type: none"> 1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition. 2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press. 3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell. 4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell. 5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.
Web Resources	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/forensic-botany 2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574 3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-

	<p>pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/ 4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299 5. http://docshare02.docshare.tips/files/25818/258183613.pdf</p>
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Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE 1

BOTANICAL GARDEN AND LANDSCAPING

Title of the Course	BOTANICAL GARDEN AND LANDSCAPING						
Paper Number	Skill Enhancement-1						
Category	Elective	Year	III	Credits	1	Course Code	
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Pre-requisite	Students should know about the fundamental concepts of gardening and landscaping.						
Learning Objectives							
C1	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: CO	Programme Outcomes						
1. Recognize fundamental concepts of gardening and landscaping.	K1						
2. Explain about significance of garden adornments and propagation structures.	K2						
3. Apply techniques of	K3 & K6						

landscaping for aesthetic purposes and gardening for recreation.	
4. Distinguish between formal, informal and free style gardens and their applications.	K4
5. Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	K5 & K6
UNIT	CONTENTS
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.
II	Flower arrangement: importance, production EXPERIMENTS and cultural operations, constraints, post harvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.
III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. 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, damsites, IT parks, corporate.
IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, eco tourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).
Extended Professional Component (is a part of	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)

internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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)

SKILL ENHANCEMENT COURSES SEC 4

HERBAL TECHNOLOGY

Title of the Course	HERBAL TECHNOLOGY						
Paper Number	Skill Enhancement-4						
Category	Elective	Year	III	Credits	1	CourseCode	U23BY3S4
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Pre-requisite	To understand the importance of herbal technology.						
Learning Objectives							
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.						
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.						
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.						
C4	To apply the knowledge to cultivate medical plants.						
C5	To know the pharmacological importance of medicinal plants.						
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes						
1. Define and describe the principle of cultivation of herbal products.	K1						
2. List the major herbs, their botanical name and chemical constituents.	K2						

3. Apply techniques for monitoring drug adulteration through the biological testing.	K3
4. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
5. Develop the skills for cultivation of plants and their value added processing / storage	K5 & K6
UNIT	CONTENTS
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.
II	Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmetics and biopesticides, their Botanical names, plant parts used, major chemical constituents.
III	Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalmegh, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.
IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (<i>Withania somnifera</i> , neem and tulsi),

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 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.
<p>Reference Books</p>	<ol style="list-style-type: none"> 1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17. 2. Arber, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur. 3. Varzakas, T., Zakyntinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88. 4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000. 5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.
<p>Web resources</p>	<ol style="list-style-type: none"> 1. https://www.kopykitab.com/Herbal-Science 2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9oIKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE 3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu 4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404 5. https://www.dattanibookagency.com/books-herbs-science.html 6. https://www.springer.com/gp/book/9783540791157

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

SKILL ENHANCEMENT COURSES SEC 5
***ENTREPRENEURIAL SKILL**

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Title of the Course	ENTREPRENEURIAL OPPORTUNITIES IN BOTANY					
Paper Number	Skill Enhancement-5					
Category	Elective	Year	III	Credits	2	Course Code U23BY3S 5
		Semester	VI			
Instructional Hours per week		Lecture		Tutorial	Lab Practice	Total
		2		-	-	2
Pre-requisite		To understand the concept of Entrepreneurial Opportunities in Botany.				
C1	To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.					
C2	To create a mindset among students to start their own companies for income generation.					
C3	The students may understand about various fields of botany.					
C4	To develop the concept of Entrepreneurial Opportunities in Botany.					
C5	Describe the new strategies to describe marketing and business management strategy.					
Course outcomes: On completion of this course, the students will be able to: CO	Programme Outcomes					
1. Relate to how various fields of botany could be understood with an entrepreneurial approach.	K1					
2. Explain the concept of Entrepreneuria	K2					

