B.SC.,
BOTANY

SYLLABUS

2023 – 2024

(SEMESTER I & II)

TAMILNADU STATE COUNCIL FOR HIGHER EDUCATION, CHENNAI – 600 005

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, theirinteractions 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 Botanywith emphasis on the operation of relevant sophisticated instruments.
PO7	To impart knowledge on the economic importance of plant/microbial resources andtheir 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 Botanyand 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

1. Introduction

Programme Outcome, Programme Specific Outcomes and Course Outcomes

Students completing this programme will be able to present their core under-graduate discipline clearly and precisely, make abstract ideas precise by formulating them in the language of the specific discipline, describe related ideas from multiple perspectives and explain fundamental concepts. Completion of this programme will also enable the learners to join teaching profession, enhance their employability for government jobs, jobs in various other public and private enterprises.

Programme Outcomes:

PO1: Disciplinary Knowledge: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that form a part of an undergraduate programme of study.

PO2: Critical Thinking: Capability to apply analytic thought to a body of knowledge; analyze and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.

PO3: Problem Solving: Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's earning to real-life situations.

PO4: Analytical Reasoning: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples and addressing opposing viewpoints.

PO5: Scientific Reasoning: Ability to analyse, interpret and draw conclusions from quantitative / qualitative data; and critically evaluate ideas, evidence, and experiences from an open-minded and reasoned perspective.

PO6: Self-directed & Lifelong Learning: Ability to work independently, identify and manage a project. Ability to acquire knowledge and skills, including "learning how to learn", through

self-placed and self-directed learning aimed at personal development, meeting economic, social and cultural objectives.

Programme Specific Outcomes:

PSO1: Acquire good knowledge and understanding, to solve specific theoretical & applied problems in different areas of the discipline.

PSO2: Understand, formulate, develop relevant arguments logically and use analytical thinking to address issues arising in social sciences, business and other context /fields.

PSO3: To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision-making and leadership skill that will facilitate startups and high potential organizations.

Mapping of Course Learning Outcomes (CLOs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)can be carried out accordingly, assigning the appropriate level in the grids:

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2. **Highlights of the Revamped Curriculum:**

- Student-centric, meeting the demands of industry & society, incorporating industrial components, hands-on training, skill enhancement modules, industrial project, project with viva-voce, exposure to entrepreneurial skills, training for competitive examinations, sustaining the quality of the core components and incorporating application-oriented content wherever required.
- The Core subjects include latest developments in the education and scientific front, practical training for providing solutions to industry / real-life situations. The curriculum also facilitates peer learning with advanced topics in the final semester, catering to the needs of stakeholders with research aptitude.
- The General Studies and discipline-based problem-solving skills are included as mandatory components in the 'Training for Competitive Examinations' course in the final semester, a first of its kind.

- The curriculum is designed so as to strengthen the Industry-Academia interface and provide more job opportunities for the students.
- The Internship during the second year vacation will help the students gain valuable work experience that connects classroom knowledge to real-world experience focussing on the career path.
- Project with viva-voce component in the fifth semester enables the student, application of conceptual knowledge to practical situations. Industrial training, project and internships will give students an edge over counterparts in the job market.
- State-of.art techniques in multi-disciplinary, cross-disciplinary and inter-disciplinary nature are incorporated as Elective courses, ranging from conventional topics to the latest Artificial Intelligence.

