

**APPENDIX –**  
**MADURAI KAMARAJ UNIVERSITY**  
**(University with Potential for Excellence)**

**B.Sc., BOTANY (Semester)**

**REVISED SYLLABUS**  
**(WITH EFFECT FROM THE ACADEMIC YEAR 2023-2024 ONWARDS)**  
**SCHEME OF EXAMINATIONS AND REGULATIONS**

**1. INTRODUCTION OF THE PROGRAMME:**

B.Sc., Botany degree course is a wonderful branch of natural sciences. It includes the comprehensive study of the diversity of plant kingdom i.e., it focuses on various groups of flowering and non-flowering plants, vascular and non – vascular plants, Prokaryotic plants and Eukaryotic plants, extinct and living plants, their structure, function, lifecycle, economic importance and applied aspects needed for current situation.

**2. Eligibility for admission:**

A pass in +2 examination minimum conducted by Board of Higher Secondary Education, Government of Tamil Nadu with Botany, Zoology, Chemistry subjects compulsory (or) any other examination accepted by the syndicate, as equivalents thereto are eligible to join the course.

**2.1 Duration of the course: 3 Years**

**2.2. Medium of Instruction: English/Tamil**

**3. OBJECTIVES:**

The syllabus for B.Sc., Botany degree under semester system has been designed on the basis of choice based credit system, which is a 'student centered' and application oriented approach for the benefit of the students of affiliated colleges of this university. It will come into effect from June 2023 onwards.

**4. OUTCOME OF THE PROGRAMME:**

After the completion of B.Sc., Botany course, a student may go for higher studies like M.Sc., Botany/Biology/Forest Science / Bio-Technology etc.,

Student may appear for Civil service examinations. Student might obtain a degree in education and get an opportunity to serve in school as a teacher. Student may also appear for Group I services of Tamil Nadu.

With the knowledge acquired the botany graduated may go for self employment in the field of Mushroom cultivation, Landscape gardening, Horticulture business like Farm management and Post harvest production Technology.

Above all, the student is fortunate enough to love and live with the communion of nature.

Students are brought to the natural habitat of primitive plant by means of educational tour programmes.

Apart from this for applied and skill based to learn the skills the student are brought to the nearby industries and research lab relate to the topic.

The following items are mentioned in tablet column:

5. List of core papers,

6. Skill Enhancement Courses (SEC1 Part - IV )

7. Skill Enhancement Courses (SEC 2 Part - IV)

Skill Enhancement Courses SEC 3

Allied : Part -III - Allied: Zoology Paper – I

Sem I	Credit	Sem II	Credit	Sem III	Credit	Sem IV	Credit	Sem V	Credit	Sem VI	Credit
1.1. Language – Tamil	3	2.1. Language – Tamil	3	3.1. Language –Tamil	3	4.1. Language - Tamil	3	5.1 Core Course – \CC IX	4	6.1 Core Course – CC XIII	4
1.2 English	3	2.2 English	3	3.2 English	3	4.2 English	3	5.2 Core	4	6.2 Core	4

								Course – CC X		Course – CC XIV	
1.3 Core Course – CC I	4	2.3 Core Course – CC III	4	3.3 Core Course – CC V	4	4.3 Core Course – CC VII Core Industry Module	4	5. 3.Core Course CC -XI	4	6.3 Core Course – CC XV	4
1.4 Core Course – CC II	4	2.4 Core Course – CC IV	4	3.4 Core Course – CC VI	4	4.4 Core Course – CC VIII	4	5. 3.Core Course – / Project with viva- voce CC -XII	4	6.4 Elective - VII Generic/ Discipline Specific	3
1.5 Elective I Generic/ Discipline Specific	3	2.5 Elective II Generic/ Discipline Specific	3	3.5 Elective III Generic/ Discipline Specific	3	4.5 Elective IV Generic/ Discipline Specific	3	5.4 Elective V Generic/ Disciplin e Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhanceme nt Course SEC-1	2	2.6 Skill Enhanceme nt Course SEC-2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneuri al Skill)	1	4.6 Skill Enhanceme nt Course SEC-6	2	5.5 Elective VI Generic/ Disciplin e Specific	3	6.6 Extension Activity	1
		2.7 Skill Enhanceme nt Course – SEC-3	2	3.7 Skill Enhancement Course SEC-5	2	4.7 Skill Enhanceme nt Course SEC-7	2	5.6 Value Educatio n	2	6.7 Professiona l Competenc y Skill	2
1.7 Ability Enhanceme nt Compulsory Course (AECC) Soft Skill-1	2	2.8 Ability Enhanceme nt Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 7 Ability Enhanceme nt Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internshi p /Industria l Training	2		
1.8 Skill Enhanceme nt - (Foundation Course)	2			3.8 E.V.S	-	4.8 E.V.S	2				
	<b>23</b>		<b>23</b>		<b>22</b>		<b>25</b>		<b>26</b>		<b>21</b>
	<b>Total Credit Points</b>										<b>140</b>

**CBCS - COURSE PATTERN AND SYLLABUS**

**UG - BOTANY**

<b>SEMESTER I</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
<b>Part I</b>	Part -I - Language –Tamil Paper I	6	3
<b>Part II</b>	Part - II - English– Paper I	4	3
<b>Part III Core I</b>	Part - III - Core – Plant Diversity I– Algae	5 (4+1)	4
<b>Core II</b>	Plant Diversity I Algae - Practical-I	4 (3+1)	3
<b>Elective Course EC 1 Discipline Specific/Generic</b>	Part -III - Allied: Zoology Paper – I	4 (3+1)	2
	Part -III - Allied: Zoology Paper – I (Practical)	2	2
<b>Skill Enhancement Courses SEC1 Part - IV - I</b>	1. Organic farming 2. Environmental Biotechnology 3. Nursery and Landscaping	2	1
<b>Foundation Course FC</b>	Basics in botany	1	1
<b>Ability Enhancement Compulsory Course AECC</b>	Soft Skill 1	2	2
<b>Total</b>		<b>30</b>	<b>21</b>
<b>SEMESTER II</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
<b>Part I</b>	Part -I - Language –Tamil Paper I	6	3
<b>Part II</b>	Part - II - English– Paper II	4	3
<b>Part III Core III</b>	Part - III - Core - Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	4 (3+1)	4
<b>Core IV</b>	Plant Diversity II - Fungi, Bacteria, Viruses, pathology and Lichens –	4 (3+1)	3

	Practical II <b>Practical Exam (Core II &amp; IV)</b>		
<b>Elective Course EC 2 Discipline Specific/Generic</b>	Part -III - Allied: Zoology Paper – II	4 (3+1)	2
	Allied Zoology Practical - I	2	2
<b>Skill Enhancement Courses SEC 2 Part - IV</b>	1. Mushroom cultivation 2. Herbal Medicine 3. Global Climate change	2	1
<b>Skill Enhancement Courses SEC 3</b>	Botanical garden and landscaping	2	1
<b>Ability Enhancement Compulsory Course AECC</b>	Soft Skill 2	2	2
	<b>Total</b>	<b>30</b>	<b>21</b>
<b>I Year Vacation Academic-Industry Activity</b> Academia-Industry-Academic interface training-30 hours		-	2
<b>SEMESTER III</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
<b>Part I</b>	Part – I – Language –Tamil – Paper III	6	3
<b>Part II</b>	Part – II –English– Paper III	*4	3
<b>Core V</b>	Part – III – Core – Plant Diversity III - Bryophytes and Pteridophytes	4 3+1)	4
<b>Core VI</b>	Part – III – Core – Plant Diversity III Bryophytes and Pteridophytes – Practical-III	4 (3+1)	3
<b>Elective Course EC 3</b>	Part -III - Allied: Chemistry Paper – III	4 (3+1)	2
	Allied Practical	2	2
<b>Skill Enhancement Courses SEC4</b>	Herbal Technology	2	1
<b>Skill Enhancement Courses SEC 5</b>	*Entrepreneurial Skill Entrepreneurial opportunities in botany	1	1
<b>Ability Enhancement Compulsory Course AECC</b>	Soft Skill 3	2	2
<b>Part IV</b>	Environmental studies	1	-

<b>Total</b>	<b>30</b>	<b>21</b>

<b>SEMESTER IV</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
<b>Part I</b>	Language –Tamil – Paper IV	6	3
<b>Part II</b>	English– Paper IV	4	3
<b>Part - III</b> Core VII	Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	5 (4+1)	4
<b>Part III</b> Core VIII	Part - III - Core - Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV  <b>Practical Exam (Core VI &amp; VIII)</b>	4 (3+1)	3
	Part -III - Allied: Chemistry Paper – IV	4	2
	Allied Chemistry Practical - II	2	2
<b>Elective – Industry Module 4</b>	Elective Course EC 4 Cultivation of Algae	4 (3+1)	2
<b>Skill Enhancement Courses SEC 6</b>	Fermentation technology	2	1
<b>Skill Enhancement Courses SEC 7</b>	Environmental impact analysis	2	1
<b>Ability Enhancement Compulsory Course AECC</b>	Soft Skill 4	2	2
<b>Part IV</b>	Environmental Studies	1	1
<b>Total</b>		<b>30</b>	<b>24</b>
<p><b>*Road map for SE5:</b> Workshop on Entrepreneurship with hands-on training special lectures by experts/industrialists on entrepreneurial schemes and funding available from Central/State Government</p>			
Second Year Vacation – <b>Internship</b> - 40 hours			<b>2 credit</b>
<b>SEMESTER V</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
<b>Part III</b> V Core IX	Part - III - Core - Plant Morphology, Taxonomy and Economic Botany	5 (4+1)	4
Core X	Part - III - Core -Plant Morphology, Taxonomy And Economic Botany - Practical-V	5 (4+1)	3
Core XI	Part - III - Core - Plant Anatomy and Embryology	5 (4+1)	4
Core XII	Part - III - Core - Cell Biology, Genetics and Plant Breeding	5 (4+1)	4

Core XIII	Practical covering – Core XI and XII- Practical VI	5 (4+1)	3
	EC5	5 (4+1)	3

Elective course 5	1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial Botany		
Elective Course 6	EC6	5 (4+1)	3
<b>Project</b>	Project with Viva-voce	4	2
<b>Part IV</b>	Value Education	1	1
<b>Part V</b>	Extension activity	-	1
<b>Total</b>		<b>30</b>	<b>30</b>
<b>SEMESTER VI</b>	<b>NAME OF THE COURSE</b>	<b>Hours Per/Week (Lecture/Tutorial)</b>	<b>CREDIT</b>
VI Core XIV	Part - III - Core – Plant Ecology and Phytogeography	5 (4+1)	4
Core XV	Part - III - Core - Plant Biotechnology and Molecular Biology	5 (4+1)	4
Core XVI	Part - III - Core -Plant Physiology and Plant Biochemistry	5 (4+1)	4
Core XVII	Practical covering – Core XIV, XV and XVI - Practical-VII  <b>Practical Exam (Core X &amp; XVII)</b>	6	3
Elective Course	<b>EC 7</b> 1. Horticulture 2. Natural Resource Management 3. Forestry	5 (4+1)	3
Elective Course	<b>EC 8</b> 1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	5 (4+1)	2
<b>Skill Enhancement Courses Professional Competency Enhancement</b>	<b>SEC 8</b> Training for Competitive examinations • Botany for Competitive examinations (2 hours) • General Studies for Competitive examinations (2 hours) Botany for Advanced Studies (4 hours)	4	2
<b>Part IV</b>	Value Education	1	1
<b>Total</b>		<b>30</b>	<b>23</b>
<b>TOTAL CREDITS</b>		----	<b>140</b>

**\*Core practical exams will be conducted at the end of every year (even semester).**

## 8. Unitization

Each paper is divided into 5 units. For core papers (total 60 hours) each unit has to be taught for 12 hours and for skill based, non major elective, environmental studies and value education papers (total 30 hours) each unit has to be taught for 6 hours.

### 9. Pattern of Semester Examinations:

The course consists of SIX semesters. For the theory papers of I/III/V semesters examinations are held in NOVEMBER/DECEMBER and for II/IV/VI semesters in APRIL/MAY months.

For practical papers examinations are usually in MARCH/APRIL.

### 10. & 11. Scheme for Internal Assessment and External Evaluation

Methods of Evaluation Theory		
<b>Internal Evaluation</b>	Continuous Internal Assessment Test	25 Marks
	Assignments	
	Seminars	
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	75 Marks
	<b>Total</b>	<b>100 Marks</b>
Methods of Evaluation Practicals		
	Continuous Internal Assessment Test	40 Marks
	Attendance and Class Participation	
<b>External Evaluation</b>	End Semester Examination	60 Marks
	Record	
	<b>Total</b>	<b>100 Marks</b>

### 12. QUESTION PAPER PATTERN:

1. The Internal and External marks for the theory papers are 25 and 75 respectively.

#### Details of Internal (25 marks)

- Continuous Internal Assessment Test – 15 marks
- Assignments – 5 marks
- Seminars - 5 marks
- Attendance and Class Participation - 5 marks

#### Detail of External (75 marks)

The pattern of question paper will be as follows

**Time : 3 Hrs**

**Max. marks = 75**

#### SECTION – A

#### QUESTION No. 1 to 10 ( Multiple choice)

**(10x1=10)**

1. Two question from each unit
2. Four choices of answers in each question
3. No answer should be “None of these”

#### Section B

1. Answer all question either (a) or (b)
2. Answer not exceeding two pages.
3. One question from each unit

11. (a) or (b)
12. (a) or (b)
13. (a) or (b)
14. (a) or (b)
15. (a) or (b)

### **Section C**

#### **Question no. 16 to 20 (Descriptive type)**

1. Answer all the three out of five
2. Answer not exceeding four pages
3. One question from each unit

#### **Practical:**

The internal and external marks for practical papers are 40 and 60 respectively.

#### **Internal (40 marks):**

1. Internal test – Model practical exam = 20 marks. (Follow the question paper pattern given in the syllabus and scale down the marks to 20)
2. Continuous assessment – 20 marks.

#### **External (60 marks):**

Detailed question paper pattern is included in the syllabus.

