B. Sc. BOTANY

Manonmaniam Sundaranar University
Tirunelveli

SYLLABUS FROM THE

ACADEMIC YEAR

2026-2027

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OUTCOME BASED EDUCATION - CHOICE BASED CREDIT SYSTEM

I UNIVERSITY VISION

"To provide quality education to reach the un-reached"

II UNIVERSITY MISSION

- To conduct research, teaching and outreach programmes to improve conditions of human living
- To offer a wide variety of off-campus educational and training programs, including the use of information technology, to individuals and groups
- To develop partnership with industries and government so as to improve the quality of the workplace and to serve as catalyst for economic and cultural development
- To provide quality / inclusive education, especially for the rural and un-reached segments of economically downtrodden students including women, socially oppressed and differently abled.

III PREAMBLE

Botany is the foundational science of plant life, ecological balance, and sustainable survival. It provides the essential framework and analytical understanding required to explore plant diversity, physiological mechanisms, and their critical role in global ecosystems and human welfare. The Undergraduate (UG) Programme in Botany is designed to transition students from basic high-school biological concepts to rigorous, advanced, and research-oriented scientific thinking.

The curriculum aims to build a robust foundation in core areas such as Plant Anatomy, Physiology, Taxonomy, Genetics, and Molecular Biology, while introducing students to applied fields like Biotechnology, Plant Pathology, Economic Botany, and Environmental Studies. Beyond technical and laboratory proficiency, this programme cultivates critical ecological awareness, data-driven problem-solving abilities, and the capacity to communicate complex biological insights with precision.

IV. PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

In alignment with the Vision and Mission of the University, the following have been defined as the PEO for the graduates.

PEO1: Developing strong positive attitude to learn independently the concepts in the field of study

PEO2: Ensuring confidence among the learners to apply the knowledge and skills gained to solve real life issues

PEO3: Habituating ethical values among the learners to succeed in personal and professional life

V. PROGRAMME OUTCOMES (PO)

Programme Outcomes for the Under Graduate Degree Programmes of the University are articulated as under.

After the successful completion of Undergraduate Programme from the University, the learner should be able to

PO1: Comprehend the knowledge acquired and communicate the same to others

PO2: Analyze and compare the factual data / situation to comprehend and to critically evaluate to find solution to the problem ahead

PO3: Apply theories and philosophies learned in solving the problem in scientific manner

PO4: Think reflectively on the earlier activities and attempt for self-directed lifelong learning process

PO5: Understand multicultural existence and identify the means to prolong moral/ethical values in personal and professional life

PO6: Explore through multiple sources and get exposed to the digital technology.

PO7: Act as a responsible member in teams and practice leadership qualities.

VI. PROGRAMME SPECIFIC OUTCOMES (PSO)

On completion of the programme, graduates will be able to:

- **PSO1: Disciplinary Knowledge** Apply fundamental and theoretical knowledge of plant diversity, anatomy, phylogenetic relationships, and evolutionary trends across diverse plant groups—from microbes to angiosperms—to support higher studies, research, and innovation.
- **PSO2: Critical Thinking** Analyse complex plant physiological, biochemical, and metabolic processes critically, and evaluate how plants function, adapt, and respond to variable environmental stressors in ecological and agricultural contexts.

- **PSO3: Problem Solving** Solve real-life botanical and ecological challenges, such as biodiversity loss, ecosystem degradation, and climate change impacts, using logical reasoning, conservation principles, and sustainable management techniques.
- **PSO4: Analytical Reasoning** Interpret cellular, genetic, and molecular data using quantitative and biotechnological techniques to address challenges in crop improvement, plant breeding, and recombinant DNA technology.
- **PSO5: Research Skills (Laboratory & Field Expertise)** Demonstrate basic research aptitude by formulating botanical problems, conducting hands-on laboratory experiments, collecting field data (including specimen identification and herbarium preparation), and presenting findings effectively.
- **PSO6: Self-directed Learning** Engage in lifelong learning and adapt to advancements in plant sciences, modern digital/ICT tools, biostatistical resources, and emerging biotechnological trends.
- **PSO7: Employability and Entrepreneurship** Develop technical and professional skills for employability and career readiness in green industries, education, research, and bio-based entrepreneurial ventures like organic farming, nursery management, and herbal product development.

Each Course has to address a minimum of 4 PSOs

Level of contribution of the Course towards attaining PSOs

0 – No Contribution 1 – Low Level 2 – Medium Level 3 – High Level

VII. COURSE OUTCOMES (CO)

Four Course Outcomes (COs) for each course that can be achieved by the learners on completion of that particular course are as follows:

Considering outcomes related to

i. K1 and K2 level of evaluation in all the Units as CO1

ii. K3 level of evaluation in all the Units as CO2

iii. K4 level of evaluation in all the Units as CO3

iv. K5 and K6 level of evaluation in all the Units as CO4.

All the COs proposed in each of the courses should be mapped with POs based on the relevance.

Level of Correlation between COs and POs

0 – No Correlation 1 – Low 2 – Medium 3 – High

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

	POs							PSOs						
	1	2	3	4	5	6	7	1	2	3	4	5	6	7
CO1														
CO2														
CO3														
CO4														

IX PROGRAMME DETAILS

1. **Eligibility crieteria**:

   Candidate should have passed the Higher Secondary Examination conducted by Government of Tamil Nadu or anyother examination recognized as equivalent thereto

   The candidate should have studied Biology / Botany and Zoology along with Chemistry as subjects at the Higher Secondary Level.

2. **Medium of instruction**:

   The medium of instruction shall be English and Tamil, as prescribed by the University and College regulations

3. **Duration of the programme**:

   The duration of the B.Sc. Botany programme shall be three academic years, comprising six semesters

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X. Credit Distribution for UG Programme in Botany

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language	3	2.1. Language	3	3.1. Language	3	4.1. Language	3	5.1 Core Course –\CC IX Plant Morphology, Taxonomy and Economic Botany	4	6.1 Core Course –CC XIII Plant Ecology and Phytogeography	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5. 2.Core Course CC –X Plant Anatomy and Embryology	4	6.2 Core Course – CC XIV Plant Biotechnology and Molecular Biology	4
1.3 Core Course – CC I Plant Diversity-I Algae	5	2.3 Core Course – CC III Plant Diversity-II	5	3.3 Core Course – CC V Plant Diversity-III	5	4.3 Core Course – CC VII Plant Diversity-IV	5	5. 3.Core Course CC – XI Cell Biology, Genetics and Plant Breeding	4	6.3 Core Course – CC XV Plant Physiology and Plant Biochemistry	4
1.4 Core Course – CC II Plant Diversity Algae-Practical-I	5	2.4 Core Course – CC IV Plant Diversity-II Practicals	5	3.4 Core Course – CC VI Plant Diversity-III Practicals	5	4.4 Core Course-CCVIII Plant Diversity-Practical -IV	5	5. 3.Core Course –/ Project with viva-voce CC -XII	4	6.4 Elective -VII Generic/ Discipline Specific 1. Horticulture 2. Natural Resource management 3. Forestry	3
1.5 Elective I Generic/ Discipline Specific Allied Zoology Paper-I	3	2.5 Elective II Generic/ Discipline Specific Allied Zoology Paper-II	3	3.5 Elective III Generic/ Discipline Specific Allied Chemistry Paper-I	3	4.5 Elective IV Generic/ Discipline Specific Allied Chemistry Paper-II	3	5.4 Elective V Generic/ Discipline Specific 1. Bio-Analytical Techniques 2. Aquatic Botany 3. Medicinal Botany and Human Welfare	3	6.5 Elective VIII Generic/ Discipline Specific 1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	3
1.6 Skill Enhancement	2	2.6 Skill Enhancement	2	3.6 Skill Enhancement	1	4.6 Skill Enhancement	2	5.5 Elective VI Generic/	3		