3. Value Additions in the Revamped Curriculum:

Semester	Newly introduced Components	Outcome / Benefits
I	**Foundation Course** To ease the transition of learning from higher secondary to higher education, providing an overview of the pedagogy of learning at the tertiary level	• Instil confidence among students • Create interest for the subject
I, II, III, IV	**Skill Enhancement papers** (Discipline centric / Generic / Entrepreneurial)	• Industry ready graduates • Skilled human resource • Students are equipped with essential skills to make them employable
		• Digital skills will improve the knowhow of solving real-life problems using ICT tools
		• Entrepreneurial skill training will provide opportunity for independent livelihood • Generates self – employment • Create small scale entrepreneurs • Training girls leads to women empowerment
III, IV, V & VI	**Elective papers-** An open choice of topics categorized under Generic and Discipline Centric	• Strengthening domain knowledge • Introducing state-of-art techniques in multi-disciplinary, cross-disciplinary and inter-disciplinary nature • Emerging topics in higher education / industry / communication network / health sector etc., are introduced with hands-on-training
IV	**Industrial Botany**	• Exposure to industry moulds students into solution providers • Generates Industry ready graduates • Employment opportunities enhanced
II year Vacation activity	**Internship / Industrial Training**	• Practical training at the Industry/ Banking Sector / Private/Public sector organizations/Educational institutions, enable the students gain professional experience and also become responsible citizens.
V Semester	**Project with Viva – voce**	• Self-learning is enhanced • Application of the concept to real situation is

		conceived resulting in tangible outcome
VI Semester	**Introduction of** **Professional Competency component**	• Curriculum design accommodates all category of learners; For example, "Botany, Tamil, Zoology for Advancement" component will comprise advanced topics in Botany, Tamil, Zoology and allied fields, for those in the peer group / aspiring researchers; • "Training for Competitive Examinations" caters to the needs of the aspirants towards most sought-after services of the nation via, UPSC, CDS, NDA, Banking Services, CAT, TNPSC group services, etc.
Extra Credits: For Advanced Learners/Honours degree		• To cater to the needs of peer learners/research aspirants

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

Template for UG Programmes – Semester-wise

First Year

Semester-I

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC1, CC2)	8	8
	Elective Course I (Generic / Discipline Specific) EC1	5	6
Part-IV	Skill Enhancement Course SEC-1	2	2
	Foundation Course FC	2	2
		23	**30**

Semester-II

Part	List of Courses	Credit	Hours per week (L/T/P)
Part-I	Language	3	6
Part-II	English	3	6
Part-III	Core Courses 2 (CC3, CC4)	8	8
	Elective Course II (Generic / Discipline Specific) EC2	5	6
Part-IV	Skill Enhancement Course -SEC-2	2	2
	Skill Enhancement Course -SEC-3	2	2
		23	**30**

Internal & External Assessment

25% internal assessment & 75% external assessment (Semester-end examination)

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 SEMESTERWISE PAPERS
(For students who join the programme from 2023-2024 onwards)

SEMESTER I	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part I	Part -I - Language – Paper I	6	3
Part II	Part - II - English– Paper I	*6	3
Part III Core I	Part - III - Core – Plant Diversity I – Algae	5 (3+2)	5
Core II	Plant Diversity I Algae - Practical-I	3 (1+2)	5
Elective Course EC 1 Discipline Specific/Generic	Part -III - Allied: Zoology - Paper – I	4 (3+1)	3
	Allied practical	2	2
Part - IV Skill Enhancement Courses SEC1	1. Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping	2	2
Foundation Course FC	Basics of Botany	2	2
	Total	**30**	**23**

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

CORE-I PLANT DIVERSITY I ALGAE

Title of the Course		**PLANT DIVERSITY I ALGAE**					
Paper Number		**CORE I**					
Category	Core	**Year**	I	**Credits**	5	**Course Code**	
		Semester	I				

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

Pre-requisite	Students should be familiar with the basics of different classes of algae.

Learning Objectives		
C1	To provide a comprehensive knowledge on the biology of algae.	
C2	To provide a basis for better understanding of the evolution higher of plants.	
C3	To understand reproductive biology, ecology of plants by studying the simpler systems in algae.	
C4	To understand the role of algae in ecosystems as primary producers of nutrition.	
C5	To understand importance of algae to animals and humans.	
Course outcomes	**On completion of this course, students will be able to:**	
CO1	Relate to the structural organization, reproduction and significance of algae.	K1
CO2	Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth	K2
CO3	Explain the benefits of various algal technologies on the ecosystem.	K3
CO4	Compare and contrast the thallus organization and modes of reproduction in algae.	K4
CO5	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.	K5
UNIT	**CONTENTS**	
I	Classification (Fritsch-1935-1945), criteria for classification, algal distribution.	
II	Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous-*Sargassum, Gracilaria*).	
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*) (Examples may be changed according to the availability of the specimens).	