#### **13. Scheme for valuation:**

The university constitutes a panel of examiners on the basis of seniority. The senior most teacher shall act as the chairman of valuation board. There shall be chief examiners and Additional examiners under him. The scheme of valuation will be strictly adhered.

Candidates who pass all the examinations prescribed for the course in the first attempt and within a period of three academic years from the year of admission to the course alone are eligible for University Ranking.

#### **14, Passing Minimum**

##### **Guidelines regarding pass minimum:**

To get a pass, a student should fulfill the following conditions.

#### **UG courses:**

##### **A) Theory:**

1. 35% of the aggregate (External and Internal)
2. No separate pass minimum for internal
3. 27 marks out of 75 is the pass minimum for the external

##### **B) Practical:**

1. 35% of the aggregate (External and Internal)
2. No separate pass minimum for internal
3. 21 marks out of 75 is the pass minimum for the external

#### 14.1. Classification:

1. Those candidate who secure 75% and above marks shall be declared as passed in First Class with distinction.
2. Those candidate who secure 60% and above marks shall be declared as passed in First Class.
3. Those candidate who secure 50% and above but less than 60% marks shall be declared as passed in Second Class.
4. Those candidate who secure less than 50% shall be declared as passed in Third Class.

#### 15. Model Question:

### QUESTION MODEL – THEORY - MICROBIOLOGY

**Time: 3hours**

**Max: 76 marks**

#### Section – A (10x1=10marks)

#### Choose the correct answer:

1. Who discovered Bacilli?  
a) Robert Koch      b) Winogradsky      c) Louis Pasteur      d) Iwanowski
2. Bacterial cell membrane is made up of-----  
a) Protein      b) Fat      c) Cellulose      d) Chitin
3. Bacteriophage consists of -----  
a) Carbon and Nitrogen      b) DNA      c) Nucleoproteins      d) Proteins only
4. A device which regulates the growth rate of the organism by regulating the concentration of an essential nutrient is -----  
a) Chemostat      b) Turbidostat      c) Autoclave      d) Calorimeter
5. Technique which is adopted for the isolation of microorganism from soil is -----  
a) Streak plate      b) Spread plate      c) Pour plate      d) Plate count
6. CFU stands for  
a) Cell Forming Unit      b) Colony Forming Unit  
b) Cell mass Forming Unit      d) Cell Activity Forming Unit
7. MIC stands for -----  
a) Microbial Inhibitory Concentration      b) Minimal Inhibitory Concentration  
c) Molecular Inhibitory Concentration      d) Macro Inhibitory Concentration
8. Mushroom is -----  
a) Fine green threads      b) Edible fruit body of fungus  
c) A Bryophyte without root      d) Flowering plant

9. Chemical additives uses as preservative of food-----

- a) Benzoic Acid      b) Sulphuric Acid
- c) Hydrochloric Acid      d) Teichoic Acid

10. Trickling filter is related to-----

- a) Sewage treatment      b) Mushroom Cultivation
- c) Pasteurization      d) Sterilization

**Section - B (5x7=35marks)**

**Answer all questions, choosing either (a) or (b)**

11. (a) Write about the structure of bacterial cell wall (OR)

(b) Note down the formation of capsule and its function.

12. (a) Draw and explain the bacterial growth curve (OR)

(b) Describe the reproduction of bacteriophage.

13. (a) Write about the spread plate and pour plate technique (OR)

(b). Write about the media preparation technique.

14. (a) Write about the source and structure of Penicillin (OR)

(b) Explain the Nutritional types of Bacteria.

15. (a) Write a short note on Trickling Filter. (OR)

(b) Describe the various Microflora of milk.

**Section - C (3x10=30marks)**

**Answer any three questions. Not exceeding four pages.**

16. Describe the structure and functions of flagella with a neat diagram. Classify the bacteria based on its flagella.

17. Outline the Bergey's classification of bacteria
18. Write in detail about Gram staining technique.
19. Write about the various disinfections.
20. Describe the various tests for the detection of coliform bacteria in water.

#### **16. TEACHING METHODOLOGY.**

Usual chalk and talk method is followed. The real plant specimen is brought to the class room and shown to the student to explain its nature and morphology.

Apart from this seminar, Group Discussion, Peer team teaching and Peer Group Learning are practiced in the class room.

Teaching aids like Bio Visual Charts are also used in the classroom. Now a day's Computer Aided Instructions, Teaching with Mobile phones, E-learning, Smart Classroom Practices with Power Point Presentation are also follow.

#### **17. List of Text Books and Reference Books:**

Mentioned below the each paper.

#### **18. Re-totaling and Revaluation Provision**

Students may apply for re-totaling and revaluation after declaration of result within 15 days

#### **19. Transitory provision (3+3)**

The candidates who are admitted to B.Sc Botany course before the academic year 2018-2019 shall be permitted to appear for the examinations under the old regulations for a period of three years and thereafter they have to appear in the examinations as per the existing regulations.

#### **20. Websites where study materials, Video lessons and Text books can be downloaded:**

1. [http://www.sceltamushrooms.com/cultivation -and- harvesting](http://www.sceltamushrooms.com/cultivation-and-harvesting)
2. <http://www.fs.fed.us/wildflowers/ethnobotany/medicinal/index.shtml>
3. [http://www.botanical-online.com/medicinal plants.htm](http://www.botanical-online.com/medicinal_plants.htm)
4. <http://www.botany.org/bsa/careers/bot-spec.html>
5. <http://www.isaaa.org/resurces/publications/pocket/23/default.asp>
6. [http:// www.biologydiscussion.com/ecology/phytogeography-climate-vegetation-and-botanciacl-zones-of-india/6925](http://www.biologydiscussion.com/ecology/phytogeography-climate-vegetation-and-botanciacl-zones-of-india/6925)
7. <http://www.biologyreference.comA-Ar/Anatomy-of-Plants.html>
8. <http://wwwcbd.int/gti.taxonomy.shtml>

This will come into effect from the academic year 2023-2024(for those who joining the first semester of the course in July 2023 and afterwards)

### CORE-I PLANT DIVERSITY I ALGAE

<b>Title of the Course</b>		<b>PLANT DIVERSITY I ALGAE</b>					
<b>Paper Number</b>		<b>CORE I</b>					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	I				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>	
		3	2		--	5	
<b>Pre-requisite</b>		Students should be familiar with the basics of different classes of algae.					
<b>Learning Objectives</b>							
<b>C1</b>		To provide a comprehensive knowledge on the biology of algae.					
<b>C2</b>		To provide a basis for better understanding of the evolution higher of plants.					
<b>C3</b>		To understand reproductive biology, ecology of plants by studying the simpler systems in algae.					
<b>C4</b>		To understand the role of algae in ecosystems as primary producers of nutrition.					
<b>C5</b>		To understand importance of algae to animals and humans.					
<b>Course outcomes</b>		On completion of this course, students will;					
<b>CO1</b>		Relate to the structural organization, reproduction and significance of algae.				K1	
<b>CO2</b>		Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth				K2	
<b>CO3</b>		Explain the benefits of various algal technologies on the ecosystem.				K3	
<b>CO4</b>		Compare and contrast the thallus organization and modes of reproduction in algae.				K4	
<b>CO5</b>		Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.				K5	
<b>UNIT</b>		<b>CONTENTS</b>					
<b>I</b>		Classification (Fritsch-1935-1945), criteria for classification, algal distribution.					
<b>II</b>		Thallus organization (unicellular- <i>Chlorella</i> , Diatoms, colonial- <i>Volvox</i> , filamentous- <i>Anabaena</i> , <i>Oedogonium</i> , siphonous- <i>Caulerpa</i> , parenchymatous- <i>Sargassum</i> , <i>Gracilaria</i> ).					
		Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, <i>Oedogonium</i> and <i>Chara</i> , diplontic-Diatoms					

<b>III</b>	and <i>Sargassum</i> , diplohaplontic- <i>Ulva</i> and diplobiontic- <i>Gracilaria</i> ) (Examples may be changed according to the availability of the specimens).
<b>IV</b>	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.
<b>V</b>	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 <sub>2</sub> 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
<b>Recommended Texts:</b>	
1	Dehradun. Edward Lee, R. 2018. Phycology, 5 <sup>th</sup> 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.
<b>References Books:</b>	
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.

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

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO6</b>	<b>PSO7</b>	<b>PSO8</b>	<b>PSO9</b>	<b>PSO10</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	2	1
<b>CO2</b>	3	3	2	2	3	3	2	1	3	3
<b>CO3</b>	2	2	1	1	2	2	1	3	2	2
<b>CO4</b>	3	3	3	3	3	2	3	3	3	2
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

**CORE-II (PRACTICAL-I)  
PLANT DIVERSITY I - ALGAE**

<b>Title of the Course</b>		<b>PLANT DIVERSITY – I: ALGAE Practical I</b>						
<b>Paper Number</b>		CORE II						
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>CourseCode</b>		
		<b>Semester</b>	I					
<b>InstructionalHours perweek</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>		<b>Total</b>
		2		-		3		5
<b>Pre-requisite</b>		Students should be familiar with the basics of algae.						
<b>Learning Objectives</b>								
<b>C1</b>				To develop skills to identify algae based on habitat, thallus structure and the internal organization.				
<b>C2</b>				To identify microalgae in a mixture.				
<b>C3</b>				To develop skills to prepare the microslides of algae.				
<b>C4</b>				To study the economic importance of few species.				
<b>C5</b>				To understand importance of algae to animals and humans				
<b>Course outcomes:</b> On completion of this course, the students will be able to				<b>Programme outcomes</b>				
CO								
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				
<b>EXPERIMENTS</b>								

	<ol style="list-style-type: none"> <li>1. Micro-preparation of the types prescribed in the syllabus.</li> <li>2. Identifying the micro slides relevant to the syllabus.</li> <li>3. Identifying types of algal mixture.</li> <li>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.</li> <li>5. Field visit to study fresh water/marine water algal habitats.</li> <li>6. Visit to nearby industry actively engaged in algal technology.</li> </ol>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/TRB/ NET/UGC–CSIR /GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill</p>
<p><b>Recommended Texts</b></p>	<ol style="list-style-type: none"> <li>1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.</li> <li>2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany- 1 (10<sup>th</sup> ed). Rastogi Publications, Meerut.</li> <li>3. Round, FE. 1984. The Ecology of Algae. Cambridge University Press.</li> <li>4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1.</li> <li>5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.</li> </ol>
<p><b>Reference Books:</b></p>	<ol style="list-style-type: none"> <li>1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying</li> <li>2. Manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.</li> <li>3. Chapman, V.J and Chapaman, D.J. 1960. The Algae, ELBS &amp; MacMillan, London.</li> <li>4. Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York.</li> <li>5. Dehradun. Edward Lee, R. 2018. Phycology, 5<sup>th</sup> Ed., Cambridge University Press, London.</li> </ol>
<p><b>Web resources:</b></p>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492">https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492</a></li> <li>2. <a href="https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&amp;redir_esc=">https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&amp;redir_esc=</a></li> <li>3. <a href="https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html">https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html</a></li> <li>4. <a href="https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/">https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/</a></li> <li>5. <a href="https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&amp;redir_esc=y">https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&amp;redir_esc=y</a></li> </ol>

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	3	2	1
<b>CO2</b>	3	3	2	2	3	3	2	3	3	3
<b>CO3</b>	2	2	3	3	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	3	2	3	3	3	2
<b>CO5</b>	3	3	2	2	2	3	3	3	2	3

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

**CORE-III (PLANT DIVERSITY II)**

**FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**

<b>Title of the Course</b>		<b>PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS</b>				
<b>Paper Number</b>		CORE III				
<b>Category</b>	Core III	<b>Year</b>	I	<b>Credits</b>	4	<b>CourseCode</b>
		<b>Semester</b>	II			
<b>Instructional Hours</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>	
<b>Per week</b>		3	2	--	5	
<b>Pre-requisite</b>		Students should be familiar with the basics of fungi, bacteria, viruses and lichens.				
<b>Learning Objectives</b>						
<b>C1</b>		To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.				
<b>C2</b>		To understand the biology of fungi and to discuss the importance of fungi in various ecological roles				
<b>C3</b>		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.				
<b>C4</b>		To identify the main groups of plant pathogens, their symptoms.				
<b>C5</b>		To understand the various types of plant diseases.				
<b>Course outcomes:On completion of this course, the students will be able to:</b>		Programme outcomes				
<b>CO</b>						
1. Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.		K1				
2. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.		K2				
3. Identify the common plant diseases, according to geographical locations and device control measures.		K3				
4. Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.		K4				

5. Determine the economic importance of microbes, fungi and lichens.	K5
UNIT	EXPERIMENTS
I	<p><b>FUNGI</b>  Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (<i>Pilobolus</i>, <i>Mucor</i>, <i>Rhizopus</i>), Ascomycotina (<i>Aspergillus</i>, <i>Saccharomyces</i> <i>Peziza</i>), Basidiomycotina (<i>Agaricus</i>, <i>Pleurotus</i>, <i>Puccinia</i>) and Deuteromycotina (<i>Cercospora</i>, <i>Alternaria</i>). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association.</p>
II	<p><b>ECONOMIC IMPORTANCE OF FUNGI:</b>  Cultivation of mushroom – <i>Pleurotus</i> (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins</p>
III	<p><b>BACTERIA, VIRUS:</b> Classification (Bergey’s, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.</p>
IV	<p><b>PLANT PATHOLOGY:</b> 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.  <b>Bacterial diseases</b> – Citrus canker and Bacterial wilt of Banana  <b>Viral diseases</b> – Tobacco Mosaic and Vein clearing of Papaya  <b>Fungal diseases</b> – Blast disease in rice and Tikka disease</p>
V	<p><b>LICHEN:</b> Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to <i>Usnea</i>.  <b>Economic importance of Lichens:</b> food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,</p>
Extended Professional Component (is a part of internal component only, Not to be	<p>Questions related to the above topics, from various competitive examinations UPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved  (To be discussed during the Tutorial hour)</p>

included in the External Examination Question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Pandey, B.P. 1997. College Botany. Vol. I Fungi &amp; Pathology.</li> <li>2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.</li> <li>3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.</li> <li>4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.</li> <li>5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.</li> <li>6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.</li> <li>7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley &amp; Sons (Asia) Singapore.</li> <li>2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.</li> <li>3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.</li> <li>4. Burnett, J.H. 1971. The fundamentals of Mycology. ELBS Publication, London.</li> <li>5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.</li> <li>6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.</li> <li>7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.</li> <li>8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.</li> <li>9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.</li> <li>10. Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand &amp; Company</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE">https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE</a></li> <li>2. <a href="http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html">http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html</a></li> <li>3. <a href="http://www.freebookcentre.net/Biology/Mycology-Books.html">http://www.freebookcentre.net/Biology/Mycology-Books.html</a></li> <li>4. <a href="https://www.kobo.com/us/en/ebook/introduction-to-fungi">https://www.kobo.com/us/en/ebook/introduction-to-fungi</a></li> <li>5. <a href="http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html">http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html</a></li> <li>6. <a href="http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-">http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	2	2
<b>CO2</b>	3	3	2	2	3	3	2	1	2	1
<b>CO3</b>	2	2	3	3	1	2	1	3	1	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	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**