Course SEC-1 1.Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping		Course SEC-2 1. Mushroom cultivation 2. Herbal Medicine 3. Global climate change		Course SEC-4, (Entrepreneurial Skill) Entrepreneurial opportunities in botany		Course SEC-6 Fermentation Technology		Discipline Specific 1. Plant Bioresources 2. Seed Biology 3. Pomology			
		2.7 Skill Enhancement Course – SEC-3 Botanical garden and landscaping	2	3.7 Skill Enhancement Course SEC-5 Herbal Technology	2	4.7 Skill Enhancement Course SEC-7 Environmental Impact analysis	2	5.6 Value Education	2	6.7 Professional Competency Skill Training for Competitive Examinations	2
								5.7Summer Internship	2	6.8 Extension Activity	1
1.8 Skill Enhancement -(Foundation Course) Basics of Botany	2					4.8 8 Environmental Studies	2				
	23		**23**		**22**		**25**		**26**		**21**
	Total Credit Points										**140**

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XI. Consolidated Semester wise and Component wise Credit distribution

Parts	Sem I	Sem II	Sem III	Sem IV	Sem V	Sem VI	Total Credits
Part I	3	3	3	3	-	-	12
Part II	3	3	3	3	-	-	12
Part III	13	13	12	12	22	18	90
Part IV	4	4	6	6	3	2	25
Part V	-	-	-	-	-	1	1
Total	23	23	24	24	25	21	**140**

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

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XII COURSES- PSO MAPPING

Title of the course	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	Total score
Plant Diversity - I Algae	3	3	3	2	2	3	2	18
Plant Diversity - I Algae - Practical-I	2	1	2	1	3	2	2	13
Allied Botany-I	3	2	2	3	2	3	2	17
Allied Botany Practicals	3	2	2	2	2		2	13
Organic Farming	1	2	3	2	2	3	2	15
Environmental Biotechnology	1	1	3	2	2	2	2	13
Nursery and Landscaping	1	2	2	1	2	3	2	13
Basics of Botany	3	3	2	3	2	1	2	16
Plant Diversity – II: Fungi, Bacteria, Viruses, Plant Pathology and Lichens	2	1	3	2	2	2	2	14
Pant Diversity – II: **Fungi, Bacteria, Viruses, Plant Pathology and Lichens – Practical II**	2	1	2	1	3	2	2	13
Elective- Allied Botany-II	3	3	2	2	2	2	2	16
Allied botany - II Practicals	2	3	2	1	3	2	2	15
Mushroom Cultivation	2	1	2	1	3	3	2	14
Herbal Medicine	2	2	2	1	2	3	2	14
Botanical Garden and Landscaping	2	2	3	1	3	3	2	16
Total score of all courses contributing to PSO	32	29	35	25	35	34	30	

XIII. MEASUREMENT OF ATTAINMENT OF COURSE OUTCOME

The Course Outcomes (COs) are measured through the performance of learners by direct and indirect assessment methods for that particular course.

i. Internal Assessment (25 Marks)

Tests – 20 Marks

Seminar / Attention (Participation) in Class – 5 Marks

ii. Semester End Examinations (75 Marks)

Written exams, Practical, Project report, and Comprehensive Viva Voce

Note: In both Internal and Semester End Examinations

Lower Order Thinking (K1, K2, & K3) – 60 % in each part

Higher Order Thinking (K4, K5, & K6) – 40 % in each part

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

EVALUATION SCHEME

- B.Sc Botany curriculum is divided and studied in six semesters.
- The internal assessments and external examination are the two parts of evaluation scheme.
- The external theory and practical examinations will be conducted by the university at the end of each semester.
- There is a separate passing minimum of 40% for the external and overall components.

XIV DISTRIBUTION OF MARKS BETWEEN INTERNAL AND EXTERNAL ASSESSMENT FOR CORE, SKILL ENHANCEMENT, ELECTIVE, AND ALLIED COURSES.

Theory Marks 25: 75

Pass minimum of 40% for external and overall components.

1. Internal Assessment.

Internal Marks for Theory shall be allotted in the following manner

The average of the best two tests from three compulsory tests. Each test is of one hour duration	20 marks
Assignment	05 marks
Total	25 Marks

Passing Minimum

The candidate shall be declared to have passed the examination if the candidates secure not less than 30 marks out of 75 marks in the semester examination in each theory course and in total (CIA mark + Theory Exam mark) not less than 40 marks.

Marks For Practical

- The Maximum Marks for Practical Examination is 100 for UG.
- External 50 Marks.
- Internal 50 Marks.

Passing Minimum

The candidates shall be declared to have passed the examination if he/she secures not less than 40 marks in total (CIA mark + Practical Exam mark) with minimum of 18 marks out of 45 marks in the Practical Exam conducted by the University. There is no passing minimum for the record notebook. However, submission of the record notebook is necessary.

Candidate who does not obtain the required minimum marks for a pass in a Course/Practical shall be declared Re-Appear (RA) and the candidate has to appear and pass the same at a subsequent appearance

2. Marks for Major Project shall be allotted in the following manner

Internal Marks: 50; External Marks: 50

External evaluation of Project;

Project report evaluation and Viva-Voce will be conducted by both the External examiner and the Guide at the end of the semester.

4. Internship

Report for Internship / Industrial Visit / Field Visit / Research Institute Visit.

Should be evaluated along with the project at the end of V semester.

Students should submit a report for internship / industrial visit / field visit / Research institute visit/ knowledge updation activity at the end of the fifth semester with attendance certificate from the concern organization.

The duration of internship should be 30 hours.

Internal: 50 marks; External: 50 marks

5. Extension Activity:

The student should participate in any one of the programme like NSS, NCC, YRC, RRC, games and sports/ youth welfare activity, outreach programmes etc. The examination / report / evaluation will be conducted at the end of sixth semester.

6. Naan mudhalvan programme is compulsory for all the students. Those who failed in naan mudhalvan should write exam for the substitute subject*.