IV	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts:	
1	Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
2	Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, 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-II PLANT DIVERSITY I ALGAE - PRACTICAL-I

Title of the Course	**PLANT DIVERSITY – I: ALGAE Practical I**						
Paper Number	CORE II						
Category	Core	**Year**	I	**Credits**	3	**CourseCode**	
		Semester	I				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	-	2	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: CO	**On completion of this course, the students will be able to Programme outcomes**	
CO1	Recall and identify algae using key identification characters.	K1
CO2	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	K2
CO3	Describe the internal structure of algae prescribed in the syllabus	K3
CO4	Decipher the algal diversity in fresh/marine water and their economic significance	K4
CO5	Evaluate the various techniques used to culture algae for commercial purposes	K5

EXPERIMENTS	
1. Micro-preparation of the types prescribed in the syllabus. 2. Identifying the micro slides relevant to the syllabus. 3. Identifying types of algal mixture. 4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth. 5. Field visit to study fresh water/marine water algal habitats. 6. Visit to nearby industry actively engaged in algal technology.	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (10^{th} ed).Rastogi Publications, Meerut. 3. Round, FE. 1984.The Ecology of Algae. Cambridge University Press. 4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. 5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books:	1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying 2. manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London. 4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. 5. Dehradun. Edwardlee, R. 2018. Phycology, 5^{th} Ed., Cambridge University Press, London.
Web resources:	1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ 5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

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

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

ELECTIVE ALLIED BOTANY-I

Title of the Course	**ALLIED BOTANY-I**						
Paper Number	Core-Allied-I						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		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: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies.	K2
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Compare the structure and function of cells and explain the development of cells.	K4
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5

UNIT	**CONTENTS**
I	**Algae:** General characters of algae - Structure, reproduction and life cycle of the following genera - *Anabaena* and *Sargassum* and economic importance of algae.
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of the following genera - *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escherichia coli* and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.

III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodium*. General characters of Gymnosperms, Structure and life cycle of *Cycas*.
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - *In vitro* culture methods. Plant tissue culture and its application in biotechnology.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference books:	1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi. 2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd. 3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi. 4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet

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

Mapping with Programme Outcomes:

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

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

ELECTIVE ALLIED BOTANY PRACTICALS

Title of the Course	**ALLIED BOTANY PRACTICALS**						
Paper Number	Core-Allied Practicals-I						
Category	Core	**Year**	I	**Credits** 2		**Course Code**	
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
				-	2	2	
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.
C3	To be familiar with the basic concepts and principles of plant systematics.
C4	Understanding of laws of inheritance, genetic basis of loci and alleles.
C5	To learn about the physiological processes that underlie plant metabolism.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	To study the internal organization of algae and fungi.	K1
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K2
CO3	To study the classical taxonomy with reference to different parameters.	K3
CO4	Understand the fundamental concepts of plant anatomy and embryology.	K4
CO5	To study the effect of various physical factors on photosynthesis.	K5

EXPERIMENTS

1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.
2. Micro photographs of the cell organelles ultra structure.
3. Simple genetic problems.
4. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms, Cell biology and

Biotechnology.	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England. 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
Reference Books	1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications. 5. Steward, F.C. 2012. Plant Physiology Academic Press, US
Web sources	1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover 3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ 4. https://medlineplus.gov/genetocs/understanding/basics/cell/

	5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf 6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf 7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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)**

SKILL ENHANCEMENT COURSE - SEC - 1

1. ORGANIC FARMING

Title of the Course	**ORGANIC FARMING**					
Paper Number	Non-Major Elective-I					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**
		Semester	I			

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	-	-	2
Pre-requisite	Students to gain knowledge on the scope of organic farming and its significance.			