1 Opportunities in Botany.	
3. Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	K3
4. Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
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, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.
II	TOOLS AND TECHNIQUES Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes,

	antibiotics.
III	NEW VENTURE CREATION Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
IV	PRODUCT DEVELOPMENT AND COMMERCIALIZATION Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
V	BIO-BUSINESS PLANS, IPR AND BIOETHICS Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 University Press, Cambridge
Web sources	<ol style="list-style-type: none"> 1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/ 2. https://www.youtube.com/watch?v=hnBla1FfcLo 3. https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation 4. http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301 4. https://www.ebooks.com/en-us/subjects/gardening/ 5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

ELECTIVE – INDUSTRY MODULE

CULTIVATION OF ALGAE

Title of the Course	INDUSTRY MODULE - CULTIVATION OF ALGAE					
Paper Number	INDUSTRY MODULE					
Category	Elective	Year	III	Credits	2	Course Code
		Semester	VI			
Instructional Hours per week		Lecture		Tutorial		Lab Practice
		3		1		-
Pre-requisite		Students should know fundamental knowledge on algae and itsbiotechnological applications.				
Learning Objectives						
C1	To impart sufficient information about the culture and cultivation of algae under laboratory andoutdoor conditions..					
C2	To study the media composition for algae cultivation and high value products and its applications.					
C3	To know about the important seaweeds and its cultivation practices.					
C4	To study the SLF production and applications in agriculture crops.					
C5	To understand about the Environment Impact Assessment of algal cultivation.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Obtain an in-depth knowledge on culture and mass cultivation of algae and its different methods.	K1					
2. Exploration and recommendation of the commercial potential of algal products.	K2					
3. Understand the applied facet of	K3					

algology and acquire a complete knowledge about the cultivation methods in algae.	
4. Describe the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	K4
5. Acquiring the information about algal applications in different industries and agriculture fields in the current scenario.	K5 & K6
UNIT	CONTENTS
I	Morphology, life history and mass culture of microalgae: <i>Spirulina, Chlorella, Dunaliella</i> and <i>Botryococcus</i> .
II	High value products: Single Cell Protein (SCP), phycocyanin, β -carotene, astaxanthin – biofuel, media composition - scale up - lab to land - raceway ponds and photobioreactor.
III	Marine macroalgae: Morphology, life history and mass cultivation of <i>Gracilaria, Kappaphycus, Sargassum</i> and <i>Ulva</i> .
IV	Polysaccharides: agar, carrageen, alginate - economic importance - seaweed as food, feed and Seaweed Liquid Fertilizer (SLF).
V	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Kumar H.D. and Singh, H.N. 1976. A Text Book of Algae Affiliated East West Press Pvt. Ltd., New Delhi, Madras.

	<ol style="list-style-type: none"> 2. Kumar, H.D. 1990. Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi, Madras, Hyderabad, Bangalore. 3. Pandey, B.P. 1993. A Text book of Botany-Algae S. Chand & Co., (P) Ltd., New Delhi. 4. Sharma, O.P. 1990. Text Book of Algae Tata McGraw Hill Publishing Co., Ltd., New Delhi. 5. Vashista, B.R. 1988. Botany for degree students-Algae. S. Chand & Co., (P) Ltd., New Delhi
Reference Books	<ol style="list-style-type: none"> 1. Bilgrami, K.S., and L.C. Saha. 1996. A Text Book of Algae, CBS Publishers & Distributors (P)Ltd., New Delhi. 2. Chapman, V.J. and Chapman, D.J., 1973. The Algae. 2nd Ed. ELBS & MacMillan, 498 pp., 3. Fritsch F.E. 1935. The Structure and Reproduction of Algae 1945. Cambridge University Press, Cambridge, U.K. Vol. I-791 pp., Vol. II-939 pp., 4. Round, F.E. 1973. Biology of the Algae. 2nd Ed. Edward Arnold, London. 278 pp., 5. Sharma, O.P. 1990. Text Book of Algae. Tata McGraw Hill Publishing Co., Ltd., New Delhi, 396
Web Resources	<ol style="list-style-type: none"> 1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production 2. https://link.springer.com/article/10.1007/s10811-013-9983-9 3. https://www.nrel.gov/docs/legosti/old/2360.pdf 4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf 5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed aquaculture Cultivation technologies_ch all.pdf