<b>Title of the Course</b>		<b>PLANT DIVERSITY – I: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II</b>					
<b>Paper Number</b>		CORE IV					
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	II				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		2	-	3	5		
<b>Pre-requisite</b>		Students should be familiar with the basics of fungi and lichens.					
<b>Learning Objectives</b>							
<b>C1</b>		To enable students to identify microscopic and macroscopic fungi.					
<b>C2</b>		To prepare microslides of fungi and lichens.					
<b>C3</b>		To know the presence of pathogen inside the plant tissues through microscopic sections.					
<b>C4</b>		To identify the bryophytes based on the morphology, and microslides.					
<b>C5</b>		To know the economic importance of the microbes studied.					
<b>Course outcomes</b> On completion of this course, the students will be able to: <b>CO</b>				<b>Programme Outcomes</b>			
1. Identify microbes, fungi and lichens using key identifying characters				K1			
2. Develop Practical skills for culturing and cultivation of fungi.				K2			
3. Identify and select suitable control measures for the common plant diseases.				K3			
4. Analyze the characteristics of microbes, fungi and plant pathogens				K4			
5. Access the useful role of fungi in agriculture and pharmaceutical industry.				K5			
<b>EXPERIMENTS</b>							
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. Ultrastructure 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, Sand Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3<sup>rd</sup> Ed. Cambridge University Press, Cambridge.
4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.

#### 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 (10<sup>th</sup> 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](https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_esc=y)
3. <https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfh9b>
4. [https://books.google.co.in/books/about/Practical\\_Botany.html?id=T5narQEACAAJ&redir\\_esc=y](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
CO2	2	3	2	2	3	3	2	3	3	3

<b>CO3</b>	2	2	3	3	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	3	2	3	3	3	2
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

**CORE-V PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES**

<b>Title of the Course</b>	<b>PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYTES</b>					
<b>Paper Number</b>	CORE V					
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	4	<b>Course</b>
		<b>Semester</b>	III			
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
		3		2		-
<b>Pre-requisite</b>		Students should be familiar with the basics of Bryophytes and Pteridophytes.				
<b>Learning Objectives</b>						
<b>C1</b>	To enable the students to have an overview of Non-vascular and Vascular plants.					
<b>C2</b>	To understand the morphological diversity of Bryophytes and Pteridophytes.					
<b>C3</b>	To know the evolution of Bryophytes and Pteridophytes.					
<b>C4</b>	To understand the economic importance of the Bryophytes and Pteridophytes.					
<b>C5</b>	To understand anatomy and reproduction of Bryophytes and Pteridophytes.					
<b>Course outcomes:</b> On completion of this course, the students will be able to:		<b>Programme Outcomes</b>				
<b>CO</b>						
1. Recognize morphological variations of Bryophytes and Pteridophytes.		K1				
2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.		K2				
3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.		K3				
4. Decipher the stages of plant evolution and their transition to land habitat.		K4				
5. Access the useful role of Bryophytes and Pteridophytes.		K5				
<b>UNIT</b>		<b>EXPERIMENTS</b>				
<b>I</b>		<b>BRYOPHYTES</b> General characters of Bryophytes, classification (Watson, 1971) (useful role) and importance of Bryophytes – Ecological importance (Pollution indicator), Medicinal uses, horticulture, industrial uses and absorbent bandages.				
<b>II</b>		Structure, reproduction and life histories of the following classes each with one representative: Hepaticopsida ( <i>Riccia/Marchantia</i> ); Anthocerotopsida ( <i>Anthoceros</i> ); Bryopsida ( <i>Funaria/Polytrichum</i> ). (Examples may be changed according to availability of specimens). Evolution of Bryophytes				
<b>III</b>		<b>PTERIDOPHYTES</b> General Characters of Pteridophytes - Classification (Reimer, 1954). A				

	homospory and heterospory.
<b>IV</b>	Morphology, anatomy and reproduction of reproduction of the taxa b following classes: Psilotopsida ( <i>Psilotum</i> ), Lycopsidea ( <i>Lycopodium/S</i> ( <i>Equisetum</i> ), Pteropsida ( <i>Adiantum/Marsilea</i> ). (Examples may be ch availability of the specimens).
<b>V</b>	Origin and evolution of Pteridophytes. Stellar Evolution. Economic impo
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 CSIR/GATE/TNPSC/otherstobesolved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.</li> <li>2. Alam, A. 2020. Contemporary Research on Bryophytes Book Ser Botanical Science. 10.2174/97898114337881200101.</li> <li>3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition Press.</li> <li>4. Chopra, R. N. 2005. Biology of bryophytes. New Age Internatio India.</li> <li>5. Prem Puri. 2001. Bryophytes– morphology growth and differentia Lucknow, India.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Eames, A. 1963. Morphology of lower vascular plant, McGraw H</li> <li>2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pter depot, Allahabad.</li> <li>3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill</li> <li>4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4<sup>th</sup> edition, B.I.</li> <li>5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchin</li> <li>6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.</li> <li>7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophyt Allahabad.</li> </ol>
<b>Web Resources:</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.bryoecol.mtu.edu/">http://www.bryoecol.mtu.edu/</a></li> <li>2. <a href="https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderp ebook/dp/B007NWFQK">https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderp ebook/dp/B007NWFQK</a></li> <li>3. <a href="http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm">http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm</a></li> <li>4. <a href="http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_234">http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_234</a></li> <li>5. <a href="http://www.botany.ubc.ca/bryophyte/mossintro.html">http://www.botany.ubc.ca/bryophyte/mossintro.html</a></li> <li>6. <a href="http://www.tiuc.edu/~esc/y">http://www.tiuc.edu/~esc/y</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	1	2	2	1	2
CO2	3	3	3	2	3	2	2	3	2	2
CO3	2	2	3	3	1	2	2	1	2	2

<b>CO4</b>	3	3	3	3	3	2	3	3	2	3
<b>CO5</b>	3	3	2	2	2	1	3	3	1	3

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

**CORE-VI PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES–  
PRACTICAL-III**

<b>Title of the Course</b>	<b>PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III</b>						
<b>Paper Number</b>	CORE VI						
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	III				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		2	-	3	5		
<b>Pre-requisite</b>		Students should be familiar with the basics of Bryophytes and Pteridophytes.					
<b>Learning Objectives</b>							
<b>C1</b>	To enable students gain expertise in hand sectioning technique.						
<b>C2</b>	To study diversity of Bryophytes and Pteridophytes.						
<b>C3</b>	To understand the anatomical structure of the Bryophytes and Pteridophytes.						
<b>C4</b>	Develop comprehensive skills in sectioning and micro preparation.						
<b>C5</b>	Describe the structure of fossil forms prescribed in the syllabus.						
<b>Course outcomes:</b> On successful completion of this course the student will be able to: CO	<b>Programme Outcomes</b>						
1. Recognize the major groups of Non-vascular and Vascular cryptogams	K1						
2. Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2						
3. Identify and illustrate the morphological and anatomical features of	K3						

bryophytes and Pteridophytes.	
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5
<p><b>EXPERIMENTS</b></p> <p><b>Bryophytes</b></p> <ol style="list-style-type: none"> <li>1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.</li> <li>2. Hepaticopsida (<i>Riccia/Marchantia</i>); Anthocerotopsida (<i>Anthoceros</i>) and Bryopsida (<i>Funaria/Polytrichum</i>) (Examples may be changed according to the availability of the specimens) (need not study developmental aspects).</li> </ol> <p><b>Pteridophytes</b></p> <ol style="list-style-type: none"> <li>3. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus. Psilotopsida (<i>Psilotum</i>), Lycopsidea (<i>Lycopodium/Selaginella</i>), Sphenopsida (<i>Equisetum</i>), Pteropsida (<i>Adiantum/Marsilea</i>). (Examples may be changed according to the availability of the specimens).</li> <li>4. Identifying the micro slides relevant to the syllabus.</li> <li>5. Botanical excursion.</li> </ol>	
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 UPS C/TRB/NET/UGC-CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.</li> <li>2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.</li> <li>3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.</li> </ol>

	<p>4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram &amp; Sons. Lucknow, India.</p> <p>5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.</p>
<b>ReferenceBooks</b>	<ol style="list-style-type: none"> <li>1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.</li> <li>2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.</li> <li>3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi.</li> <li>4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai.</li> <li>5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand &amp; Co. New Delhi.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4">https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4</a></li> <li>2. <a href="https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883">https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883</a></li> <li>3. <a href="http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html">http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html</a></li> <li>4. <a href="https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual">https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual</a></li> <li>5. <a href="https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/">https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	1	2
<b>CO2</b>	3	3	2	2	3	3	2	3	3	2
<b>CO3</b>	2	2	3	3	1	2	1	3	2	1
<b>CO4</b>	3	3	3	3	3	2	3	2	2	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	3

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

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

<b>Title of the Course</b>	<b>PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION</b>						
<b>Paper Number</b>	CORE VII						
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>		
		3	2	-	5		
<b>Pre-requisite</b>		Students should know about the fundamentals of Gymnosperms, fossil records and evolution.					
<b>Learning Objectives</b>							
<b>C1</b>	To enable the students to understand thallus organization,						
<b>C2</b>	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.						
<b>C3</b>	to acquaint students with evidences of the past history of plant groups and significance of the fossilization.						
<b>C4</b>	To know the scope of pleobotany, types of fossils and geological time scale.						
<b>C5</b>	Understand the various fossil genera representing different fossil groups.						
<b>Course outcomes:</b>	<b>Programme Outcomes</b>						
On completion of this course, the students will be able to: CO							
1. Relate to the general characteristics of Gymnosperms and fossil forms	K1						
2. Explain about the morphology and anatomy Gymnosperms.	K2						
3. Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3						
4. Analyze	K4						

the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	
5. Determine the various fossilization methods and their significance in paleobotany.	K5
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	<b>GYMNOSPERMS</b> Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
<b>II</b>	<b>GYMNOSPERMS</b> Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales ( <i>Cycas</i> ), Coniferales ( <i>Pinus</i> ), Gnetales ( <i>Gnetum</i> ).
<b>III</b>	<b>PALEOBOTANY</b> Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni
<b>IV</b>	<b>PALEOBOTANY</b> Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
<b>V</b>	<b>EVOLUTION</b> Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamarck and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
Extended Professional Component (is a part of internal component only, Not to be included in	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC-CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)

the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Gupta, M.N. 1972. The Gymnosperms (2<sup>nd</sup> Edition) Shiva Lal Agarwala &amp; Co., Agra.</li> <li>2. Vashista, P.C. 1976. Gymnosperms, S.Chand &amp; Co. New Delhi.</li> <li>3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.</li> <li>4. <u>Anil Kumar</u>. 2006. Gymnosperms. S. Chand &amp; Company Pvt. Ltd. New Delhi.</li> <li>5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi.</li> <li>2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.</li> <li>3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.</li> <li>4. <u>Raup, D.M</u> and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.</li> <li>5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction+to+Gymnosperms&amp;ots=sfYsZCL02&amp;sig=ysX1KRvetV0bAza4Sq6RWau4XU8&amp;redir_esc=y#v=onepage&amp;q=Introduction%20to%20Gymnosperms&amp;f=false">https://books.google.co.in/books?hl=en&amp;lr=&amp;id=Pn7CAAAQBAJ&amp;oi=fnd&amp;pg=PA1&amp;dq=Introduction+to+Gymnosperms&amp;ots=sfYsZCL02&amp;sig=ysX1KRvetV0bAza4Sq6RWau4XU8&amp;redir_esc=y#v=onepage&amp;q=Introduction%20to%20Gymnosperms&amp;f=false</a></li> <li>2. <a href="https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&amp;redir_esc=y">https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&amp;redir_esc=y</a></li> <li>3. <a href="https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC">https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC</a></li> <li>4. <a href="https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf">https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf</a></li> <li>5. <a href="https://www.palaeontologyonline.com/">https://www.palaeontologyonline.com/</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	2	1	1	2	2	2	2
CO2	3	3	2	2	3	3	2	3	2	3
CO3	3	3	2	2	1	2	1	3	1	3