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XV Question pattern for all theory courses shall be as follows.

Duration of Exam: 3 Hours

Section	Type of questions	Mark Distribution
Part A	Ten Multiple choice question (Two question from each unit compulsory)	10 x1=10 Marks
Part B	Five Internal Choice questions (One question from each unit: either or choice)	5x5=25 marks
Part C	Five Internal Choice questions (One question from each unit: either or choice)	5x8=40 marks
	Total	**75 Marks**

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MODEL QUESTION PAPER

PLANT DIVERSITY – I ALGAE

Qn. No	Bloom's K-Level	**SECTION – A (10 x 1 = 10 marks)**
1	K2	Which pigment is commonly present in all algae a. Xanthophyll b. Chlorophyll – a c. Phycocyanin d. Fucoxanthin
2	K1	Which algae exhibits a colonial thallus organization a. Volvox b. Chlorella c. Spirogyra d. Sargassum
3	K4	Caulerpa appears to have roots, stems and leaves, but classified as an alga because a. It reproduces only sexually b. Its thallus lacks true vascular tissues c. It grows only in fresh water d. It contains chlorophyll b only
4	K3	A researcher wants to determine whether an unknown micro organism is a diatom. Which characteristic should be examined first a. Presence of silica wall b. Presence of flowers c. Presence of roots d. Presence of vascular tissue
5	K1	Air bladders in Sagassum help in a. Reproduction b. Anchoring c. Buoyancy d. Absorption
6	K5	Which argument best supports the conservation of Nostoc in paddy fields a. I t increases soil nitrogen naturally and reduces fertilizer dependence b. It prevents all plant diseases c. It eliminates weed completely d. It replaces crop plants
7	K2	Open pond systems are used in algal cultivation because they a. Require no water b. Prevent sunlight exposure

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		c. Eliminates algal growth d. Allow large – scale cultivation at relativrly low cost
8	K1	A marine alga transferred to freshwater begins to die. Which factor is primarily responsible a. Light intensity b. Salinity change c. Carbon dioxide concentration d. PH neutrality
9	K6	To reduce dependence onsynthetic fertilizers, which algal based strategy would be most effective a. Develop biofertilizers using nitrogen fixing algae b. Increase herbicide application c. Eliminate micro organism from soil d. Reduce crop cultivation
10	K4	A food industry uses agar as a culture medium. Which property of agar makes it suitable for this purpose a. It is toxic to micro organism b. It forms a stable gel and is not easily degraded by most bacteria c. It contains high amount of starch d. It acts as an antibiotic
		SECTION – B (5 X5 = 25 Marks)
11 a	K2	List the crieteria used in classification of algae
b	K1	List the different habitats in which algae occur
12 a	K4	Compare and evaluate the relative importance of sexual and vegetative reproduction in the life cycle of Caulerpa
b	K2	Explain the structure and organization of a Volvox colony
13 a	K3	How would you identify a specimen of Sargassum collected from a seashore using its external features
b	K5	Evaluate how the carposporophyte stage contributes to the survival and propagation of Gracilaria
14 a	K1	Enumerate the steps involved in algal cultivation
b	K2	Explain the role of light in algal cultivation
15 a	K6	Propose innovative applications of algae in the pharmaceutical industry
b	K3	Explain how algae can be used as bio fertilizers in sustainable agriculture

		SECTION – C (5 X8 = 40 Marks)
16 a	K2	Describe the classification of algae according to Fritch and explain the salient features of each class
b	K5	Evaluate the role of thallus organization in the classification and identification of algae
17 a	K4	Explain the process of sexual reproduction in volvox
b	K3	Differentiate between centric and pennate diatoms by analyzing their morphology, reproduction and habitat preferences
18 a	K1	Discuss the reproduction methods found in Sargassum
b	K3	Describe the colony structure of Nostoc and illustrate how its organization helps in nitrogen fixation
19 a	K2	Explain the different methods used for the cultivation of algae
b	K5	Assess the role of temperatue as a limiting factor in growth and distribution of algae
20 a	K1	Write an esson commercial applications of algae
b	K3	Explain how algae can be utilized to improve agriculture productivity and soil fertility

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XVI. Illustrative B.Sc. Botany Curriculum Design

SEMESTER I	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part I Part II	Part -I - Language – Paper I	6	3
	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)	3
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 II	Part -I - Language – Paper I I	6	3
	Part - II - English– Paper II	4	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	Part -III - Allied: Zoology Paper – II	4 (3+1)	3

EC 2 Discipline Specific/Generic	Allied practical	2	2
Part - IV Skill Enhancement Courses SEC 2	1. Mushroom cultivation 2. Herbal Medicine	2	1
Skill Enhancement Courses SEC 3	Botanical garden and landscaping	2	1
	Naan Mudhalvan	2	2
	Total	**30**	**23**

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B.Sc. Botany Core Component Syllabus

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Syllabus for different Courses of B.Sc. Botany

Title of the Course		**PLANT DIVERSITY - I ALGAE**						
Paper Number		**CORE 1**						
Category	Core	**Year**	I	**Credits**	5	**Course Code**		
		Semester	I					
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
		3		2		--	5	
Course Outcome		**On completion of this course students will be able to** CO1: K1, K2 (Remember, Understand) Explain the taxonomic criteria, Fritsch's classification, and structural diversity of major algal classes (Chlorophyceae, Bacillariophyceae, Phaeophyceae, Rhodophyceae, Cyanophyceae), and recall their standard cultivation parameters, harvesting techniques, and commercial/ecological applications. CO2: K3 (Apply) Apply taxonomic principles, anatomical knowledge, and life cycle traits of representative algal genera to identify specimens, execute indoor and large-scale culture systems, and utilize specific algae practically for biofertilization and pollution bioindication. CO3: K4 (Analyze) Analyze the evolutionary complexity of thallus organizations and reproductive strategies among diverse algal taxa, and examine how variations in environmental factors and cellular biochemistry affect biomass yield, harvesting efficiency, and industrial product quality. CO4: K5, K6 (Evaluate, Create) Evaluate the evolutionary resilience of algal groups and the economic viability of their commercial applications, and design optimized scale-up cultivation pipelines and integrated, sustainable biorefinery models for industrial products and environmental remediation						
UNIT		**CONTENT**						**No.of Hrs**
I		General Characters of Algae, Classification (Fritsch-1935-1945), criteria used in algal classification, distribution and habitat of algae, Range of thallus organization						**12**
II		Detailed study (occurrence, thallus structure, cell structure, reproduction and life cycle) Chlorophyceae – *Volvox* and *Caulerpa,* , Bacillariophyceae – *Pinnularia* (diatom)						**18**