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

SKILL ENHANCEMENT COURSES SEC 6

FERMENTATION TECHNOLOGY

Title of the Course		FERMENTATION TECHNOLOGY					
Paper Number		Skill Enhancement					
Category	Elective	Year	III	Credits	1	Course Code	U23 BY 4S6
		Semester	VI				
Instructional Hours per week		Lecture		Tutorial		Lab Practice	Total
		2		-		-	2
Pre-requisite		To students to know about the various fermentation technology.					
Learning Objectives							
C1	To appreciate the significance of microbes synthesizing fermented products.						
C2	To gain insights on safety and quality control in large scale production of fermentative products.						
C3	To design and operation of industrial practices in mass production of fermented products.						
C4	To know about the various fermentation technology.						
C5	To learn about the bioproduct recovery.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Enumerate the significance of industrially useful microbes.	K1						
2. Explain the design and operation of industrial practices in mass production of fermented products.	K2						
3. Explain the	K3						

process of maintenance and preservation of microorganisms.	
4. Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
5. Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6
UNIT	CONTENTS
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
IV	Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.
Extended Professional Component (is a part of internal component only, Not to be included in the	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)

External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK. 2. Pepler, 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	<ol style="list-style-type: none"> 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/
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Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

SKILL ENHANCEMENT COURSES SEC 7

ENVIRONMENTAL IMPACT ANALYSIS

Title of the Course	ENVIRONMENTAL IMPACT ANALYSIS						
Paper Number	Skill Enhancement						
Category	Elective	Year	III	Credits	1	Course Code	U23BY4S7
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Pre-requisite	To students to know about the environmental impact assessment.						
Learning Objectives							
C1	To understand about the theory and practice of environmental impact assessment.						
C2	To develop skills in identifying and solving problems of environmental concerns.						
C3	Define and classify Environmental Impacts and the terminology.						
C4	Understands the environmental Impact assessment procedure.						
C5	List and describe environmental audits.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Enumerate the fundamental concepts and significance of environmental impact assessment.	K1						
2. Explain the important steps of EIA process.	K2						
3. Interpret the environmental appraisal and procedures in	K3						

India.	
4. Decipher how to prepare the various documents required by state and federal regulations.	K4
5. Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6
UNIT	CONTENTS
I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.
II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,
III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document.
IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.
V	Environmental Appraisal and Procedures in India and EIA Methodology, indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question	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)

paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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
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S-Strong (3) M-Medium (2) L-Low(1)

**SKILL ENHANCEMENT COURSES SEC 8 –TRAINING
FOR COMPETITIVE EXAMINATIONS.**

BOTANY FOR COMPETITIVE EXAMINATIONS (2 hours)

Title of the Course	BOTANY FOR COMPETITIVE EXAMINATIONS						
Paper Number	Skill Enhancement						
Category	Elective	Year	III	Credits	2	Course Code	U23BY6G1
		Semester	VI				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Pre-requisite	To develop the students for preparing various competitive examination.						
Learning Objectives							
C1	To develop the student for competitive examination.						
C2	To select the important topics as far as possible, with reference to the examination point of view. It gives a comprehensive account of botany.						
C3	To understand not only the basics of botany and also gives the broader perspective to prepare for the competitive examinations.						
C4	The essays give a detailed account of each aspect of botany to help students preparing for IAS, IFS and state civil services.						
C5	General understanding of plants around us, the different biophysical and biochemical processes that occur within them and their importance to human life.						
Course outcomes:	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Identify and define different groups of plants with their	K1, K2 & K5						

<p>taxonomic position Compare the different groups of plants and evaluate their economic importance</p>	
<p>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</p>	<p>K1,K3 & K5</p>
<p>3.Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.</p>	<p>K3 & K5</p>
<p>4.Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked</p>	<p>K2, K3 & K5</p>

<p>inheritance. Tabulate the different cell organelles with their functions.</p>	
<p>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.</p>	<p style="text-align: center;">K1, K5 & K6</p>
	<p style="text-align: center;">GENERAL STUDIES FOR COMPETITIVE EXAMINATIONS (2 hours)</p> <p>Physical Geography Indian and World Geography Indian and World History International Organizations Everyday Science Awards and Honors Indian Economy Indian Polity</p>
UNIT	CONTENTS
I	<p>PLANT WORLD: Plant science and its branches . Five kingdom classification. Outline of Kingdom plantae General characters and Economic importance of Algae, Fungi and Lichens.</p>
II	<p>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.</p>
III	<p>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</p>