<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	2	1	3	1	3

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

**CORE-VIII PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV**

<b>Title of the Course</b>	<b>PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV</b>						
<b>Paper Number</b>	CORE VIII						
<b>Category</b>	Core	<b>Year</b>	II	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	IV				
<b>Instructional Hours</b>		<b>Lecture</b>	<b>Tutorial</b>		<b>LabPractice</b>	<b>Total</b>	
<b>Per week</b>		2	-		3	5	
<b>Pre-requisite</b>		Students should be familiar with the fundamentals of Gymnosperms, Paleobotany.					
<b>Learning Objectives</b>							
<b>C1</b>	To enable students observe and record the morphological features of selected species of Gymnosperms.						
<b>C2</b>	To enable students observe and record the anatomical features of selected species of Gymnosperms.						
<b>C3</b>	To develop the skill of preparation of microslides of the gymnosperm samples.						
<b>C4</b>	To enable students to gain insights into the basics of paleobotany and methods of fossilization.						
<b>C5</b>	To understand the anatomy of the fossil plants through microscopy.						
<b>Course outcomes:</b>	<b>Programme Outcomes</b>						
On completion of this course, the students will be able to: CO							
1. Analyze and observe and record the morphological features of selected species of Gymnosperms..	K1						
2. Describe the structure of fossil forms prescribed in the syllabus.	K2						
3. Identify and Illustrate the morphological	K3						

and anatomical features of gymnosperms.	
4. Develop comprehensive skills in sectioning and micro preparation.	K4
5. Interpret the significance of reproductive structures in gymnosperms.	K5
<b>EXPERIMENTS</b>	
<p>1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of <i>Cycas</i>, <i>Pinus</i> and <i>Gnetum</i>.</p> <p>2. Identifying the micro slides relevant to the syllabus.</p> <p>3. Field visit to study the habitat (Hill station).</p> <p>Study the following fossil members: <i>Rhynia</i>, <i>Lepidodendron</i>, <i>Lepidocarpon</i>, <i>Calamites</i> and <i>Williamsonia seawardiana</i> through permanent slides.</p> <p>2. Photograph of evolution scientists.</p>	
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC-CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.</li> <li>2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.</li> <li>3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.</li> <li>4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago (Reprinted 1950). New York.</li> <li>5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Smith, G.M. 1955. Cryptogamic Botany Vol. II. Tata McGraw Hill. New Delhi.</li> </ol>

	<ol style="list-style-type: none"> <li>2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford,SG137BX, United Kingdom.</li> <li>3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.</li> <li>4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.</li> <li>5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&amp;gbv=1&amp;dq=gymnosperms&amp;printsec=frontcover">https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&amp;gbv=1&amp;dq=gymnosperms&amp;printsec=frontcover</a></li> <li>2. <a href="https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721">https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721</a></li> <li>3. <a href="https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ">https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ</a></li> <li>4. <a href="https://trove.nla.gov.au/work/11471742?q&amp;versionId=46695996">https://trove.nla.gov.au/work/11471742?q&amp;versionId=46695996</a></li> <li>5. <a href="http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html">http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html</a>.</li> </ol>

**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	2	3	2	1	2	2	2	3
<b>CO2</b>	3	3	2	2	3	3	2	3	2	2
<b>CO3</b>	2	2	3	3	1	2	1	3	3	3
<b>CO4</b>	3	3	3	3	3	2	2	3	3	3
<b>CO5</b>	3	3	2	2	3	3	2	3	2	2

**S-Strong (3)**

**M-Medium (2)**

**L-Low(1)**

## CORE IX PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

<b>Title of the Course</b>	<b>PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY</b>						
<b>Paper Number</b>	CORE IX						
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>CourseCode</b>	
		<b>Semester</b>	V				
<b>InstructionalHours perweek</b>		<b>Lecture</b>	<b>Tutorial</b>		<b>LabPractice</b>	<b>Total</b>	
		3	-		2	5	
<b>Pre-requisite</b>		Prior knowledge on morphological, anatomical characteristics and uses of plants.					
<b>Learning Objectives</b>							
<b>C1</b>	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.						
<b>C2</b>	Students will know about the basic concepts of classification of plants.						
<b>C3</b>	Understand major evolutionary trends in Angiospermic plants.						
<b>C4</b>	To know the characteristic features of the selected families.						
<b>C5</b>	To know the economic importance of plants.						
<b>Course outcomes:</b>	<b>Programme Outcomes</b>						
On completion of this course, the students will be able to:							
<b>CO</b>							
1. Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1						
2. Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2						
3. Describe the core concepts of	K3						

economic Botany and relate its applications in human life.	
4. Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
5. Assess terms and concepts related to Phylogenetic Systematics.	K5
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound- phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.
<b>II</b>	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, an overview of APG Classification. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.
<b>III</b>	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
<b>IV</b>	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
<b>V</b>	Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).

<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC-CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill</p>
<p><b>Recommended Texts</b></p>	<ol style="list-style-type: none"> <li>1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.</li> <li>2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi</li> <li>3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London.</li> <li>4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Wesley Publishing Co. Ind USA.</li> <li>5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York.</li> <li>6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.</li> <li>7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. <u>Vedams (P) Ltd. New Delhi.</u></li> </ol>
<p><b>Reference Books</b></p>	<ol style="list-style-type: none"> <li>1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London.</li> <li>2. Gamble, J.S., Fisher, L.E.F. 1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta</li> <li>3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh.</li> <li>4. Clive AS. 1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York.</li> <li>5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London.</li> <li>6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA.</li> <li>7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition).</li> </ol>

	McGraw-Hill Book Co., New York.
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=px_WAwHiZIC&amp;redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&amp;redir_esc=y_esc=y">https://books.google.co.in/books/about/Plant Taxonomy 2E.html?id= px_WAwHiZIC&amp;redirhttps://books.google.co.in/books/about/Plant Taxonomy and Biosystematics.html?id=VfQnuwh3bw8C&amp;redir_esc=y_esc=y</a></li> <li>2. <a href="https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnuUC&amp;redir_esc=y">https://books.google.co.in/books/about/PLANT TAXONOMY 2E.html?id=Roi0lwSXFnuUC&amp;redir_esc=y</a></li> <li>3. <a href="https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&amp;redir_esc=y">https://books.google.co.in/books/about/Plant Taxonomy.html?id=0bYs8F0Mb9gC&amp;redir_esc=y</a></li> <li>4. <a href="https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Economic Botany.html?id=2ahsDQAAQBAJ&amp;redir_esc=y</a></li> <li>5. <a href="https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&amp;redir_esc=y">https://books.google.co.in/books/about/Textbook Of Economic Botany.html?id=XmZFJO_JHv8C&amp;redir_esc=y</a></li> </ol>

**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	1	3	2	1	2	2	1	2
<b>CO2</b>	3	3	2	2	3	3	2	3	3	2
<b>CO3</b>	2	2	3	3	1	2	1	3	2	1
<b>CO4</b>	3	3	3	3	3	2	3	2	2	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	3

**S-Strong (3)**

**M-Medium (2)**

**L-Low(1)**

**CORE X PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-  
PRACTICAL-V**

<b>Title of the Course</b>	<b>PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY- PRACTICAL-V</b>						
<b>Paper Number</b>	CORE X						
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	3	<b>CourseCode</b>	
		<b>Semester</b>	V				
<b>InstructionalHours perweek</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>		
		2	-	3	5		
<b>Pre-requisite</b>		Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.					
<b>Learning Objectives</b>							
<b>C1</b>	To study morphological characters of the families.						
<b>C2</b>	Able to describe the plant technically using the floral characteristics.						
<b>C3</b>	To preserve the plants and prepare herbarium sheets.						
<b>C4</b>	To be able to identify the local flora.						
<b>C5</b>	To understand the economic importance of the plants.						
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO	<b>Programme Outcomes</b>						
1. Recognize the distinguishing plant morphological characters.	K1						
2. Identify locally available plants to their respective families.	K2						
3. Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical	K3						

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

### EXPERIMENTS

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

Extended Professional Component (is a part of internal component only, Not 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/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.</li> <li>2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of</li> </ol>

	<p>Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.</p> <p>3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I &amp; II), Vikas Students Education.</p> <p>4. Pandely, B.P. 1987. Taxonomy of Angiosperms.</p> <p>5. Nordenstam, B., El Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.</p>
<b>ReferenceBooks</b>	<p>1. MannJ.Davidson,R.SandJ.B.Hobbs,D.V.Banthorpe,J.B.Harborne.1994.<i>NaturalPr oducts</i>.Longman Scientificand TechnicalEssex.</p> <p>2. Gopalan,C., B.V.RamasastriandS.C.Balasubramanian.1985.NutritiveValueofIndianFoods. NationalInstituteofNutrition,Hyderabad.</p> <p>3. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.</p> <p>4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.</p> <p>5. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand &amp; Co. Educational Books Ltd. London.</p>
<b>Web resources</b>	<p>1. <a href="https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210">https://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210</a></p> <p>2. <a href="https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html">https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html</a></p> <p>3. <a href="https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8">https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8</a></p> <p>4. <a href="https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C">https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76rCqA68C</a></p> <p>5. <a href="https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592">https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592</a></p> <p>6. <a href="https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook">https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook</a>.</p>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	1	3
<b>CO2</b>	3	3	2	2	3	3	2	3	2	2
<b>CO3</b>	2	2	3	3	1	2	1	2	3	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

**S-Strong (3)**

**M-Medium (2)**

**L-Low(1)**

## CORE XI PLANT ANATOMY AND EMBRYOLOGY

<b>Title of the Course</b>	<b>PLANT ANATOMY AND EMBRYOLOGY</b>						
<b>Paper Number</b>	CORE XI						
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	V				
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practise</b>	<b>Total</b>		
		3	2	-	5		
<b>Pre-requisite</b>		To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					
<b>Learning Objectives</b>							
<b>C1</b>	To know fundamental concepts of plant anatomy and embryology.						
<b>C2</b>	To understand the internal tissue organization of various plant organs.						
<b>C3</b>	To differentiate normal and abnormal secondary growth.						
<b>C4</b>	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.						
<b>C5</b>	To know embryology of plants.						
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO	<b>Programme Outcomes</b>						
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1						
2. Describe the internal tissue organization of various plant organs.	K2						
3. Elucidate the stages of normal and abnormal secondary growth.	K3						
4. Compare the structural	K4						

organization of flower in relation to the process of pollination and fertilization.	
5. Access the various anatomical adaptations in plants.	K5
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
<b>II</b>	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in root and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
<b>III</b>	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- <i>Boerhaavia</i> , <i>Nyctanthes</i> and <i>Dracaena</i> . Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
<b>IV</b>	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule, types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis ( <i>Polygonum</i> type); Organization and ultra structure of mature embryo sac.
<b>V</b>	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)

questionpaper)	
Skillsacquired fromthiscourse	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.</li> <li>2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4<sup>th</sup> revised and enlarged edition). Vikas Publishing House, New Delhi.</li> <li>3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.</li> <li>4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.</li> <li>5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.</li> <li>6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.</li> <li>7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.</li> <li>8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.</li> <li>2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..</li> <li>3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,</li> <li>4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.</li> <li>5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.</li> <li>6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.</li> <li>7. Mauseth, J.D. 1988. Plant Anatomy. The Benjamm/Cummings Publisher, USA.</li> <li>8. Evert, R.F. 2006. Esau’s Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency.</li> <li>9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2">https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2</a></li> <li>2. <a href="https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy">https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy</a></li> <li>3. <a href="https://archive.org/EXPERIMENTS/plantanatomy031773mbp">https://archive.org/EXPERIMENTS/plantanatomy031773mbp</a></li> <li>4. <a href="https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPOG">https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPOG</a></li> <li>5. <a href="https://www.worldcat.org/title/embryology-of-">https://www.worldcat.org/title/embryology-of-</a></li> </ol>

	<a href="https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&amp;redir_esc=y">angiosperms/oclc/742342811</a> 6. <a href="https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&amp;redir_esc=y</a> .
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**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	2	1
<b>CO2</b>	3	3	2	2	3	3	2	3	3	3
<b>CO3</b>	2	2	3	3	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	3	2	3	3	3	2
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

## CORE XII CELL BIOLOGY, GENETICS AND PLANT BREEDING

<b>Title of the Course</b>	<b>CELL BIOLOGY, GENETICS AND PLANT BREEDING</b>					
<b>Paper Number</b>	CORE XII					
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>CourseCode</b>
		<b>Semester</b>	V			
<b>InstructionalHours perweek</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>	<b>Total</b>
	3		2		-	5
<b>Pre-requisite</b>	To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.					
<b>Learning Objectives</b>						
<b>C1</b>	To enable students to gain insights into cell wall organization and its functions.					
<b>C2</b>	To familiarize with various cell organelles and their functions.					
<b>C3</b>	To gain knowledge in classical genetics.					
<b>C4</b>	To know about sexlinked inheritance.					
<b>C5</b>	To have knowledge about plantbreeding techniques for crop improvement.					
<b>Course outcomes:</b>	<b>Programme Outcomes</b>					
On completion of this course, the students will be able to: CO						
1 Enumerate the structure and functions of cells, cellular structures and organelles.	K1					
2. Explain about cell cycle, cell division and laws of inheritance with suitable examples.	K2					
3. Elucidate concepts of sex determination and sex linked inheritance.	K3					

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

	cs–Hardy–Weinberg principle.
V	Principles involved in plant breeding. Plant introduction and acclimatization. Methods of crop improvement: selection (mass, pure line and clonal), hybridization techniques. Heterosis – Interspecific and intergeneric, causes and effects. Mutation in plant breeding, polyploidy in plant breeding and its applications. Breeding for crop improvement for paddy and sugarcane. Biotechnology in crop improvement: Transgenics – scope and limitations; Bt-Cotton.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPS C/TRB/NET/UGC–CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand &amp; Co. Ltd., New Delhi-55.</li> <li>2. Sinnott, E.W., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi.</li> <li>3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co.</li> <li>4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA.</li> <li>5. Singh, R.J. 2017. Practical Manual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA.</li> <li>2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8<sup>th</sup> Edn., New York.</li> <li>3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California.</li> <li>4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press &amp; Sunderland, Washington, D.C. Sinauer Associates, MA.</li> <li>5. Becker, W.M., Kleinsmith, L.J., Hardin. J and Bertoni, G. P. 2009. The World of the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco.</li> <li>6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A.</li> <li>7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223.</li> <li>8. Strickberger, M.W. 1999. Genetics. Prentice Hall of India Pvt Ltd, New Delhi.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.freebookcentre.net/Biology/Cell-Biology-Books.html">http://www.freebookcentre.net/Biology/Cell-Biology-Books.html</a></li> <li>2. <a href="https://www.us.elsevierhealth.com/medicine/cell-biology">https://www.us.elsevierhealth.com/medicine/cell-biology</a></li> </ol>