III	Detailed study (occurrence, thallus structure, cell structure, reproduction and life cycle) Phaeophyceae – *Sargassum;* Rhodophyceae – *Gracillaria*; Cyanophyceae –*Nostoc*	**18**
IV	Algal cultivation methods, indoor cultivation methods (any two)and large-scale cultivation of algae, (any two), Environmental factors affecting algal growth; harvesting of algae.	**12**
V	Economic Importance: Algae as food and feed; Industrial products: Agar, Alginate, Carrageenan, Diatomite; Role of algae as bio fertilizer; Applications of algae as fuel, bio fertilizer and pharmaceutical; Role of algae as bioindicators of water pollution	**15**

Recommended Text	Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut. Vashishta, P.C. 2014. S Botany for Degree Students Algae.Chand & Company Ltd, New Delhi. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.
Reference Books	Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press. Round, FE. 1984.The Ecology of Algae. Cambridge University Press. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New

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	York. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi
Website and e-Learning Source	https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382 https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382 https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327 https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678 https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh https://www.wileyindia.com/a-textbook-of-algae.html https://www.kobo.com/in/en/ebook/algae-biotechnology https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (Remember & Understand)	3	1	1	2	1	1	0	3	2	2	1	1	2	1
CO2 (Apply)	3	2	3	2	1	2	2	3	2	3	1	3	3	2
CO3 (Analyze)	2	3	2	3	1	2	1	3	3	2	2	2	2	3
CO4 (Evaluate & Create)	3	3	3	3	2	3	2	3	3	3	2	2	3	3

Title of the Course							
Paper Number							
Category	Core		**Year**	I	**Credits**	3	**Course Code**
			Semester	I			

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

Course Outcome	On completion of this course students will be able to **CO1: (K1, K2)** Recall specific habitats, describe diverse thallus structures, and explain the fundamental economic uses of algae while identifying distinct microscopic slides and mixtures. **CO2: (K3)** Execute precise micro-preparations, isolate complex biological mixtures, and apply standard field and industrial sampling methods to practical phycological scenarios. **CO3: (K4)** Analyze mixed populations and differentiate complex anatomical structures by examining and comparing the distinct properties of industrial algal strains. **CO4: (K5, K6)** Evaluate the quality of prepared microscopic slides, justify sustainable algal usage practices, and formulate comprehensive field or industrial technology reports.
UNIT	**CONTENT**
I	**Micro-preparation of** *Caulerpa* – Thallus *Sargassum* – Stipe and Leaf *Gracilaria* – Thallus **Identifying the macrophytes relevant to the syllabus.** *Caulerpa*-Thallus *Sargassum*– Thallus *Gracilaria*- Thallus
II	**Identification of Microslides** *Nostoc , Diatoms – Pinnularia,* *Volvox* - with daughter colony, *Sargassum* - male and female conceptacle *Gracilaria* - cystocarp
III	**Identifying types ofAlgae in Algal Mixture**

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IV	**Economic Importance of Algae:** i. Food : ii Feed iii . Bio fertilizers iv Agar-Agar v. Alginate vi Diatomaceous earth
V	**Field Visit** Field visit to study freshwater and marine water algal habitats. Visit to a nearby industry actively engaged in algal technology.

Recommended Text	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. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books	. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying . manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. . Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London. . Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. . Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
Website and e-Learning Source	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/ https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	2	1	2	1	1	0	3	1	2	0	2	2	1
CO2 (K3)	2	2	3	2	1	2	2	2	1	2	0	3	2	2
CO3 (K4)	2	3	3	2	0	2	1	2	2	1	1	3	2	3
CO4 (K5, K6)	3	3	3	3	2	2	2	1	1	3	2	2	3	3

MSU

Title of the Course		**ALLIED BOTANY-I**						
Paper Number		**CORE-ALLIED-I**						
Category	**Elective**	**Year**	I	**Credits**	53	**Course Code**		
		Semester	I					
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
		3		1		-	4	

Course Outcome	**On completion of this course students will be able to** **CO1 (K1 & K2):** Recall and explain the fundamental structures, life cycles, and economic values of major plant groups, medicinal flora, and tissue culture components. **CO2 (K3):** Apply structural, biochemical, and biotechnological principles to identify botanical specimens, utilize medicinal extracts, and execute micropropagation protocols. **CO3 (K4):** Analyze evolutionary adaptations, reproductive complexities, phytochemical profiles, and tissue culture growth variations across diverse plant systems. **CO4 (K5 & K6):** Evaluate the ecological and commercial efficacy of plant resources, and design optimized media protocols or herbal formulations for biotechnological applications

UNIT	**CONTENT**	**No. of Hrs.**
I	**Algae and Fungi**: General characters of algae, structure, reproduction and life cycle of Sargassum, Economic importance of algae. General characters of fungi, structure, reproduction and life cycle of Mucor. Economic importance of fungi.	**12**
II	**Lichen and Bryophytes**,: General characters of Lichen, thallus types and Economic importance of lichen. General characters of Bryophytes, Structure and life cycle of Marchantia Economic importance of Bryophytes	**13**

III	**Pteridophytes and Gymnosperms** General characters of Pteridophytes, Structure and life cycle of Selaginella Economic importance of Pteridophytes. General characters of Gymnosperms, Structure and life cycle of Cycas. Economic importance of Gymnosperms	**13**
IV	**Medicinal Botany**: Morphology, Useful parts, Active principles and medicinal uses of the following plants: Azadirachta indica, Aloe vera, Curcuma longa, Syzygium aromaticum, Piper nigrum, Vinca rosea	**11**
V	**Plant Biotechnology:** Plant tissue culture, totipotency, Nutrient medium, preparation and composition (M.S medium), Callus culture, Meristem culture, Application of Plant biotechnology	**11**

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Recommended Text	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.
Website and e-Learning Source	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 https://www.kobo.com/us/en/ebook/plant-biotechnology-1

MSU

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific

Outcomes (PSOs)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1	3	1	1	2	1	2	1	3	2	2	2	1	3	1
CO2	2	2	3	2	1	2	2	2	2	2	3	3	3	2
CO3	2	3	2	3	1	2	1	3	3	2	2	2	2	3
CO4	3	3	3	3	2	3	2	2	2	3	3	3	3	3

MSU

Title of the Course		**ALLIED BOTANY PRACTICALS**					
Paper Number		**CORE-ALLIED PRACTICALS - I**					
Category	Core	**Year**	I	**Credits**	2	**Course Code**	**FC**
		Semester	I				

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

Course Outcome	**After completion of this course, the students will be able to** CO1 (K1,K2) Identify and explain the basic parts of the studied plants/fungi, the steps of plant tissue culture, the uses of key medicinal plants, and the purpose of the field trip. CO2 (K3) Prepare plant tissue slides under a microscope, use photos/specimens to name plants, and apply knowledge to find and use medicinal plant parts. CO3 (K4) Compare how different plant structures have evolved, tell the difference between tissue culture types, and group medicinal plants by their active chemicals and habitats. CO4 (K5,K6) Judge the quality of your microscope slides, assess the value of medicinal plants, and write/create a detailed report based on your field trip observations.
UNIT	**CONTENT**
I	**Micro-preparation of** Sargassum stipe and leaf, Marchantia thallus Selaginella rhizome Cycas rachis and leaflet
II	**Identification of microslides** Sargassum male and female conceptacles, Mucor mycelium Marchantia Gemma, sporophyte Selaginella male and female cone, Cycas ovule