Learning Objectives		
C1	To enable students to gain knowledge on the scope of organic farming and its significance.	
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.	
C3	To understand the physical and chemical properties of soil.	
C4	To study sustainable agriculture.	
C5	To know about the importance of biofertilizers.	
Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Recognize the different forms of biofertilizers and their uses.	K1
CO2	Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.	K2
CO3	Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	K3
CO4	Analyze and decipher the significance of biofertilizers in soil fertility	K4
CO5	Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	K5
UNIT	**CONTENTS**	
I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.	

II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost-methods, production and utilization.
IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla* and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitiveexaminations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services. 2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. 3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech. 4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
Reference Books	1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers. 3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi. 4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh

	5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi
Web Resources	1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY 2. https://www.e-booksdirectory.com/listing.php?category=323 3. http://www.freebookcentre.net/Biology/Agriculture-Books.html 4.https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf 5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=726365635751333&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 1

2. ENVIRONMENTAL BIOTECHNOLOGY

Title of the Course	**ENVIRONMENTAL BIOTECHNOLOGY**						
Paper Number	Non-Major Elective-I						
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		To understand the various applications of environmental biotechnology.					

Learning Objectives	
C1	To introduce the student to the various developed and applications of environmental biotechnology.
C2	To provide knowledge about the scope of bioremediation and bioleaching using GMOs.
C3	To study about pollution of water bodies.
C4	To know about bioremediation.
C5	To study about biomineralization.

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Recognize the various causes of pollution and control measures.	K1
CO2	Explain about the beneficially role of GMOs on environment.	K2
CO3	Reflect upon various sustainable environmental protection strategies.	K3
CO4	Analyze the different methods of air, water, and soil quality monitoring process.	K4
CO5	Evaluate the implications of international legislations and policies for environmental protection.	K5

UNIT	**CONTENTS**
I	**Introduction:** The environment-soil, water and air, Pollution and its causes (outline only)
II	**Source and treatment of polluted waters and effluents:** Pollution of water bodies by heavy metals and pesticides – removal of heavy metals and pesticides by Biosorption. Removal of oil spills by using microbes. Biological treatment of sewage – characteristics of sewage and objectives in sewage treatment – Anaerobic digestion.

III	**Soil and air pollution and their treatment:** Soil pollution by Xenobiotics. Degradation of Xenobiotics – pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.
IV	**Bioremediation:** Introduction to bioremediation, *ex situ* and *in situ* bioremediation.
V	**Biometallurgy and related topics:** Biomineralization – bioleaching - Biofilms and biocorrosion.
Extended Professional Component (is a part of internal component only, Not to be included in the External 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. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited. 2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication. 3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication. 4. Keeshav Thehan. 1997. Biotechnology, New age international)P) Limited, New Delhi. 5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.
Reference Books:	1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi. 2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K. 3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology. 4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of Science Communication and Information Resources, CSIR New Delhi. 5. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed.

	Cambridge University Press. ISBN. 978-1107114234.
Web Resources	1. https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8 2. http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html 3. https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI 4. https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&redir_esc=y 5. http://library.umac.mo/ebooks/b28045907.pdf

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 1

3. NURSERY AND LANDSCAPING

Title of the Course	**NURSERY AND LANDSCAPING**						
Paper Number	Non-Major Elective-I						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	
		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: CO	**On completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Recognize the basic principles and components of gardening.	K1
CO2	Explain about bio-aesthetic planning and conceptualize flower arrangement.	K2
CO3	Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3 & K6
CO4	Compare and contrast different garden styles and landscaping patterns.	K4
CO5	Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6

UNIT	**CONTENTS**
I	Introduction, prospects and scope of nursery and landscaping.
II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.
III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.

IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.
V	Manures, composting – vermicomposting.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi. 2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.
Reference Books	1.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi. 2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co.,San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788

	3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

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

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

FOUNDATION COURSE FOR BOTANY

BASICS OF BOTANY

Title of the Course	**BASICS OF BOTANY**						
Paper Number	Foundation Course						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	
		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 CO	**On completion of this course, the students will be able to**					**Programme Outcomes**	
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.					K1	
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies.					K2	
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.					K3	
CO4	Compare the structure and function of cells and explain the development of cells.					K4	
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.					K5	

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

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

Recommended Texts	1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications,Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi. 6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.
Reference books	1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes -

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

Mapping with Programme Outcomes:

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

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

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

Title of the Course	**PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**						
Paper Number	CORE III						
Category	Core III	**Year**	I	**Credits**	5	**Course Code**	
		Semester	II				
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**			
	3	2	--	5			
Pre-requisite	Students should be familiar with the basics of fungi, bacteria, viruses and lichens.						

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

Course outcomes: CO	**On completion of this course, the students will be able to:**	**Programme outcomes**
CO1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
CO2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.	K2
CO3	Identify the common plant diseases, according to geographical locations and device control measures.	K3
CO4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
CO5	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 (*Pilobolus*, *Mucor*, *Rhizopus*), Ascomycotina (*Aspergillus*, *Saccharomyces Peziza*), Basidiomycotina (*Agaricus*, *Pleurotus*, *Puccinia*) and Deuteromycotina (*Cercospora*, *Alternaria*). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association.
II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins
III	**BACTERIA, VIRUS:** Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses. **Bacterial diseases** – Citrus canker and Bacterial wilt of Banana **Viral diseases** – Tobacco Mosaic and Vein clearing of Papaya **Fungal diseases** – Blast disease in rice and Tikka disease
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*. **Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,
Extended Professional Component (is a part of internal 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)

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	1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology. 2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi. 3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India. 7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore. 2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge. 3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi. 4. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London. 5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi. 6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi. 7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi. 8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi. 9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH. 10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company
Web Resources	1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE 2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html

	3. http://www.freebookcentre.net/Biology/Mycology-Books.html 4. https://www.kobo.com/us/en/ebook/introduction-to-fungi 5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html 6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

Mapping with Programme Outcomes:

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

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

CORE-IV 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 IV						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		Semester	II				

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	1	-	2	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 **CO**	**Completion of this course, the students will be able to:**	**Programme Outcomes**
CO1	Identify microbes, fungi and lichens using key identifying characters	K1
CO2	Develop practical skills for culturing and cultivation of fungi.	K2
CO3	Identify and select suitable control measures for the common plant diseases.	K3
CO4	Analyze the characteristics of microbes, fungi and plant pathogens	K4
CO5	Access the useful role of fungi in agriculture and pharmaceutical industry	K5

EXPERIMENTS

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

7. Visit to fungal biotechnology laboratories.
8. Ultra sturcture of bacteria.
9. Structure of bacteriophage.
10. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
11. Identifying the micro slides relevant to the syllabus.
12. Study of thallus and reproductive structures (apothecium) through permanent slides.
13. Economic importance of Lichens - Dye and perfume.

Recommended Texts:

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

Reference Books:

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

Web resources:

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

Mapping with Programme Outcomes:

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

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

ELECTIVE ALLIED BOTANY-II

Title of the Course	ALLIED BOTANY-II
Paper Number	Allied-II

Category	Core	**Year**	I	**Credits**	3	**CourseCode**	
		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: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Understand the fundamental concepts of plant anatomy and embryology.	K1
CO2	Analyze and recognize the different organs of plants and secondary growth.	K2
CO3	Understand water relation of plants with respect to various physiological processes	K3
CO4	Classify aerobic and anaerobic respiration.	K4
CO5	Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	K5