	3. <a href="https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A">https://www.amazon.in/Cell-Biology-Thomas-D-Pollard-ebook/dp/B01M7YAL2A</a> 4. <a href="http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html">http://www.freebookcentre.net/medical_text_books_journals/genetics_ebooks_online_texts_download.html</a> 5. <a href="https://www.us.elsevierhealth.com/medicine/genetics">https://www.us.elsevierhealth.com/medicine/genetics</a> 6. <a href="https://libguides.uthsc.edu/genetics/ebooks">https://libguides.uthsc.edu/genetics/ebooks</a> 7. <a href="https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding">https://www.kobo.com/us/en/ebook/principles-of-plant-genetics-and-breeding</a> 8. <a href="http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson">http://sharebooks.com/content/plant-breeding-ebooks-raoul-robinson</a>
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**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	1	3	2	1	2	2	3	1
<b>CO2</b>	3	3	2	2	3	3	2	3	3	2
<b>CO3</b>	3	3	2	3	1	2	1	3	3	2
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	2

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

## CORE XIV PLANT ECOLOGY AND PHYTOGEOGRAPHY

<b>Title of the Course</b>	<b>PLANT ECOLOGY AND PHYTOGEOGRAPHY</b>						
<b>Paper Number</b>	CORE XIV						
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>
		3		2		-	5
<b>Pre-requisite</b>		Understanding the environmental factors impacting biodiversity is crucial after taking this course.					
<b>Learning Objectives</b>							
<b>C1</b>	To relate to the significance of the biotic and abiotic components of the ecosystems.						
<b>C2</b>	To understand the energy flow in ecosystem.						
<b>C3</b>	To conceptualize the biodiversity.						
<b>C4</b>	To know implication of pollution on the environment.						
<b>C5</b>	To familiarize with the phytogeography.						
<b>Course outcomes:</b> On completion of this course, the students will be able to: <b>CO</b>	<b>Programme Outcomes</b>						
1. Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1						
2. Summarize the phytogeographical division of India.	K2						
3. Explain the implication of pollution on the environment.	K3						
4. Analyze the implications of functional	K4						

and behavioral ecology in natural and man-made areas, biodiversity and conservation.	
5. Develop mitigations for the effective conservation of biodiversity and disaster management.	K5
<b>Unit</b>	<b>CONTENTS</b>
<b>I</b>	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.
<b>II</b>	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
<b>III</b>	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation ( <i>In situ</i> and <i>ex situ</i> ).
<b>IV</b>	<b>Pollution:</b> Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.
<b>V</b>	<b>Phytogeography Introduction</b> , continuous and discontinuous distribution, Phytogeography of India, Vegetational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance. Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation ( <i>In situ</i> and <i>ex situ</i> methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.
Extended Professional Component (is a	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)

part of internal component only, Not to be included in the External Examination question paper)	
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.</li> <li>2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India. 8th edition.</li> <li>3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,</li> <li>4. Shukla, R.S and Chandel, P.S. 1990. Plant Ecology, S.Chand &amp; Co. Pvt. Ltd.,</li> <li>5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.</li> <li>6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.</li> <li>2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.</li> <li>3. Kumar, H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,</li> <li>4. Smith, W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.</li> <li>5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.</li> <li>6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.</li> <li>7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.</li> <li>8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.</li> <li>9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.</li> <li>10. <u>Ambasht, R.S.</u> 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/us/en/ebook/plant-ecology-3">https://www.kobo.com/us/en/ebook/plant-ecology-3</a>.</li> <li>2. <a href="https://www.worldcat.org/title/plant-ecology/oclc/613206385">https://www.worldcat.org/title/plant-ecology/oclc/613206385</a></li> <li>3. <a href="https://books.google.co.in/books/about/Plant_Ecology.html?">https://books.google.co.in/books/about/Plant_Ecology.html?</a></li> <li>4. <a href="https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP5">https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP5</a>. <a href="http://www.freebookcentre.net/Biology/Ecology-Books.html">http://www.freebookcentre.net/Biology/Ecology-Books.html</a></li> <li>6. <a href="https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X">https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X</a></li> <li>7. <a href="https://www.tandfonline.com/toc/tped20/current">https://www.tandfonline.com/toc/tped20/current</a> (Plant Ecology and</li> </ol>

Diversity)  
8. <https://link.springer.com/journal/11258> (Plant Ecology)

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	2	1
<b>CO2</b>	3	3	2	2	3	3	1	3	3	3
<b>CO3</b>	2	2	3	3	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	3	1	3	3	3	1
<b>CO5</b>	3	3	2	3	1	2	3	1	1	2

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

## CORE XV PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY

<b>Title of the Course</b>	<b>PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY</b>				
<b>Paper Number</b>	CORE XV				
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>
			3	2	-
<b>Pre-requisite</b>	To empower students recognize and appreciate the basic principles that an interdisciplinary domain of learning and research.				
<b>Learning Objectives</b>					
<b>C1</b>	To know various aspects of biotechnology				
<b>C2</b>	To know the concept and techniques of plant tissue culture.				
<b>C3</b>	To familiarize with the gene transfer techniques.				
<b>C4</b>	To know about DNA replication and repair.				
<b>C5</b>	To familiarize with gene regulation.				
<b>Course outcomes:</b> On the completion of the course the students will be able to: <b>CO:</b>	<b>Programme Outcomes</b>				
1. Recognize the fundamentals concepts of plant biotechnology and genetic engineering.	K1				
2. Explain various steps in transcription, protein synthesis and protein modification.	K2				
3. Elucidate gene cloning and evaluate different methods of gene transfer.	K3				
4. Analyze the major concerns and applications of transgenic technology.	K4				
5. Develop their competency on different types of plant tissue culture.	K5				
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Recombinant vaccines, insulin and interferons. Environment – Biopesticides. Industry – ethanol production (yeast), citric acid production ( <i>Aspergillus niger</i> ), penicillin production ( <i>Bacillus sps</i> ).				
	Plant tissue culture - introduction, scope and importance, concepts and techniques in plant tissue culture. Composition of media, types of media.				

<b>II</b>	preparation and inoculation. Callus induction and micropropagation. A culture in agriculture, horticulture and forestry. Synthetic seed technology.
<b>III</b>	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction DNA technology, gene transfer – indirect method, <i>Agrobacterium</i> mediated method – Biolistic method. Development of transgenic plants with reference to safety. Pros and cons of GM food.
<b>IV</b>	Nature and function of genetic materials, Nucleic acid – base pairing – structure. Types, denaturation - renaturation. Replication of DNA in prokaryotes and types. DNA repair mechanism.
<b>V</b>	Transcription – Enzymology – RNA polymerase – classes of RNA molecules in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Regulation in Prokaryotes – <i>lac</i> operon and <i>trp</i> operon
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations like CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice.</li> <li>2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers.</li> <li>3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford &amp; IBH Publishing, New Delhi.</li> <li>4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India.</li> <li>5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur.</li> <li>6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications, recombinant DNA, (2nd Edition), ASM Press, Washington, D.C.</li> <li>2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi.</li> <li>3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology.</li> <li>4. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co.</li> <li>5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, D. Harlow and J. D. Baltimore, Cold Spring Harbor Laboratory Press, New York.</li> <li>6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York.</li> <li>7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum Press, New York.</li> <li>8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plants – Springer – Verlag, Berlin.</li> <li>9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin.</li> <li>10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac millan, New York.</li> <li>11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.freebookcentre.net/Biology/BioTechnology-Books.html">http://www.freebookcentre.net/Biology/BioTechnology-Books.html</a></li> <li>2. <a href="https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.f">https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.f</a></li> <li>3. <a href="https://www.kobo.com/us/en/ebook/plant-biotechnology-1">https://www.kobo.com/us/en/ebook/plant-biotechnology-1</a></li> <li>4. <a href="https://www.kobo.com/us/en/ebook/plant-biotechnology-1">https://www.kobo.com/us/en/ebook/plant-biotechnology-1</a></li> <li>5. <a href="https://www.worldcat.org/title/molecular-biology/oclc/1062496183">https://www.worldcat.org/title/molecular-biology/oclc/1062496183</a></li> <li>6. <a href="http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html">http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html</a></li> <li>7. <a href="https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook">https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	1	3
<b>CO2</b>	3	3	2	2	3	3	2	3	2	2
<b>CO3</b>	3	2	3	3	2	1	2	1	3	3
<b>CO4</b>	3	3	3	3	3	2	3	2	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

## CORE XVI PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

<b>Title of the Course</b>		<b>PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY</b>			
<b>Paper Number</b>		CORE XVI			
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>	4
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>
		3		2	-
<b>Pre-requisite</b>		Basic knowledge on physiological processes in plants and plant metabolites and enzymes.			
<b>Learning Objectives</b>					
<b>C1</b>		To relate to water relation of plants with respect to various physiological			
<b>C2</b>		To know the pathways of photosynthesis.			
<b>C3</b>		To familiarize with respiration and nitrogen metabolism.			
<b>C4</b>		To know about plant growth regulators.			
<b>C5</b>		To familiarize with plant biochemistry.			
<b>Course outcomes:</b> On completion of this course, the students will be able to: <b>CO</b>		<b>Programme Outcomes</b>			
1. Relate to water relation of plants with respect to various physiological phenomenon.		K1			
2. Explain the process and significance of photosynthesis and respiration.		K2			
3. Elucidate properties of nutrients and their deficiency symptoms in plants.		K3			
4. Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.		K4			
5. Decipher the phenomenon of seed dormancy and germination in plants.		K5			
<b>UNIT</b>		<b>CONTENTS</b>			
<b>I</b>		<b>WATER RELATIONS:</b> Properties of water—imbibition, diffusion, osmosis and plasmolysis- as of water absorption – active and passive, apoplast and symplast pathways and factors affecting transpiration and significance. Opening and closing mechanisms and theories of transpiration.			
		<b>PHOTOSYNTHESIS:</b> Radiant energy, Photosynthetic unit, photosynthetic pigments and their r			

<b>II</b>	of carbon in photosynthesis - Light reaction, electron transport system (Z-scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespiration.
<b>III</b>	<p><b>RESPIRATION</b></p> <p>Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient.</p> <p><b>NITROGEN METABOLISM</b></p> <p>Biological nitrogen fixation, nitrogen cycle.</p>
<b>IV</b>	<p><b>GROWTH:</b></p> <p>Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene). Practical applications - Photo morphogenesis – photoperiodism – vernalization – phytochromes. <b>Stress Physiology:</b> Concepts of plant responses to abiotic stress (drought, temperature).</p>
<b>V</b>	<p><b>PLANT BIOCHEMISTRY:</b></p> <p>Classification, properties and biological role of carbohydrates, proteins, lipids. Enzyme – properties – classification – nomenclature of enzymes – factors influencing enzyme action.</p>
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations like CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, Englewood Cliffs, NJ.</li> <li>2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publications, New Delhi.</li> <li>3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi.</li> <li>4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant, Blackwell Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Wiley, New Delhi.</li> <li>5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company, New Delhi.</li> <li>6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry, Narosa, New Delhi.</li> <li>7. Metz, E.T. 1960. Elements of Biochemistry. V.F &amp; S (P) Ltd., Bombay.</li> <li>8. Verma, V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.</li> <li>2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1996. Biochemistry of Plants (second edition). Longman Essex, England.</li> </ol>

	<ol style="list-style-type: none"> <li>3. Galston, A.W. 1989. Life Processes in Plants. Scientific American I New York, USA.</li> <li>4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biocher Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands</li> <li>5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley, USA.</li> <li>6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer-Verlag, NewYork, USA.</li> <li>7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiolo Academic Press, San Diego, USA.</li> <li>8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Co., California, USA.</li> <li>9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee Photobiology: Photosynthesis and Photo morphogenesis. Narosa Pu Delhi.</li> <li>10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Publishers, Massachusetts, USA.</li> <li>11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (sec Press, San Diego. USA.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-bio">https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-bio</a></li> <li>2. <a href="https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-eboo">https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-eboo</a></li> <li>3. <a href="https://www.kobo.com/us/en/ebook/plant-biochemistry">https://www.kobo.com/us/en/ebook/plant-biochemistry</a></li> <li>4. <a href="https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-">https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-</a></li> <li>5. <a href="https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook">https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook</a></li> <li>6. <a href="https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9">https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9</a></li> <li>7. <a href="https://www.amazon.com/Introduction-Plant-Physiology-William-Ho ebook/dp/B006R6I850">https://www.amazon.com/Introduction-Plant-Physiology-William-Ho ebook/dp/B006R6I850</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	2	2
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3
<b>CO3</b>	2	2	3	3	1	2	1	3	1	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	3	3

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

**CORE XIII COVERING PRACTICAL COVERING – CORE XI AND XII- -  
PRACTICAL-VI**

<b>Title of the Course</b>	<b>PRACTICAL-VI</b>				
<b>Paper Number</b>	CORE XIII				
<b>Category</b>	<b>Year</b>	III	<b>Credits</b>	3	<b>Cou</b>
	<b>Semester</b>	V			
<b>InstructionalHours perweek</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>
	2		-		3
<b>Pre-requisite</b>	Theoretical understanding of anatomy, embryology, cell biology, genetics as well as basic laboratory skills for the relevant core course.				
<b>Learning Objectives</b>					
<b>C1</b>	To study the anatomy of the plant organs using various techniques.				
<b>C2</b>	To study the embryology of the plant.				
<b>C3</b>	To identify the structure of various cell organelles.				
<b>C4</b>	To understand genetics through problem solving.				
<b>C5</b>	To study various plant breeding techniques.				
<b>Course outcomes:</b>	<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: <b>CO</b>					
1. Identify the structure of cell organelles and stages of cell division.	K1				
2. Classify the types of stomata and ovules.	K2				
3. Compare the functions of various ergastic substances present in plant tissues.	K3				
4. Perform free hand sectioning of plant materials and decipher the internal tissue organization.	K4				
5. Interpret the given genetic data to develop genetic map based on the principles of Mendelian inheritance and gene interaction.	K5				
<b>EXPERIMENTS</b>					