III	**Identification of Specimen / Photograph** Sargassum Thallus, Marchantia Thallus, Selaginella plant, Cycas - male and female cone Callus culture, Meristem culture
IV	**Medicinal Botany** **Identification, parts used, active principles and medicinal uses of** Azadirachta indica, Aloe vera, Curcuma longa, Syzygium aromaticum, Piper nigrum, Vinca rosea
V	**Field trip to study plants in their natural habitat**
Recommended Text	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. 1. 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
Reference Books	1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & WileyPublications. Steward, F.C. 2012. Plant Physiology Academic Press, US
Website and e-Learning Source	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=gymnosperms&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 https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	1	1	3	2	2	2	1	2	1
CO2 (K3)	2	2	3	2	1	2	2	2	1	1	1	3	3	2
CO3 (K4)	2	3	2	2	1	2	1	3	2	2	2	2	2	3
CO4 (K5, K6)	3	3	3	3	2	2	3	2	1	3	1	3	2	3

MSU

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">1.ORGANIC FARMING</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">SKILL ENHANCEMENT COURSE - SEC – 1</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">-</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Course Outcome</td><td colspan="8">After completion of this course, the students will be able to

CO1 (K1,K2) Define and explain soil properties, the harms of chemicals, basic concepts of organic farming/sustainable agriculture, types of biofertilizers, and waste recycling methods.

CO2 (K3) Implement crop rotation and mixed cropping, prepare vermicompost and biocompost, and use biofertilizers (Rhizobium and VAM) to manage agricultural and municipal wastes.

CO3 (K4) Examine how chemical inputs damage soil quality, and compare the efficiency of different organic manures, green manures, and waste recycling systems.

CO4 (K5,K6) Assess the value of organic vs. chemical farming, judge the quality of produced composts, and design a complete recycling and sustainable cultivation plan.</td></tr>
<tr><td colspan="2">UNIT</td><td colspan="8">CONTENT</td></tr>
<tr><td colspan="2">I</td><td colspan="8">Soil – physical, chemical properties. Ill effects of oil, chemicals –fertilizers, pesticide and herbicides</td></tr>
<tr><td colspan="2">II</td><td colspan="8">Organic farming – definition, basic concept of organic farming, , t. Sustainable agriculture practices-crop rotation, mixed cropping.</td></tr>
<tr><td colspan="2">III</td><td colspan="8">Management of organic wastes and green manures: Farm manures, Composts and Mulches importance of organic manure, importance of green manure, , oil cake.; vermicompost-methods, production and utilization.</td></tr>
</table>

IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – bio-compost making methods.
Recommended Text	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
Website and e-Learning Source	1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY 2. https://www.e-booksdirectory.com/listing.php?category=323 3. http://www.freebookcentre.net/Biology/Agriculture-Books.html 4.https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf 5.https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	2	2	3	1	1	3	1
CO2 (K3)	2	2	3	3	2	1	3	1	2	3	1	3	3	2
CO3 (K4)	2	3	2	2	1	2	1	1	3	3	2	2	2	3
CO4 (K5, K6)	3	3	3	3	2	1	2	1	2	3	2	2	3	3

MSU

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">2. ENVIRONMENTAL BIOTECHNOLOGY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">SKILL ENHANCEMENT COURSE - SEC –1.</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">-</td><td>--</td><td>2</td></tr>
<tr><td colspan="2">Course Outcome</td><td colspan="6">After completion of this course, the students will be able to

CO1 (K1,K2) Define and explain the causes of pollution, sewage characteristics, biological treatment methods, xenobiotic degradation pathways, bioremediation types, and bioleaching terms.

CO2 (K3) Use microbes to clean up oil spills and remove heavy metals, apply in situ and ex situ bioremediation techniques, and employ biological methods for wastewater treatment and mineral extraction.

CO3 (K4) Examine and trace the breakdown pathways of chemical pollutants (like phenols and PCBs), compare wastewater treatment efficiencies, and differentiate between useful bioleaching and harmful biocorrosion.

CO4 (K5,K6) Assess the success of different environmental cleanup strategies, judge the efficiency of anaerobic digestion systems, and design a complete biological plan to treat industrial waste.</td></tr>
<tr><td colspan="2">UNIT</td><td colspan="6">CONTENT</td></tr>
<tr><td colspan="2">I</td><td colspan="6">Introduction:
The environment-soil, water and air, Pollution and its causes (outline only)</td></tr>
<tr><td colspan="2">II</td><td colspan="6">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.</td></tr>
</table>

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.
Recommended Text	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. 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.
Website and e-Learning Source	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 http://library.umac.mo/ebooks/b28045907.pdf

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	2	1	3	2	1	1	1
CO2 (K3)	2	2	3	2	1	2	2	1	1	3	2	3	2	2
CO3 (K4)	2	3	2	2	1	2	1	1	2	3	2	2	1	3
CO4 (K5, K6)	3	3	3	3	2	1	2	1	1	3	3	2	2	3

MSU

Title of the Course	3. NURSERY AND LANDSCAPING							
Paper Number	SKILL ENHANCEMENT COURSE - SEC – 1							
Category: Allied	Year: I		Credits: 2		Course Code:			
	Semester: I							
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total	
	2		-		--		2	

Course Outcome	**After completion of this course, the students will be able to** **CO1 (K1,K2)** Define and explain nursery scope, propagation methods (cutting, grafting), garden types (formal/informal), green houses, bonsai rules, and composting steps. **CO2 (K3)** Perform plant propagation, cultivate commercial flowers (Rose, Jasmine), lay out a lawn, and produce vermicompost for plant nutrition. **CO3 (K4)** Compare and differentiate between formal/informal garden layouts, examine the structural benefits of shade houses vs. mist chambers, and test manure types. **CO4 (K5,K6)** Judge the quality of nursery stock and bonsai setups, assess project feasibility, and design custom landscape blueprints with integrated waste management.
UNIT	**CONTENT**
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.

Recommended Text	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. 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.
Website and e-Learning Source	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 https://www.gardenvisit.com/ebooks

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	2	2	2	1	1	3	1
CO2 (K3)	2	1	3	2	1	1	3	1	3	2	1	3	3	2
CO3 (K4)	2	3	2	2	1	2	1	1	2	2	1	2	2	3
CO4 (K5, K6)	3	3	3	3	2	2	3	1	1	2	1	2	3	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="8">BASICS OF BOTANY</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="8">FOUNDATION COURSE FOR BOTANY</td></tr>
<tr><td rowspan="2">Category</td><td rowspan="2">Elective</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>I</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td colspan="2">Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2">2</td><td colspan="2">--</td><td colspan="2">--</td><td>2</td></tr>
<tr><td colspan="2">Course Outcome</td><td colspan="8">After completion of this course, the students will be able to

CO1 (K1,K2) Define and explain the traits of microbes and plant groups, plant cell organelles, organ modifications, Mendel's inheritance laws, and water concepts like osmosis.