	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 – <i>ex situ</i> and <i>in situ</i> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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)

BOTANY FOR ADVANCED STUDIES (4 hours)

Title of the Course	BOTANY FOR ADVANCED STUDIES					
Paper Number	Skill Enhancement					
Category	Elective	Year	III	Credits	2	Course Code
		Semester	VI			
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total	
		4	-	-	4	
Pre-requisite		To develop the botany students for preparing advanced studies.				
Learning Objectives						
C1	To be familiar with the basic concepts and principles of plant systematics.					
C2	Learn the importance of plant anatomy in plant production systems.					
C3	To expose the students a fundamental of the various techniques used in molecular studies.					
C4	To learn about the physiological processes that underlie plant metabolism.					
C5	To know the energy production and its utilization in plants.					
Course outcomes:	Programme Outcomes					
On completion of this course, the students will be able to: CO						
1. Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data	K1, K2 & K5					
2. Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant	K1, K3 & K5					

growth.	
3. Understand the organization of nuclear genome	K3 & K5
4. Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.	K2, K3 & K5
5. Gain awareness about the various processes involved in the energy production in plants and metabolic pathways.	K1, K5 & K6

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

	and evolutionary relationships prokaryotes, organelles and eukaryotes, orthologues and paralogues. Metabolomics: Identification and quantification of cellular metabolites in biological samples. Pharmacogenomics and drug designing.
II	<p>ADVANCED TRENDS IN SYSTEMATICS</p> <p>(i) Basic concepts of:</p> <p>a. Morphology - History, general morphology, types of data, methods of gathering data, b. Anatomy - History, general anatomy, types of data, methods of gathering data, c. Embryology – History, types of data, methods of gathering data; d. Palynology: History, general palynological characters, types of data, methods of gathering data; e. Cytology and Cytogenetics: History, general cytological and cytogenetic characters, types of data, methods of gathering data; f. Ecology, History, general ecology, types of data, methods of gathering data (At least two examples from each section should be studied to substantiate the taxonomic significance)</p> <p>(ii) Chemotaxonomy:</p> <p>a. History, general chemical and chemotaxonomic characters, types of data, methods of gathering data. b. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources 8 (phenolics, steroids, terpenoids glycosides and alkaloids). c. Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention, biotechnology in the production of phytochemicals. Phytochemical databases</p> <p>(iii) Molecular trends in Biosystematics</p> <p>a. Molecules and genomes in plant systematics, techniques used in molecular taxonomy, molecular systematics in crop evolution b. Serology in relation to plant taxonomy- Methods, role of serology in taxonomy. c. Cladistics and Phenetics (iv) Molecular trends in Reproductive Biology: (i) Apomixis – Types, cytogenetic basis and induction of apomixes, applications.</p> <p>) Biochemistry and genetics of incompatibility, methods to overcome incompatibility, pollen viability tests, molecular basis of incompatibility) Sterility – Male sterility, CMS, GMS, CGMS, temperature sensitive and photosensitive male sterility, transgenic male sterility, female sterility and zygotic sterility.</p>
	<p>PLANT PHYSIOLOGY</p> <p>(i) Modern concepts Photosynthesis – Environmental and agricultural relevance; Respiration – Biochemical control of respiration (ii) Photomorphogenesis Phytochrome genes and their expression, control of photo-morphogenic responses. Dose-response relations in photomorphogenesis, light induced chloroplast differentiation, effect of</p>