<b>Anatomy</b>	
<ol style="list-style-type: none"> <li>1. Study of simple and complex (Primary and Secondary) tissues by maceration.</li> <li>2. Study the internal structure of primary (young) and secondary (old) stems. Internal structure of dicot and monocot stems. Internal structure of dicot and monocot root.</li> <li>3. Anomalous secondary growth in the stems of <i>Boerhaavia</i>, <i>Nyctanthes</i> and <i>Dracaena</i>.</li> <li>4. T.S of dicot and monocot leaves.</li> <li>5. Study of stomatal types.</li> </ol>	
<b>Embryology</b>	
<ol style="list-style-type: none"> <li>1. T.S of (young and mature) anther (section from <i>Datura</i> or <i>Cassia</i> flower).</li> <li>2. Observation of pollinia (slide only).</li> <li>3. Types of ovules- Anotropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent).</li> <li>4. Types of Endosperm - Nuclear, cellular and helobial.</li> </ol> <p>Dissection and display of any two stages of embryo in <i>Tridax</i></p>	
<b>Cell biology</b>	
<ol style="list-style-type: none"> <li>1. Study of the photomicrographs of cell organelles.</li> <li>2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide.</li> <li>3. Study the polytene and lamp brush chromosome structure through photograph.</li> <li>4. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.</li> </ol>	
<b>Genetics</b>	
<ol style="list-style-type: none"> <li>2. Genetic problems – test cross, back cross and allelic interaction.</li> <li>3. Construction of chromosome map – three point test cross</li> <li>4. Multiple alleles problems.</li> </ol>	
<b>Plant Breeding</b>	
<ol style="list-style-type: none"> <li>1. Emasculation technique.</li> <li>2. To test the viability of seeds using Tetrazolium chloride.</li> <li>3. Genetic models of heterosis.</li> <li>4. Phenotype of heterosis (Maize).</li> </ol>	
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 UPSI, CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. LTD, New Delhi.</li> <li>2. Panshin, A.J and C. de Zeeuw. 1980. Textbook of wood technology. Structure and uses of the commercial woods of the United States and Canada. New York: McGraw-Hill Book Company.</li> <li>3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental. Prakashan, ISBN-8173199698, 9788173199691.</li> </ol>

	<ol style="list-style-type: none"> <li>4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Publications.</li> <li>5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES X, 10th Edition, W. H. Freeman and Company, Bartlett Learning.</li> <li>6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp 101-110). Springer, New York.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Histology, Anmol Publications, ISBN-812610668.</li> <li>2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wiley &amp; Sons, New York.</li> <li>3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall.</li> <li>4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Genetics, 7th Edition, W. H. Freeman and Sons, New York.</li> <li>5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecular Biology (South Asian Edition), Lea and Febiger, Philadelphia, USA.</li> <li>6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012. exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp 101-110). Springer, New York, NY.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/812610668">https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/812610668</a></li> <li>2. <a href="https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_Em.html?id=Cq1KPwAACAAJ&amp;redir_esc=y">https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_Em.html?id=Cq1KPwAACAAJ&amp;redir_esc=y</a></li> <li>3. <a href="https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219">https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219</a></li> <li>4. <a href="https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/9350000000">https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/9350000000</a></li> <li>5. <a href="https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9350000000">https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9350000000</a></li> </ol>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	1	3	2	1	2	2	1	3
<b>CO2</b>	3	3	2	2	3	3	2	3	2	2
<b>CO3</b>	2	2	3	3	1	2	1	3	3	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

**CORE XVII PRACTICAL COVERING – CORE XIV, XV AND XVI- PRACTICAL-VII**

<b>Title of the Course</b>	<b>PRA</b>			
<b>Paper Number</b>	CORE XVII			
<b>Category</b>	Core	<b>Year</b>	III	<b>Credits</b>
		<b>Semester</b>	VI	
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>	
	2		-	
<b>Pre-requisite</b>	Practicals pertaining to above subjects is important to ge			
<b>Learning Objectives</b>				
<b>C1</b>	To study morphological and anatomical adaptations of plants of variou			
<b>C2</b>	To demonstrate techniques of plant tissue culture.			
<b>C3</b>	To familiarize with the structure of DNA, RNA.			
<b>C4</b>	To carryout experiments related with plant physiology.			
<b>C5</b>	To perform biochemistry experiments.			
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO	<b>Program</b>			
1. Relate to the distribution and adaptations of plants pertaining to their habitat				
2. Demonstrate skills in green planning and callus culture.				
3. Elucidate the basic principles involved in the plant physiology and biochemistry experiments.				
4. Appreciate the structure and functions of DNA and RNA.				
5. Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.				
<b>EXPERIMENTS</b>				
<b>Plant Ecology and Phytogeography</b>				
1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesop				
Hydrophytes : <i>Nymphaea, Hydrilla</i>				

Xerophytes : *Nerium, Casuarina*

Mesophytes : *Tridax, Vernonia*

Halophytes : *Avicennia, Rhizophora*

Epiphytes : *Vanda*

2. Map of the phytogeographical regions of India.
3. Quadrature study and line transect.
4. Plan for a green building.
5. Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub jungle/Pallik Marsh/Adyar Poonga).

### **Plant Biotechnology - Demonstration**

1. Sterilization techniques in plant tissue culture.
2. MS - Media preparation.
3. Explant sterilization, Callus induction, Plantlet, hardening.

### **Molecular Biology – Photographs**

1. DNA Structure
2. tRNA
3. DNA – Replication
4. DNA – Repair
5. Genetic code

### **Plant Physiology and Plant Biochemistry**

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

Biochemical test for carbohydrates, proteins and lipids

### Demonstration – Experiments

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

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UP (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.</li> <li>2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Oxford and IBH.</li> <li>3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Cytogenetics (pp. 323-333). Springer, New York.</li> <li>4. Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw Hill.</li> <li>5. Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and separation techniques. New Age International.</li> <li>6. Jayaraman, J. 1981. Laboratory Manual in Biochemistry. Wiley Eastern.</li> <li>7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I &amp; II.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.</li> <li>2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Wiley.</li> <li>3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology. Wiley.</li> <li>4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in Plant Physiology. New Age International.</li> <li>5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Botany. Wiley.</li> <li>6. Bendre, A.M. and Ashok Kumar. 2009. A text book of practical Botany. Vol. I &amp; II.</li> <li>7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology. New Age International.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.com/Practical-plant-ecology-beginners-community-edition/dp/0716754414">https://www.amazon.com/Practical-plant-ecology-beginners-community-edition/dp/0716754414</a></li> <li>2. <a href="https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/0716754414">https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/0716754414</a></li> <li>3. <a href="https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-387195-8">https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-387195-8</a></li> <li>4. <a href="https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9351131111">https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9351131111</a></li> <li>5. <a href="https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/0716754414">https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/0716754414</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	3	1
CO2	3	3	2	2	3	3	2	3	3	2
CO3	2	2	3	3	1	2	1	2	2	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	3	3	2	3	2	3	3	3	3	2

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

## ELECTIVE ALLIED BOTANY-I

<b>Title of the Course</b>		<b>ALLIED BOTANY-I</b>			
<b>Paper Number</b>		Core-Allied-I			
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	2
		<b>Semester</b>	I		
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>
		3		1	-
<b>Pre-requisite</b>		To study the basics of botany.			
<b>Learning Objectives</b>					
<b>C1</b>		To study morphological and anatomical adaptations of plants of			
<b>C2</b>		To demonstrate techniques of plant tissue culture.			
<b>C3</b>		To familiarize with the structure of DNA, RNA.			
<b>C4</b>		To carry out experiments related with plant physiology.			
<b>C5</b>		To perform biochemistry experiments.			
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO		<b>Programme Outcomes</b>			
1. Increase the awareness and appreciation of human friendly algae and their economic importance.		K1			
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies		K2			
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.		K3			
4. Compare the structure and function of cells and explain the development of cells.		K4			
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.		K5			
<b>UNIT</b>		<b>CONTENTS</b>			
<b>I</b>		<b>Algae:</b> General characters of algae - Structure, reproduction and life cycle of <i>Anabaena</i> and <i>Sargassum</i> and economic importance of algae.			
<b>II</b>		<b>Fungi, Bacteria and Virus:</b> General characters of fungi, structure, reproduction and life cycle of <i>Penicillium</i> and <i>Agaricus</i> and economic importance of fungi. Bacteria - general characters, structure and reproduction of <i>Escherichia coli</i> and economic importance of bacteria. Virus - general characters, structure of TMV, str			

<b>III</b>	<b>Bryophytes, Pteridophytes and Gymnosperms:</b> General characters of Bryophytes, Structure and life cycle of <i>Funaria</i> . General characters of Pteridophytes, Structure and life cycle of <i>Lycopodium</i> . General characters of Gymnosperms, Structure and life cycle of <i>Cycas</i> .
<b>IV</b>	<b>Cell Biology:</b> Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
<b>V</b>	<b>Genetics and Plant Biotechnology:</b> Mendelism - Law of dominance, Law of segregation, Incomplete dominance and codominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross - Reciprocal cross - <i>In vitro</i> culture methods. Plant tissue culture and its 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 like CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publishers, Meerut.</li> <li>2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age Publishers, Bengaluru.</li> <li>3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.</li> <li>4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press.</li> <li>5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, Viswanathan Pvt. Ltd., Madras.</li> </ol>
<b>Reference books:</b>	<ol style="list-style-type: none"> <li>1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes, New Age Publications, Delhi.</li> <li>2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey East Asia, Singapore.</li> <li>3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms, New Age Publishers, Delhi.</li> <li>4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Meerut.</li> <li>5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. New Age Publishers, Delhi.</li> <li>6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes, New Age Publications, Delhi.</li> <li>7. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &amp; II, S.Chand and Co. New Delhi.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/us/en/ebook/the-algae-world">https://www.kobo.com/us/en/ebook/the-algae-world</a></li> <li>2. <a href="http://www.freebookcentre.net/biology-books-download/Fungi-(Mycology)-1.pdf">http://www.freebookcentre.net/biology-books-download/Fungi-(Mycology)-1.pdf</a></li> <li>3. <a href="http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm">http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm</a></li> <li>4. <a href="https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/">https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/</a></li> <li>5. <a href="https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-be-introduction-to-gymnosperms.pdf">https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-be-introduction-to-gymnosperms.pdf</a></li> <li>6. <a href="https://www.us.elsevierhealth.com/medicine/cell-biology">https://www.us.elsevierhealth.com/medicine/cell-biology</a></li> <li>7. <a href="https://www.us.elsevierhealth.com/medicine/genetics">https://www.us.elsevierhealth.com/medicine/genetics</a></li> <li>8. <a href="https://www.kobo.com/us/en/ebook/plant-biotechnology-1">https://www.kobo.com/us/en/ebook/plant-biotechnology-1</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	3	3	3	3
<b>CO3</b>	2	3	3	3	3	1	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	2	3	2	3
<b>CO5</b>	3	2	2	2	2	2	2	1	2	1

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

## ELECTIVE ALLIED BOTANY-II

<b>Title of the Course</b>	ALLIED BOTANY-II				
<b>Paper Number</b>	Coree-Allied-II				
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>	2
		<b>Semester</b>	II		
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>
			3	1	-
<b>Pre-requisite</b>	To study basics of botany.				
<b>Learning Objectives</b>					
<b>C1</b>	To be familiar with the basic concepts and principles of plant systematics.				
<b>C2</b>	Learn the importance of plant anatomy in plant production systems.				
<b>C3</b>	Understand the mechanism underling the shift from vegetative to reproductive p				
<b>C4</b>	To learn about the physiological processes that underlie plant metabolism.				
<b>C5</b>	To know the energy production and its utilization in plants.				
<b>Course outcomes:</b>	<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: CO					
1. Understand the fundamental concepts of plant anatomy and embryology.	<b>K1</b>				
2. Analyze and recognize the different organs of plants and secondary growth.	<b>K2</b>				
3. Understand water relation of plants with respect to various physiological processes.	<b>K3</b>				
4. Classify aerobic and anaerobic respiration.	<b>K4</b>				
5. Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	<b>K5</b>				
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	<b>MORPHOLOGY OF FLOWERING PLANTS:</b> Plant and its parts. Structure and function of root and stem. Leaf and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and reference to flower description.				

<b>II</b>	<b>TAXONOMY:</b> Study of the range of characters and plants of economic importance in Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae
<b>III</b>	<b>ANATOMY</b> Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.
<b>IV</b>	<b>EMBRYOLOGY</b> Structure of mature anther and ovule - Types of ovules, structure of fertilization, structure of dicotyledonous and monocotyledonous seeds.
<b>V</b>	<b>PLANT PHYSIOLOGY</b> Absorption of water, photosynthesis - light reaction - Calvin cycle; respiratory electron transport system. Growth hormones - auxins and cytokinins and
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 like CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw Hill Companies.</li> <li>2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (enlarged edition). Vikas Publishing House, New Delhi.</li> <li>3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Vikas Publishing House, New Delhi.</li> <li>4. Salisbury, F. B.C.W. Ross. 1991. Plant Physiology. W. H. Freeman and Co. New York.</li> <li>5. Ting, I.P. 1982. Plant Physiology. Addison Wesley P. Philippines.</li> </ol>
<b>Reference books</b>	<ol style="list-style-type: none"> <li>1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Board of Secondary Education, New Delhi.</li> <li>2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (enlarged edition). Vikas Publishing House, New Delhi.</li> <li>3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.</li> <li>4. Jain, V.K. 2006. Fundamentals of Plant Physiology, S. Chand and Company.</li> <li>5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedam Books.</li> <li>6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company.</li> <li>7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand &amp; Co., Meerut.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs">https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs</a></li> <li>2. <a href="https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.htm">https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.htm</a></li> <li>3. <a href="https://archive.org/EXPERIMENTS/plant-anatomy031773mbp">https://archive.org/EXPERIMENTS/plant-anatomy031773mbp</a></li> <li>4. <a href="https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-">https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-</a></li> <li>5. <a href="https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/97">https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/97</a></li> </ol>

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	3	3	3	3
<b>CO3</b>	2	3	3	3	3	1	3	3	3	3
<b>CO4</b>	3	3	2	3	3	3	3	2	3	2
<b>CO5</b>	3	2	2	2	2	2	2	1	2	2