CO2 (K3) Identify plant groups by their features, solve genetic problems (dihybrid, test crosses), and demonstrate experimental setups for plasmolysis and transpiration.

CO3 (K4) Differentiate between prokaryotes and eukaryotes, compare organ modifications and fruit types, and examine how external factors change transpiration rates.

CO4 (K5,K6) Assess the evolutionary trends of plant groups, judge organ efficiency under stress, and predict phenotypic variations by combining genetic and physiological data.</td></tr>
<tr><td colspan="2">UNIT</td><td colspan="8">CONTENT</td></tr>
<tr><td colspan="2">I</td><td colspan="8">BIODIVERSITY
Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.</td></tr>
<tr><td colspan="2">II</td><td colspan="8">CELL BIOLOGY
Cell as the basic unit of life - Ultra Structure of Prokaryotic and Eukaryotic Cell (Plant Cell) - Cell Wall - Cell Membrane, Chloroplasts and Ribosomes</td></tr>
</table>

III	**PLANT MORPHOLOGY** Structure and Modification of Root, Stem and Leaf - Inflorescences – racemose and cymose types. Fruits types.
IV	**GENETICS** Concept of Heredity and Variation - Mendel's Laws of Inheritance. Monohybrid and dihybrid cross, Back cross and Test cross**.**
V	**PLANT PHYSIOLOGY** Water relations -: Diffusion, Osmosis, Plasmolysis, Imbibition . Transpiration – Types, factors affecting transpiration and significance**.**

Recommended Text	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. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.
Website and e-Learning Source	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 https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	3	2	3	1	1	1
CO2 (K3)	2	2	3	2	1	1	2	2	3	2	3	3	1	2
CO3 (K4)	2	3	2	2	1	2	1	3	2	2	3	2	1	3
CO4 (K5, K6)	3	3	3	3	2	1	2	3	2	2	2	2	1	3

MSU

Title of the Course		**PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**					
Paper Number		**CORE III**					
Category	Skill Enhance-ment Course	**Year**	I	**Credits**	5	**Course Code**	
		Semester	II				
Instructional Hours per week		**Lecture**	**Tutorial**	**Lab Practice**	**Total**		
		3	2	--	5		

Course Outcome

After completion of this course, the students will be able to

CO1 (K1,K2) Define and describe fungal and lichen classifications, bacterial reproduction methods, thallus structures (Mucor, Usnea), industrial products, and common plant disease symptoms.

CO2 (K3) Identify microorganisms and pathogens under a microscope, use fungi/VAM as agricultural biofertilizers, and apply chemical or biological control measures to treat crop diseases.

CO3 (K4) Compare bacterial genetic exchanges (conjugation vs. transduction), examine symbiotic relationships between algae and fungi in lichens, and trace disease cycles of crop pathogens.

CO4 (K5,K6) Assess the value of lichens as bioindicators, critique the economic loss caused by mycotoxins, and design a comprehensive, integrated management plan to control field epidemics.

UNIT	**CONTENT**	**No. of Hrs.**
I	**FUNGI** Characteristic features of Fungi, Classification of fungi (Alexopoulos and Mims, 1979),.Thallus organization, mode of nutrition, structure, reproduction and life-history of Zygomycotina - Mucor, Ascomycotina - Peziza, Basidiomycotina - Puccinia and Deuteromycotina - Cercospora. .	**15**
II	**ECONOMIC IMPORTANCE OF FUNGI:** Fungi as food; Fungi in agriculture application – bio-fertilizers; Mycotoxins - biopesticides; Production of industrially important products	**15**

	from fungi -- ethanol, organic acids - citric acid, Applications of fungi in pharmaceuticals -Penicillin. Importance of VAM fungi. Harmful effects of Fungi (any five)	
III	**BACTERIA, VIRUS:** Classification- outline (Bergey, 1994), Ultra structure and reproduction of bacteria - vegetative (budding, fragmentation and binary fission), asexual (endospore, conidia and zoospore) and sexual (transduction, transformation and conjugation), Viruses: general characters, structure and reproduction of bacteriophage.	**15**
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases, etiology, disease cycle. prevention and control measures of the following plant diseases: Bacterial diseases - Citrus canker and Bacterial wilt of Banana Viral diseases-Tobacco Mosaic and Vein Bunchy top of banana Fungal diseases - Blast disease in rice and Tikka disease of Groundnut.	**15**
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), Structure, distribution and reproduction of *Usnea*. Economic importance of Lichens.-Food, Medicine, Dye, Ecological importance, ,	**15**
Recommended Text	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. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.	7.
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	10.

	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. 1. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company	
Website and e-Learning Source	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 http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html	6.

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	1	2	2	1	2	1
CO2 (K3)	2	2	3	2	1	1	2	2	1	2	2	3	3	2
CO3 (K4)	2	3	2	2	1	2	1	2	1	3	3	2	1	3
CO4 (K5, K6)	3	3	3	3	2	1	2	1	1	3	2	2	2	3

<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE IV</td></tr>
<tr><td>Category</td><td>Skill Enhance-ment Course</td><td>Year</td><td>I</td><td>Credits</td><td>3</td><td>Course Code</td><td></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">1</td><td colspan="2">--</td><td>2</td><td>3</td></tr>
<tr><td colspan="2">Course Outcome</td><td colspan="7">After completion of this course, the students will be able to

CO1 (K1,K2) Identify and state traits of fungal spores, lichen thalli, bacterial ultrastructures, industrial products (Penicillin, citric acid), and diagnostic symptoms of crop diseases.

CO2 (K3) Prepare microslides through hand-sectioning, mount specimens (Peziza, Puccinia), collect field disease samples for herbaria, and participate in agricultural farm/lab visits.

CO3 (K4) Differentiate between diverse spore stages under a microscope, compare internal tissue structures (Usnea V.S.), and categorize different disease types (wilt, mosaic, spots).