UNIT	**CONTENTS**
I	**MORPHOLOGY OF FLOWERING PLANTS:** Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.
II	**TAXONOMY:** Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae

III	**ANATOMY** Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.
IV	**EMBRYOLOGY** Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.
V	**PLANT PHYSIOLOGY** Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies. 2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi. 4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont. 5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
Reference books	1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing. 4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd. 5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P)

	Ltd. New Delhi. 6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi. 7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi.
Web Resources	1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	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**		**Course Code**	
		Semester	II	**2**			
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
				-	2	2	
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.
C3	To be familiar with the basic concepts and principles of plant systematics.
C4	Understanding of laws of inheritance, genetic basis of loci and alleles.
C5	To learn about the physiological processes that underlie plant metabolism.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	To study the internal organization of algae and fungi.	K1
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K2
CO3	To study the classical taxonomy with reference to different parameters.	K3
CO4	Understand the fundamental concepts of plant anatomy and embryology.	K4
CO5	To study the effect of various physical factors on photosynthesis.	K5

EXPERIMENTS.

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
    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 anatomy and Embryology	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England. 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
Reference Books	6. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 7. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 8. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 9. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & Wiley Publications. 10. Steward, F.C. 2012. Plant Physiology Academic Press, US
Web sources	8. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 9. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover 10. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-ebook/dp/B07CV96NZJ 11. https://medlineplus.gov/genetocs/understanding/basics/cell/ 12. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf

	13. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf 14. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

1. MUSHROOM CULTIVATION

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

Course Objectives	
C1	To learn and develop skills in mushroom cultivation.
C2	To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.
C3	To cultivate mushroom cultivation in small scale industry.
C4	To learn about diseases and post harvest technology.
C5	To study new methods and strategies to contribute to mushroom production.

Course outcomes: CO	**On completion of this course, the students will be able to**:	**Programme Outcomes**
CO1	Recall various types and categories of mushroom.	K1
CO2	Explain about various types of food technologies associated with mushroom industry.	K2
CO3	Apply techniques studied for cultivation of various types of mushroom.	K3
CO4	Analyze and decipher the environmental factors and economic value associated with mushroom cultivation.	K4
CO5	Develop new methods and strategies to contribute to mushroom production.	K5 & K6

UNIT	**CONTENTS**
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
III	Life cycle of *Pleurotus spp* and *Agaricus spp.*

IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovement with their marketing. Daya Publishing House.
Reference Books	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. 5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web Resources	1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/

	5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

2. HERBAL MEDICINE

Title of the Course		**HERBAL MEDICINE**					
Paper Number		Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**	
		Semester	II				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		To understand the importance of herbal medicine.					

Learning Objectives	
C1	To understand the nuances of medicinal plants and their phytoconstituents of commercial value
C2	To design and develop medicinal garden.
C3	To apply the knowledge to cultivate medical plants.
C4	To know the pharmacological importance of medicinal plants.
C5	To enlist phytochemicals and secondary metabolites of market and commercial value.

Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Define and describe the principle of cultivation of herbal products.	K1
CO2	Explain about the phytochemistry of economically important medicinal herbs.	K2
CO3	Apply techniques for evaluation of drug adulteration through biological testing.	K3
CO4	Formulate the value added processing / storage / quality control for the better use of herbal medicine.	K4
CO5	Develop the skills for cultivation of plants and their value added processing/storage/quality control.	K5 & K6

UNIT	**CONTENTS**
I	Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.
II	Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons, some poisonous plants; their toxicity and action.
III	Adulteration of crude drugs and its detection – methods of adulteration; types of adulteration. Medicinal plants of export values; rejuvenating herbs; Medicinal uses of Non-flowering plants.
IV	Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).