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

## ELECTIVE ALLIED BOTANY PRACTICALS

<b>Title of the Course</b>	<b>ALLIED BOTANY PRACTICALS</b>			
<b>Paper Number</b>	Core-Allied Practicals-I			
<b>Category</b>	Core	<b>Year</b>	I	<b>Credits</b>
		<b>Semester</b>	II	
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>
		1		-
<b>Pre-requisite</b>		Practicals pertaining to above subjects is important to g		
<b>Learning Objectives</b>				
<b>C1</b>	To enhance information on the identification of each taxono morphology and microstructure of microorganisms, algae, and f			
<b>C2</b>	To comprehend the fundamental concepts and methods used to i morphological changes and evolution, anatomy and reproduction			
<b>C3</b>	To be familiar with the basic concepts and principles of plant sy			
<b>C4</b>	Understanding of laws of inheritance, genetic basis of flo and alleles			
<b>C5</b>	To learn about the physiological processes that underlie plant me			
<b>Course outcomes:</b>		<b>Programme</b>		
On completion of this course, the students will be able to:				
CO				
1. To study the internal organization of algae and fungi.		<b>K1</b>		
2. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms..		<b>K2</b>		
3. To study the classical taxonomy with reference to different parameters.		<b>K3</b>		
4. Understand the fundamental concepts of plant anatomy and embryology		<b>K4</b>		
5. To study the effect of various physical factors on photosynthesis.		<b>K5</b>		
<b>EXPERIMENTS</b>				
<ol style="list-style-type: none"> <li>1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.</li> <li>2. Micro photographs of the cell organelles ultra structure.</li> <li>3. Simple genetic problems.</li> <li>4. To describe in technical terms, plants belonging to any of the family prescribes and to identify the</li> <li>5. To dissect a flower, construct floral diagram and write floral formula.</li> <li>6. Demonstration experiments <ol style="list-style-type: none"> <li>1. Ganong's Light screen</li> <li>2. Ganong's respiroscope</li> </ol> </li> </ol>				

7. To make suitable micro preparations of anatomy materials prescribed in the syllabus.	
8. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anatomy	
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 (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.</li> <li>2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.</li> <li>3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. VI</li> <li>4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. F</li> <li>5. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prenti</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Dell</li> <li>2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Gu Ottawa Agriculture and Agri food Canada publisher.</li> <li>3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Academic Publishing.</li> <li>4. Aler Gingauz. 2001. Medicinal Chemistry. Oxford University Press &amp; V</li> <li>5. Steward, F.C. 2012. Plant Physiology Academic Press, US</li> </ol>
<b>Web sources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sund">https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sund</a></li> <li>2. <a href="https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm">https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm</a></li> <li>3. <a href="https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sark">https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sark</a></li> <li>4. <a href="https://medlineplus.gov/genetocs/understanding/basics/cell/">https://medlineplus.gov/genetocs/understanding/basics/cell/</a></li> <li>5. <a href="https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf">https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf</a></li> <li>6. <a href="http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica">http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica</a></li> <li>7. <a href="https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar">https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	3	3	3	3
<b>CO3</b>	2	3	3	3	3	1	3	3	1	3
<b>CO4</b>	3	3	2	3	3	3	3	2	3	3
<b>CO5</b>	3	2	2	2	2	2	2	1	2	2

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

## NON-MAJOR ELECTIVE-I

### 1. ORGANIC FARMING

<b>Title of the Course</b>	<b>ORGANIC FARMING</b>					
<b>Paper Number</b>	Non-Major Elective-I					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	I			
<b>Instructional Hours</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>	<b>Total</b>
<b>Per week</b>	2		-		-	2
<b>Pre-requisite</b>	Students to gain knowledge on the scope of organic farming and its significance.					
<b>Learning Objectives</b>						
<b>C1</b>			To enable students to gain knowledge on the scope of organic farming and its significance.			
<b>C2</b>			To impart practical insights sustainable agriculture, green manuring, recycling and composting.			
<b>C3</b>			To understand the physical and chemical properties of soil.			
<b>C4</b>			To study sustainable agriculture.			
<b>C5</b>			To know about the importance of biofertilizers.			
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO			<b>Programme Outcomes</b>			
1. Recognize the different forms of biofertilizers and their uses.			<b>K1</b>			
2. Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.			<b>K2</b>			
3. Apply techniques for synthesizing green manure and develop strategies to increase crop yield.			<b>K3</b>			
4. Analyze and decipher the significance of biofertilizers in soil fertility.			<b>K4</b>			
5. Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.			<b>K5</b>			
<b>UNIT</b>	<b>CONTENTS</b>					
<b>I</b>	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.					

<b>II</b>	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.
<b>III</b>	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.
<b>IV</b>	Biofertilizers–classification, nitrogen fixers– <i>Rhizobium</i> , Cyanobacteria, <i>Azolla</i> and Vesicular Arbuscular Mycorrhiza.
<b>V</b>	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 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.</li> <li>2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.</li> <li>3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition. Medtech.</li> <li>4. Vayas, S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.</li> <li>5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Vayas, S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.</li> <li>2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers.</li> <li>3. Subha Rao, N.S. 2000. Soil Microbiology, Oxford &amp; IBH Publishers, New Delhi.</li> <li>4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh</li> <li>5. Tolanur, S. 2018. Fundamentals of Soil Science IInd Edition , CBS Publishers , New Delhi</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY">https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY</a></li> <li>2. <a href="https://www.e-booksdirectory.com/listing.php?category=323">https://www.e-booksdirectory.com/listing.php?category=323</a></li> <li>3. <a href="http://www.freebookcentre.net/Biology/Agriculture-Books.html">http://www.freebookcentre.net/Biology/Agriculture-Books.html</a></li> <li>4. <a href="https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf">https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf</a></li> <li>5. <a href="https://www.amazon.in/s?k=the+organic+farming+manual&amp;hvadid=72636563575133&amp;hvbmt=bb&amp;hvdev=c&amp;hvqmt=b&amp;tag=msndeskstdin-">https://www.amazon.in/s?k=the+organic+farming+manual&amp;hvadid=72636563575133&amp;hvbmt=bb&amp;hvdev=c&amp;hvqmt=b&amp;tag=msndeskstdin-</a></li> </ol>

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	2	1	3	2	1	2	2	2	2
<b>CO2</b>	3	3	2	1	2	3	2	3	2	3
<b>CO3</b>	2	2	3	3	1	2	2	3	2	3
<b>CO4</b>	3	2	1	1	2	3	2	3	2	3
<b>CO5</b>	3	3	2	3	1	2	3	3	3	3

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

## NON-MAJOR ELECTIVE-I

### 2. ENVIRONMENTAL BIOTECHNOLOGY

<b>Title of the Course</b>	<b>ENVIRONMENTAL BIOTECHNOLOGY</b>					
<b>Paper Number</b>	Non-Major Elective-I					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	I			
<b>Instructional Hours Per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>
		2		-	-	2
<b>Pre-requisite</b>		To understand the various applications of environmental biotechnology.				
<b>Learning Objectives</b>						
<b>C1</b>			To introduce the student to the various developed and applications of environmental biotechnology.			
<b>C2</b>			To provide knowledge about the scope of bioremediation and bioleaching using GMOs.			
<b>C3</b>			To study about pollution of water bodies.			
<b>C4</b>			To know about bioremediation.			
<b>C5</b>			To study about biomineralization.			
<b>Course outcomes:</b>			<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO						
1. Recognize the various causes of pollution and control measures.			<b>K1</b>			
2. Explain about the beneficially role of GMOs on environment.			<b>K2</b>			
3. Reflect upon various sustainable environmental protection strategies.			<b>K3</b>			
4. Analyze the different methods of air, water, and soil quality monitoring Process.			<b>K4</b>			
5. Evaluate the implications of international legislations and policies for environmental protection.			<b>K5</b>			
<b>UNIT</b>		<b>CONTENTS</b>				
<b>I</b>		<b>Introduction:</b> The environment-soil, water and air, Pollution and its causes (outline only)				

<b>II</b>	<b>Source and treatment of polluted waters and effluents:</b> 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.
<b>III</b>	<b>Soil and air pollution and their treatment:</b> Soil pollution by Xenobiotics. Degradation of Xenobiotics – pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.
<b>IV</b>	<b>Bioremediation:</b> Introduction to bioremediation, <i>ex situ</i> and <i>in situ</i> bioremediation.
<b>V</b>	<b>Biometallurgy and related topics:</b> Biomining – 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited.</li> <li>2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication.</li> <li>3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication.</li> <li>4. Keeshav Thehan. 1997. Biotechnology, New age international Pvt New Delhi.</li> <li>5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.</li> </ol>
<b>Reference Books:</b>	<ol style="list-style-type: none"> <li>1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi.</li> <li>2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K.</li> <li>3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology.</li> <li>4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of</li> </ol>

	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.
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8">https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8</a></li> <li>2. <a href="http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html">http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html</a></li> <li>3. <a href="https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI">https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI</a></li> <li>4. <a href="https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&amp;redir_esc=y">https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&amp;redir_esc=y</a></li> <li>5. <a href="http://library.umac.mo/ebooks/b28045907.pdf">http://library.umac.mo/ebooks/b28045907.pdf</a></li> </ol>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	1	3	2	1	2	2	1	3
<b>CO2</b>	3	3	2	2	2	3	2	3	2	2
<b>CO3</b>	2	2	3	3	1	2	1	3	3	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	3	3	3	2	3

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

## NON-MAJOR ELECTIVE-I

### 3. NURSERY AND LANDSCAPING

Title of the Course		NURSERY AND LANDSCAPING					
Paper Number		Non-Major Elective-I					
Category	Elective	Year	I	Credits	1	CourseCode	
		Semester	I				
<b>InstructionalHours perweek</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>		
		2	-	-	2		
<b>Pre-requisite</b>		Students should know about the fundamental concepts of nursery and landscaping.					
<b>Learning Objectives</b>							
<b>C1</b>		To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.					
<b>C2</b>		To be able to design gardens and become entrepreneur in Horticulture.					
<b>C3</b>		To study the methods of propagation.					
<b>C4</b>		To know about nursery structure.					
<b>C5</b>		To learn about gardening.					
<b>Course outcomes:</b>				<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO							
1. Recognize the basic principles and components of gardening.				K1			
2. Explain about bio-aesthetic planning and conceptualize flower arrangement.				K2			
3. Apply techniques for design various types of gardens according to the culture and art of bonsai.				K3 & K6			
4. Compare and contrast different garden styles and landscaping patterns.				K4			
5. Establish and maintain special types of gardens for outdoor and indoor landscaping.				K5 & K6			
<b>UNIT</b>		<b>CONTENTS</b>					
<b>I</b>		Introduction, prospects and scope of nursery and landscaping.					
<b>II</b>		Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.					
<b>III</b>		Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.					
<b>IV</b>		Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.					

<b>V</b>	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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi.</li> <li>2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.</li> <li>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.</li> <li>4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.</li> <li>5. Butts, E. and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans and Plants. Dundurn Group Ltd.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi.</li> <li>2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.</li> <li>3. Janick Jules. 1979. Horticultural Science. (3<sup>rd</sup> Ed.), W.H. Freeman and Co., San Francisco, USA.</li> <li>4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.</li> <li>5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath">https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath</a></li> <li>2. <a href="https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788">https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788</a></li> <li>3. <a href="https://www.amazon.in/Gardening/b?ie=UTF8&amp;node=1637077031">https://www.amazon.in/Gardening/b?ie=UTF8&amp;node=1637077031</a></li> <li>4. <a href="https://in.pinterest.com/pin/496733033900458021/?lp=true">https://in.pinterest.com/pin/496733033900458021/?lp=true</a></li> <li>5. <a href="https://www.gardenvisit.com/ebooks">https://www.gardenvisit.com/ebooks</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	2	1	3	2	1	2	2	1	3
<b>CO2</b>	3	3	2	2	3	3	2	2	2	2

<b>CO3</b>	2	2	3	1	1	1	1	3	3	1
<b>CO4</b>	3	2	2	1	3	2	1	3	2	1
<b>CO5</b>	3	3	2	3	2	1	2	3	2	3

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

## NON-MAJOR ELECTIVE-II

### 1. MUSHROOM CULTIVATION

<b>Title of the Course</b>	<b>MUSHROOM CULTIVATION</b>					
<b>Paper Number</b>	Non-Major Elective-II					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	II			
<b>InstructionalHours perweek</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>	<b>Total</b>
	2		-		-	2
<b>Pre-requisite</b>	Basic knowledge on structure and function of various groups of mushrooms.					
<b>Course Objectives</b>						
<b>C1</b>			To learn and develop skills in mushroom cultivation.			
<b>C2</b>			To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.			
<b>C3</b>			To cultivate mushroom cultivation in small scale industry.			
<b>C4</b>			To learn about diseases and post harvest technology.			
<b>C5</b>			To study new methods and strategies to contribute to mushroom production.			
<b>Course outcomes:</b> On completion of this course, the students will be able to: CO			<b>Programme Outcomes</b>			
1. Recall various types and categories of mushroom.			K1			
2. Explain about various types of food technologies associated with mushroom industry.			K2			
3. Apply techniques studied for cultivation of various types of mushroom.			K3			
4. Analyze and decipher the environmental factors and economic value associated with mushroom cultivation			K4			
5. Develop new methods and strategies to contribute to mushroom production.			K5 & K6			
<b>UNIT</b>			<b>CONTENTS</b>			
<b>I</b>			Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.			