CO4 (K5,K6) Judge the structural quality of your own slide preparations, assess farm/biotech lab workflows, and compile a diagnostic field report tracking pathogen threats.</td></tr>
<tr><td colspan="2">UNIT</td><td colspan="7">CONTENT</td></tr>
<tr><td colspan="2">I</td><td colspan="7">Micro-preparation of
Peziza Apothecium
Puccinia uredospore, teleutospore
Cercospora
Usnea thallus</td></tr>
</table>

II	**Identification of Microslides / specimens / Photograph** Mucor mycelium, Peziza entire Puccinia aecidiospore Ultra structure of Bacteria Structure of Bacteriophage Usnea soredia, Usnea V.S. of Apothecium
III	**Economic Importance of Fungi and lichen** Edible mushroom, Bio fertilizer, Bio pesticides, citric acid production, Penicillin production. Lichen used as food, dye
IV	**Herbarium / specimens /photograph of Plant disease** Bacterial diseases - Citrus canker and Bacterial wilt of Banana Viral diseases-Tobacco Mosaic and Vein Bunchy top of banana Fungal diseases - Blast disease in rice and Tikka disease of Groundnut.
V	**Visit to fungal biotechnology laboratories. / agricultural Farms.**

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Recommended Text	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 NewDelhi. 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. 1. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
Website and e-Learning Source	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 https://www.kobo.com/us/en/ebook/introduction-to-fungi

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	1	2	1	2	2	1
CO2 (K3)	2	2	3	2	1	1	3	2	1	2	1	3	2	2
CO3 (K4)	2	3	2	2	1	2	1	2	1	2	1	3	2	3
CO4 (K5, K6)	3	3	3	3	2	2	3	1	1	2	1	2	3	3

Title of the Course		**ELECTIVE- ALLIED BOTANY-II**						
Paper Number		**CORE-ALLIED-II**						
Category	Allied	**Year**	I	**Credits**	3	**Course Code**		
		Semester	II					
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**	
		3		1		--	4	

Course Outcome

After completion of this course, the students will be able to

CO1 (K1,K2) Define and describe leaf arrangements, inflorescences, diagnostic traits of families (Rutaceae to Poaceae), tissue systems, seed/ovule structures, and basic steps of photosynthesis.

CO2 (K3) Sketch and identify internal tissue layers under a microscope, use taxonomic keys to classify family specimens, and run experiments showing water movement and transpiration.

CO3 (K4) Differentiate between monocot and dicot structures (stems, roots, leaves, seeds), compare light vs. dark reactions, and examine the structural process of double fertilization.

CO4 (K5,K6) Assess structural adjustments of tissue systems in different environments, judge the economic worth of plant families, and predict how growth hormones control crop development.

UNIT	CONTENT	No. of Hrs.
I	**MORPHOLOGY OF FLOWERING PLANTS:** Plant and its parts. Structure and function of root and stem and leaf Leaf types - simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types.	**12**
II	**TAXONOMY:** Study of the vegetative floral characters and economic importance of the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Poaceae.	**12**

III	**EMBRYOLOGY:** Structure of mature anther; Structure of ovule; Types of ovules; Structure of embryo sac; double fertilization; Endosperm, structure of dicotyledonous and monocotyledonous seeds	**12**
IV	**UNIT: ANATOMY:** Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot root, stem and leaf.	**11**
V	**UNIT: PLANT PHYSIOLOGY** Water relations in plants - Absorption of water, Ascent of sap, Photosynthesis - light reaction and dark reaction (Calvin cycle), Factors affecting Photosynthesis; Transpiration: Types, factors affecting transpiration and significance. Growth hormones - Physiological role of Auxin, Gibberelins and Cytokinin.	**13**
Recommended Text	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. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.	5.
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. 1. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi.	7.
Website and e-Learning Source	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.ht	5.

	ml?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 https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692	

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	3	2	2	1	2	1
CO2 (K3)	2	2	3	2	1	1	2	2	2	1	1	3	2	2
CO3 (K4)	2	3	2	2	1	2	1	3	3	2	2	2	1	3
CO4 (K5, K6)	3	3	3	3	2	1	2	2	3	3	2	2	3	3

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<table>
<tr><td colspan="2">Title of the Course</td><td colspan="7">ALLIED BOTANY - II PRACTICALS</td></tr>
<tr><td colspan="2">Paper Number</td><td colspan="7">CORE - ALLIED PRACTICALS - II</td></tr>
<tr><td>Category</td><td>Skill Enhance-ment Course</td><td>Year</td><td>I</td><td>Credits</td><td>2</td><td>Course Code</td><td></td></tr>
<tr><td colspan="2"></td><td>Semester</td><td>II</td><td colspan="4"></td></tr>
<tr><td colspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td>Total</td></tr>
<tr><td colspan="2"></td><td colspan="2">--</td><td colspan="2">--</td><td>2</td><td>2</td></tr>
<tr><td colspan="2">Course Outcome</td><td colspan="7">After completion of this course, the students will be able to

CO1 (K1,K2) Identify and state phyllotaxy arrangements, inflorescence types, structural parts of family flowers, seed/anther profiles, and basic rules of water/light experiments.

CO2 (K3) Dissect floral structures, sketch reproductive organs, prepare anatomical microslides of roots/stems/leaves, and set up lab setups like osmoscopes and light screens.

CO3 (K4) Differentiate between alternate/opposite leaves, compare internal tissue structures of monocots vs. dicots, and examine the results of transpiration and photosynthetic tests.

CO4 (K5,K6) Judge the accuracy of your own slide preparations and floral diagrams, assess structural variations in ovules, and write up complete botanical reports linking structure to function.</td></tr>
<tr><td colspan="2">UNIT</td><td colspan="7">CONTENT</td></tr>
<tr><td colspan="2">I</td><td colspan="7">Morphology
Phyllotaxy types – Alternate,Opposite and Whorled,
Inflorescence types –Racemose,Cymose and Special type of inflorescence</td></tr>
<tr><td colspan="2">II</td><td colspan="7">Taxonomy
Dissect out and draw the floral parts of the plants belonging to the families
Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Poaceae</td></tr>
</table>

III	**Identification of Microslides / Photograph** Structure of dicotyledonous and monocotyledonous seeds, Anther, Types of Ovules
IV	**Micro-preparation of** Anatomy of monocot and dicot root, stem and leaf.
V	**Demonstration of following experiments:** Potato osmoscope, Bell jar experiment, Ganong's light screen experiment

Recommended Text	1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Freeman and Company, New York, England. 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentice Hall of India, New Delhi.
Reference Books	1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India. 2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press & WileyPublications. 5. Steward, F.C. 2012. Plant Physiology Academic Press, US
Website and e-Learning Source	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 https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	2	2	1	2	1	1
CO2 (K3)	2	2	3	2	1	1	2	2	3	1	1	3	2	2
CO3 (K4)	2	3	2	2	1	1	1	2	3	2	1	3	1	3
CO4 (K5, K6)	3	3	3	3	1	2	2	2	2	2	1	2	2	3

MSU

Title of the Course	1. MUSHROOM CULTIVATION							
Paper Number	SKILL ENHANCEMENT COURSE - SEC – 2							
Category: Allied	Year: I		Credits: 2		Course Code:			
	Semester: II							
Instructional Hours per week	Lecture		Tutorial		Lab Practice		Total	
	2		-		--		2	

Course Outcome

After completion of this course, the students will be able to

CO1 (K1,K2) Identify and state traits of edible/poisonous mushrooms, Pleurotus and Agaricus life cycles, spawn methods, bag/bed techniques, storage types, and mushroom pests.