<p>III</p>	<p>photoreceptors. (iii) Biological clock: Circadian rhythms, rhythm responses to environment, clock mechanism (iv) Photoperiodism General principles , florigen concept (v) Plant growth and development Patterns of growth and differentiation; Gene expression and mutations regulating meristem function, embryogenesis, seedling, root, leaf and flower development. Homeotic genes, ABCD model in Arabidopsis flower, hormonal control of plant tissue development, effect of auxins on root and root formation, gibberellin promoted growth of plants, ethylene and triple response mutants, brassinosteroids and photomorphogenesis.</p>
<p>IV</p>	<p>PLANT PHYSIOLOGY (i) Enzymes: General account: Importance and properties of enzymes in biological sciences, the classification and nomenclature of enzymes with examples, Mechanism of enzyme action role of enzyme in chemical action, various factors affecting the enzyme activity. Molecular genetics in plant physiology, Environmental plant physiology, Stress physiology .</p>
<p>V</p>	<p>ECONOMIC BOTANY Economic importance of Cereals, Tuber Crops, Fibre yielding plants, Plantation Crops, Sugar yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Beverages</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>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)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p>Recommended Texts</p>	<ol style="list-style-type: none"> 1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies. 2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi. 3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

	<ol style="list-style-type: none"> 4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company Ltd. New Delhi. 5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US. 6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The World of the Cell (6th edition). Benjamin/Cummings Pub. Co. New York. 7. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York. 8. Bruce, A. et. al. 2002. Molecular Biology of the Cell. Garland Publishing. New York.
Reference books	<ol style="list-style-type: none"> 1. Mabberley, J.D. 2014. Mabberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp. 2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi. 3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany. 4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA. 5. Steward, F.C. 2012. Plant Physiology Academic Press, US. 6. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A. 7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi. 8. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York. 9. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston. 10. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York. 11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York. 12. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco. 13. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A. 14. Mabberley, J.D. 2014. Mabberley's Plant-Book: A portable dictionary of plants, their classification and uses, 3rd ed. Cambridge University Press, Cambridge, U.K. 1021pp. 15. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi. 16. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany. 17. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy:

	<p>An Applied Approach. Blackwell Publishing, Malden, USA.</p> <p>18. Steward, F.C. 2012. Plant Physiology Academic Press, US.</p> <p>19. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology (4th ed.). John Wiley & Sons. U.S.A.</p> <p>20. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.</p> <p>21. Anthony J . F. G .2000. An Introduction to Genetic Analysis. W. H. Freeman &Co. New York.</p> <p>22. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Genes and Genomes Jones and Bartlett Pub, Boston.</p> <p>23. Klug .S.W. & Cummings, M.R. 2003. Concepts of Genetics . Pearson Education Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA and Biotechnology. American Society for Cell Biology, New York.</p> <p>24. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman &Co. New York.</p> <p>25. Russell, P.J. 2005. Genetics: A Molecular Approach (2nd edition). Pearson/Benjamin Cumming, San Francisco.</p> <p>26. Snustad, D. P. & Simmons M.J. 2003.Principles of Genetics. John Hailey & Sons Inc. U.S.A.</p>
Web resources	<p>1. http:// www.ornl.gov.</p> <p>2. http:// ash. gene. ncl. ac .nk..</p> <p>3. http://tor. cshl. org. http://www. gdb. org.</p> <p>4. http: //www. neg r. org.</p> <p>5. http: // www. genetics. wustl. edu.</p> <p>6. http: // genome. imb- jena. dc.</p>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

FOUNDATION COURSE FOR BOTANY

BASICS OF BOTANY

Title of the Course	BASICS OF BOTANY						
Paper Number	Foundation Course						
Category	Elective	Year	I	Credits	2	Course Code	U23BY1N1
		Semester	I				
Instructional Hours per week	Lecture		Tutorial		Lab Practice	Total	
	2		-		-	2	
Pre-requisite	To recall the students about the basic aspects of botany.						
Learning Objectives							
C1	To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.						
C2	To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.						
C3	To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.						
C4	Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.						
C5	Understanding of laws of inheritance, genetic basis of loci and alleles.						
Course outcomes	Programme Outcomes						
On completion of this course, the students will be able to: CO							
1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1						
2. Develop an	K2						

understanding of microbes and fungi and appreciate their adaptive strategies	
3.Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
4.Compare the structure and function of cells and explain the development of cells.	K4
5.Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

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	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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. 6. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. 7. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet

	Publications, Delhi.
Web Resources	<ol style="list-style-type: none"> 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)