V	Botanical description and active principles of leaves; Flowers; Fruits seed and entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).
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. Somasundaram, S. 1997. Medicinal botany (Maruthuvar Thavaraviyal) – (Tamil Medium Book). 2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. & A. Churchill Ltd., London, 3. Jains, S.K.. 1996. Medicinal Plants. Deep Publications, New Delhi. 4. Srivastava, A.K. 2006, Medicinal Plants, International Book Distributors, Dehradun. 5. Agarwal,O.P. 1985, Vol. II, Chemistry of organic – natural products. S Chand & Company, New Delhi. 6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency, Madras Volumes. 7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.
Reference Books	1. Nair, N.C and Henrry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India. 2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of Indian Medicinal Plants. 3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994, Indigenous drugs of India. 4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous plants in India. 5. Miller, L and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass, Fourth edition.* 6. Patri, F and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.
Web Resources	1. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu 2. https://www.springer.com/gp/book/9783540791157 3. https://www.gpatonline.com/gpat/book-reference-pharmacognosy

	4. https://www.researchgate.net/publication/334670695_Book_review-_Herbal_Drug_Technology 5. http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE - SEC - 2

3. GLOBAL CLIMATE CHANGE

Title of the Course	**GLOBAL CLIMATE CHANGE**					
Paper Number	Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	2	**CourseCode**
		Semester	II			
Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
	2	-	-	2		
Pre-requisite	To understand the implications of carbon and ecological footprint.					

Learning Objectives		
C1	To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.	
C2	To understand the implications of carbon and ecological footprint.	
C3	To apply the knowledge to green house effects.	
C4	To know the rain and its effects on plants.	
C5	To know about Global Environmental change issues.	
Course outcomes: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
1.	Relate to the anthropogenic pressure on the environment and carbon footprint.	K1
2.	Explain about the physical basis of natural green gas house effect on man and materials.	K2
3.	Evaluate human influenced driver of our climate system and its applications.	K3
4.	Analyze the causes and effects of depletion of the stratospheric ozone layer.	K4
5.	Develop new strategies to mitigate issues of global environmental change.	K5 &K6

UNIT	**CONTENTS**
I	Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.
II	Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts for mitigation ozone layer depletion.
III	Climate change: Green house effects; causes; Green house gases and their sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.

IV	Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.
V	Acid rain and its effects on plants, animals, microbes and ecosystems.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press. 2.Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall. 3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru. 4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut. 5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
Reference Books	1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA. 2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry. 3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234. 4. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity-Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi. 5. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
Web Resources	1. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/ 2. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html 3. https://www.smashwords.com/books/category/4727/newest/0/free/any 4. https://www.free-ebooks.net/environmental-studies-academic/Global-Warming

	5. https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

Mapping with Programme Outcomes:

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

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

SKILL ENHANCEMENT COURSE 3

BOTANICAL GARDEN AND LANDSCAPING

Title of the Course	**BOTANICAL GARDEN AND LANDSCAPING**						
Paper Number	Skill Enhancement-3						
Category	Elective	**Year**	I	**Credits**	2	**Course Code**	
		Semester	II				
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: CO	**On completion of this course, the students will be able to**	**Programme Outcomes**
CO1	Recognize fundamental concepts of gardening and landscaping.	K1
CO2	Explain about significance of garden adornments and propagation structures.	K2
CO3	Apply techniques of landscaping for aesthetic purposes and gardening for recreation.	K3 & K6
CO4	Distinguish between formal, informal and free style gardens and their applications.	K4
CO5	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, postharvest 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, ecotourism, 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 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. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd. 3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency 4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I – IV, Deep And Deep Publ. Pvt. Ltd. 5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
Reference Books	1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books. 2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides).

	4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 5. Edment Senn Andrews. 1994. Fundamentals of Horticulture.Tata. McGraw Hill Publishing Co., Ltd., Delhi.
Web resources	1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden 2. https://www.overdrive.com/subjects/gardening 3. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers 4. https://www.scribd.com/book/305542619/Botanic-Gardens 5. https://www.overdrive.com/subjects/gardening

Mapping with Programme Outcomes:

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

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