CO2 (K3) Prepare growth media, inoculate spawn, set up bag/bed cultivation systems, apply pest control measures, and process mushrooms into preserves (pickles, canning).

CO3 (K4) Differentiate safe vs. toxic wild species, compare growth timelines of different mushroom varieties, and examine symptoms of fungal, viral, or nematode crop contamination.

CO4 (K5,K6) Assess market viability for a small-scale industry, judge the quality of value-added food products, and design a production plan optimizing yield and shelf-life.

UNIT	CONTENT
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values.
II	Structure and Life cycle of Pleurotus sps..and Agaricus sps
III	Spawn production, growth media, spawn running and harvesting of mushroom and marketing
IV	Mushroom cultivation methods: Bag method, Bed method. Prospects and scope of musroom cultivation in small scale industry Significance of Mushrooms.

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V	Protection of Mushrooms from Pests , nematodes, mites, viruses, fungal competitors Post Harvesting Technology : Storage and Food Preparation - Short term storage (Refrigeration - up to 24 hours), Long term storage (Canning, Pickles, Papads), Types of Food prepared from Mushroom: Soup, cutlet, omelette, samosa.
Recommended Text	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.
Website and e-Learning Source	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/ https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	1	2	1	2	3	1
CO2 (K3)	2	2	3	2	1	1	3	1	1	2	1	3	3	2
CO3 (K4)	2	3	2	2	1	1	1	2	1	2	1	3	2	3
CO4 (K5, K6)	3	3	3	3	2	2	3	1	1	2	1	2	3	3

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Title of the Course	2. HERBAL MEDICINE					
Paper Number	SKILL ENHANCEMENT COURSE - SEC – 2					
Category: Allied	Year: I		Credits: 2		Course Code:	
	Semester: II					
Instructional Hours per week	Lecture	Tutorial	Lab Practice	Total		
	2	-	--	2		

Course Outcome

After completion of this course, the students will be able to

CO1 (K1,K2) Identify and state the relevance of herbal medicine, garden layout types, distillation principles, and the active chemical molecules found in root, bark, leaf, and whole-plant drugs.

CO2 (K3) Cultivate key therapeutic species (Tulsi, Aloe), implement hill/plain gardening steps, and run distillation apparatuses to isolate essential oils like Eucalyptus, Clove, or Rose.

CO3 (K4) Differentiate between oil extraction methods, compare structural profiles of varied drug types (rhizomes vs. seeds), and examine how geography influences secondary metabolite accumulation.

CO4 (K5,K6) Assess the purity and yield of extracted essential oils, judge the market feasibility of drug components, and design a functional layout plan for a sustainable home or commercial medicinal garden.

UNIT	CONTENT
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- cultivation of Aloe vera, Gloriossa superba, Vinca, Tulsi
III	Extraction methods – Water distillation, and steam distillation. .Extraction of Eucalyptus oil, Sandal oil, Rose oil, Clove oil

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IV	Botanical description, active principles and uses of Root drugs – Vetiveria zizanioides, Vinca rosea; Rhizomes – Ginger and Acorus; wood – Sandal and bark drugs - Cinnamon
V	Botanical description active principles and uses of leaves – Aloe, Coleus; seed – Pepper, Neem and entire plants – Phyllanthus, Andrographis paniculata.
Recommended Text	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. 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.
Website and e-Learning Source	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 http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	2	2	1	3	2	2	1	2	3	1
CO2 (K3)	2	2	3	2	1	1	2	2	2	2	1	3	3	2
CO3 (K4)	2	3	2	2	1	1	1	2	3	2	1	2	2	3
CO4 (K5, K6)	3	3	3	3	2	2	3	1	2	3	1	2	3	3

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<table>
<tr><td>Title of the Course</td><td colspan="6">BOTANICAL GARDEN AND LANDSCAPING</td></tr>
<tr><td>Paper Number</td><td colspan="6">SKILL ENHANCEMENT COURSE - SEC – 3</td></tr>
<tr><td rowspan="2">Category Allied</td><td>Year</td><td>I</td><td rowspan="2">Credits</td><td rowspan="2">2</td><td rowspan="2">Course Code</td><td rowspan="2"></td></tr>
<tr><td>Semester</td><td>II</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>2</td><td>-</td><td>--</td><td colspan="2">2</td></tr>
<tr><td>Course Outcome</td><td colspan="6">After completion of this course, the students will be able to

CO1: (K1 & K2) Understand the foundational principles of formal and informal gardening, the characteristics of core garden components and structural features, and the technical requirements for indoor, topiary, bonsai, and landscape designs.

CO2: (K3) Apply principles of garden design and soil management to establish lawns, cultivate diverse plant types (trees, shrubs, climbers, hedges), maintain bonsai and indoor plants, and implement residential, public, and vertical landscapes.

CO3: (K4) Analyze the relationships between plant materials and structural features (such as pergolas, rockeries, water gardens, and vertical structures) to optimize spatial harmony, aesthetic value, and maintenance efficiency across varied landscaping styles.

CO4: (K5 & K6) Critically evaluate the environmental and aesthetic components of public and residential spaces to design, construct, and manage comprehensive, sustainable indoor and outdoor landscape projects from soil preparation to specialized topiary and structural installations.</td></tr>
<tr><td>UNIT</td><td colspan="6">CONTENT</td></tr>
<tr><td>I</td><td colspan="6">Types of gardening – Formal and Informal garden - Ornamental garden, Importance of garden making- Principles of designing a garden.</td></tr>
<tr><td>II</td><td colspan="6">Garden components – Green house- Lawn – trees, shrubs and shrubberies – climbers and creepers – flower beds and borders</td></tr>
<tr><td>III</td><td colspan="6">Unit: Ornamental hedges – Edges, Pergola, Rockery and water garden.</td></tr>
</table>

IV	Topiary, indoor gardening, Bonsai -preparation of soil and its composition, manuring, watering and maintenance,
V	Basic principles of landscape design – components of landscape design – plant materials and structural materials- Vertical gardens. Landscaping of residential and public areas.
Recommended Text	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.
Website and e-Learning Source	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 https://www.overdrive.com/subjects/gardening

Mapping of Course Outcomes (COs) with Programme Outcomes (POs) and Programme Specific Outcomes (PSOs)

Course Outcomes (COs)	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7
CO1 (K1, K2)	3	1	1	2	1	2	1	3	2	2	1	2	3	1
CO2 (K3)	2	2	3	2	1	1	2	2	2	2	1	3	3	2
CO3 (K4)	2	3	2	2	1	2	2	2	1	3	0	2	2	2
CO4 (K5, K6)	3	3	3	3	2	2	3	2	2	3	1	3	3	3

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