<b>II</b>	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
<b>III</b>	Life cycle of <i>Pleurotus spp</i> and <i>Agaricus spp</i> .
<b>IV</b>	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
<b>V</b>	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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Handbook of Mushroom Cultivation. 1999. TNAU publication.</li> <li>2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.</li> <li>3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.</li> <li>4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.</li> <li>5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Handbook of Mushroom Cultivation. 1999. TNAU publication.</li> <li>2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.</li> <li>3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.</li> <li>4. Nita Bahl. 2002. Handbook on Mushroom 4<sup>th</sup> edition Vijayprimlani for oxford &amp; IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.</li> <li>5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X">https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X</a></li> <li>2. <a href="http://nrcmushroom.org/book-cultivation-merged.pdf">http://nrcmushroom.org/book-cultivation-merged.pdf</a></li> <li>3. <a href="http://agricoop.nic.in/sites/default/files/ICAR_8.pdf">http://agricoop.nic.in/sites/default/files/ICAR_8.pdf</a></li> <li>4. <a href="http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/">http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/</a></li> <li>5. <a href="https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&amp;redir_esc=y">https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&amp;redir_esc=y</a></li> </ol>

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PO6</b>	<b>PO7</b>	<b>PO8</b>
<b>CO1</b>	S			S	M	L	M	M
<b>CO2</b>	S			M		S	M	S
<b>CO3</b>	M			S		M		S
<b>CO4</b>	S	S	S	S		M		S
<b>CO5</b>	S	S	M				S	S

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

**NON-MAJOR ELECTIVE-II**  
**2. HERBAL MEDICINE**

<b>Title of the Course</b>		<b>HERBAL MEDICINE</b>				
<b>Paper Number</b>		Non-Major Elective-II				
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	II			
<b>InstructionalHours perweek</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>
		2		-	-	2
<b>Pre-requisite</b>		To understand the importance of herbal medicine.				
<b>Learning Objectives</b>						
<b>C1</b>			To understand the nuances of medicinal plants and their phytoconstituents of commercial value			
<b>C2</b>			To design and develop medicinal garden.			
<b>C3</b>			To apply the knowledge to cultivate medical plants.			
<b>C4</b>			To know the pharmacological importance of medicinal plants.			
<b>C5</b>			To enlist phytochemicals and secondary metabolites of market and commercial value.			
<b>Course outcomes:</b>  On completion of this course, the students will be able to: CO				<b>Programme Outcomes</b>		
1. Define and describe the principle of cultivation of herbal products.				K1		
2. Explain about the phytochemistry of economically important medicinal herbs				K2		
3. Apply techniques for evaluation of drug adulteration through biological testing.				K3		
4. Formulate the value added processing / storage / quality control for the better use of herbal medicine.				K4		
5. Develop the skills for cultivation of plants and their value added processing/storage/quality control.				K5 &K6		
<b>UNIT</b>		<b>CONTENTS</b>				
<b>I</b>		Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.				

<b>II</b>	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.
<b>III</b>	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.
<b>IV</b>	Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).
<b>V</b>	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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Somasundaram, S. 1997. Medicinal botany (Maruthuvar Thavaraviyal) – (Tamil Medium Book).</li> <li>2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. &amp; A. Churchill Ltd., London,</li> <li>3. Jains, S.K... 1996. Medicinal Plants. Deep Publications, New Delhi.</li> <li>4. Srivastava, A.K. 2006, Medicinal Plants, International Book Distributors, Dehradun.</li> <li>5. Agarwal, O.P. 1985, Vol. II, Chemistry of organic – natural products. S Chand &amp; Company, New Delhi.</li> <li>6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency, Madras Volumes.</li> <li>7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.\</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Nair, N.C and Henry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India.</li> <li>2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of Indian Medicinal Plants.</li> <li>3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994, Indigenous drugs of India.</li> <li>4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous</li> </ol>

	<p>plants in India.</p> <p>5. Miller, L and Miller, B. 2017. Ayurveda &amp; Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. <i>Motilal Banarsidass, Fourth edition.</i></p> <p>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.</p>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li><a href="https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu">https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu</a></li> <li><a href="https://www.springer.com/gp/book/9783540791157">https://www.springer.com/gp/book/9783540791157</a></li> <li><a href="https://www.gpatonline.com/gpat/book-reference-pharmacognosy">https://www.gpatonline.com/gpat/book-reference-pharmacognosy</a></li> <li><a href="https://www.researchgate.net/publication/334670695_Book_review-Herbal_Drug_Technology">https://www.researchgate.net/publication/334670695_Book_review-Herbal_Drug_Technology</a></li> <li><a href="http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future">http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future</a></li> </ol>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	2	1	2	1	2	1	3	2	1
<b>CO2</b>	3	3	2	1	1	2	2	2	2	2
<b>CO3</b>	2	2	1	3	1	2	1	3	2	1
<b>CO4</b>	3	2	1	2	1	2	3	3	2	3
<b>CO5</b>	3	3	2	2	1	1	3	3	1	3

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

## NON-MAJOR ELECTIVE-II

### 3. GLOBAL CLIMATE CHANGE

<b>Title of the Course</b>	<b>GLOBAL CLIMATE CHANGE</b>					
<b>Paper Number</b>	Non-Major Elective-II					
<b>Category</b>	Elective	<b>Year</b>	I	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	II			
<b>InstructionalHours perweek</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>	
		2	-	-	2	
<b>Pre-requisite</b>		To understand the implications of carbon and ecological footprint.				
<b>Learning Objectives</b>						
<b>C1</b>			To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.			
<b>C2</b>			To understand the implications of carbon and ecological footprint.			
<b>C3</b>			To apply the knowledge to green house effects.			
<b>C4</b>			To know the rain and its effects on plants.			
<b>C5</b>			To know about Global Environmental change issues.			
<b>Course outcomes:</b>			<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO						
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			
4. Evaluate human influenced driver of our climate system and its applications 5.			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			
<b>UNIT</b>			<b>CONTENTS</b>			
<b>I</b>			Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.			
<b>II</b>			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.
<b>III</b>	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.
<b>IV</b>	Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace elements; Eutrophication.
<b>V</b>	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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press.</li> <li>2. Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall.</li> <li>3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru.</li> <li>4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut.</li> <li>5. Neeraj Nachiketa. 2018 Environmental &amp; Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.</li> <li>2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.</li> <li>3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.</li> <li>6. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.</li> <li>7. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/">https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/</a></li> <li>2. <a href="http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html">http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html</a></li> <li>3. <a href="https://www.smashwords.com/books/category/4727/newest/0/free/any">https://www.smashwords.com/books/category/4727/newest/0/free/any</a></li> <li>4. <a href="https://www.free-ebooks.net/environmental-studies-">https://www.free-ebooks.net/environmental-studies-</a></li> </ol>

	academic/Global-Warming 5. <a href="https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet">https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet</a>
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**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO2	3	2	1	2	3	3	2	3	1	2
CO3	2	2	3	1	1	2	3	2	3	1
CO4	3	3	3	2	1	1	3	2	3	2
CO5	3	2	2	3	2	3	1	2	2	3

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

**ELECTIVE COURSE I  
BIO-ANALYTICAL TECHNIQUES**

<b>Title of the Course</b>	<b>BIO-ANALYTICAL TECHNIQUES</b>			
<b>Paper Number</b>	Elective-I			
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>

		Semester	V
Instructional Hours per week	Lecture		Tutorial
	3		1
Pre-requisite	To impart expertise about analysis and research		
<b>Learning Objectives</b>			
C1	To understand the principle, operation and maintenance of laboratory instruments.		
C2	Perform experiments using the laboratory instruments and the acquisition of data.		
C3	To equip students to collect, analyze and evaluate data.		
C4	To give an exposure to various forms of field research.		
C5	To provide an overview on modern equipments that the research careers and/or start entrepreneurial ventures.		
<b>Course outcomes:</b>	<b>Program</b>		
On completion of this course, the students will be able to:			
CO			
1. Relate to the various biological techniques and its importance.			
2. Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.			
3. Apply suitable strategies in data collections and disseminating research findings.			
4. Compare and contrast the significance of different types of chromatography techniques.			
5. Develop methodologies for extraction and analysis of biochemical compounds.			
<b>UNIT</b>	<b>CONTENT</b>		
<b>I</b>	<b>I MICROSCOPY:</b> Principles of microscopy; Light microscopy; compound microscopy, microscope, Fluorescence microscopy; Transmission and Scanning Microscopy drawing: Camera Lucida.		
<b>II</b>	<b>CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:</b> Principle; Paper chromatography, Thin Layer Chromatography (TLC), Gas chromatography (GC), Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).		
<b>III</b>	<b>ELECTROPHORESIS AND pH METER:</b> Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis.		
<b>IV</b>	<b>UV SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUES:</b> Principle and law of absorption, construction, operation of UV-Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuges.		
<b>V</b>	<b>BIOSTATISTICS:</b> Data collection methods, population, samples, parameters; Representation of data: Bar diagram – measures of central tendency – Mean, Median and Mode; Hypothesis testing: t-test, F-test, Chi-square test, of fit – t-test.		
Extended Professional Component (is a part of internal component)	Questions related to the above topics, from various competitive examinations (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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata M</li> <li>2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochem</li> <li>3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publication</li> <li>4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Ch</li> <li>5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.</li> <li>6. Palanivelu, P. 2013. Analytical Biochemistry and Separation technique</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Public</li> <li>2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication</li> <li>3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics an</li> <li>4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book</li> <li>5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill pu</li> <li>6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley &amp; sons,</li> <li>7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia I</li> <li>8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Ed</li> <li>9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, Engl</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/in/en/ebook/bioinstrumentation-1">https://www.kobo.com/in/en/ebook/bioinstrumentation-1</a></li> <li>2. <a href="https://www.worldcat.org/title/bioinstrumentation/oclc/74848857">https://www.worldcat.org/title/bioinstrumentation/oclc/74848857</a></li> <li>3. <a href="https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-F">https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-F</a></li> <li>4. <a href="https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-21&amp;tag=kindlecontentin50-21&amp;gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpBwE">https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-21&amp;tag=kindlecontentin50-21&amp;gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpBwE</a></li> <li>5. <a href="https://www.kobo.com/us/en/ebooks/biostatistics">https://www.kobo.com/us/en/ebooks/biostatistics</a></li> <li>6. <a href="https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B0">https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B0</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	2	2	3	2	1	2	2	3	2
<b>CO2</b>	3	3	2	2	1	3	2	3	3	3
<b>CO3</b>	2	2	3	2	1	2	1	3	2	2
<b>CO4</b>	3	2	1	1	3	2	1	3	3	2
<b>CO5</b>	3	2	1	3	2	2	3	3	3	2

**S-Strong (3)**

**M-Medium (2)**

**L-Low(1)**





<b>III</b>	<b>PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATE</b> Common marine microalgae of India, including phytoplanktons and diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial algae of India.
<b>IV</b>	<b>AQUATIC ANGIOSPERMS:</b> Common aquatic angiosperms of India, including Lotus, Water Lilly, Vallisneria, etc. life cycle, taxonomy and economic importance of aquatic angiosperms.
<b>V</b>	<b>VALUES AND USES OF AQUATIC PLANTS:</b> Economic importance of aquatic plants, Ecosystem services of aquatic plants, biogeochemical cycles, oxygen production and carbon sequestration and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations like CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Lee, R.E. 2008. Phycology. 4<sup>th</sup> edition. Cambridge University Press.</li> <li>2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Prescott and Tomlinson's Microbiology. 10<sup>th</sup> Edition. Mc Graw Hill International.</li> <li>3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press.</li> <li>4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.</li> <li>5. Daubenmire, R.F. 1973. Plant and Environment. John Willey.</li> <li>6. Sharma, J.P. 2004. Environmental Studies, Laxmi Publications.</li> <li>7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. <i>Journal of Applied Phycology</i> 19(2) 1032-1043 ISSN: 0971-8044.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. CRC Press, Boca Raton, FL, USA.</li> <li>2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (2<sup>nd</sup> Edition). Elsevier, Amsterdam, Netherlands.</li> <li>3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (ed. by R.S.K. Barnes and J. Mann, eds.), Blackwell Sci. Publ., London, 229 pp.</li> <li>4. Bennet, G.W. 1971 Management of Lakes and Ponds. vander Noort, New York, NY. 375 pp.</li> <li>5. Goldman, C.R. &amp; A.J. Horne 1983. Limnology. Prentice Hall, Englewood Cliffs, NJ. 464 pp.</li> <li>6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-s">http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-s</a></li> <li>2. <a href="http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-s">http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-s</a></li> <li>3. <a href="https://www.springer.com/gp/book/9788132221777">https://www.springer.com/gp/book/9788132221777</a></li> <li>4. <a href="http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-s">http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-s</a></li> <li>5. <a href="https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B000APR004">https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B000APR004</a></li> </ol>

#### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
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<b>CO1</b>	3	3	1	3	2	1	2	2	2	1
<b>CO2</b>	3	2	1	1	2	3	2	3	2	3
<b>CO3</b>	2	2	3	1	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	3	2	1	2	3	2
<b>CO5</b>	3	2	1	1	2	3	3	3	2	3

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

**ELECTIVE I**

**3. ENTREPRENEURIAL BOTANY**

<b>Title of the Course</b>	<b>ENTREPRENEURIAL BOTANY</b>				
<b>Paper Number</b>	Elective-I				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3
		<b>Semester</b>	V		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	3		1		-
<b>Pre-requisite</b>	To develop innovative ideas to exploit the economically commercial purposes.				
<b>Learning Objectives</b>					
<b>C1</b>	To enable students to develop innovative ideas to exploit the economically for commercial purposes.				
<b>C2</b>	To inculcate entrepreneurial values to start a new business. To enlighten p				
<b>C3</b>	To comprehend the molecular processes.				
<b>C4</b>	To expose the students a fundamental of the various value added product				
<b>C5</b>	To introduce the entrepreneurial opportunities.				
<b>Course outcomes:</b>	<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: CO					
1. Recognize the significance of government agencies for entrepreneurship development.	K1				
2. Explain about entrepreneurial values, risk assessment and solutions	K2				
3. Make use of entrepreneurial opportunities.	K3				
4. Analyze and decipher the significance of bioventure and value added products.	K4				
5. Devise innovative methods for making value added products.	K5 & K6				
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	<b>INTRODUCTION:</b> Need - definition and concept - Types and characterization - entrepreneurship and barriers-entrepreneurship as innovation, risk assessment and solution				
<b>II</b>	<b>BIOVENTURE:</b> Industry - overview of <i>Spirulina</i> , <i>Pleurotus</i> , Natural dyes, Banana fibre, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant marketing - fresh and dry flowers for aesthetics.				



**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	2	1	3	2	1	2	2	1	2
<b>CO2</b>	3	1	3	2	1	3	1	3	3	1
<b>CO3</b>	2	2	3	3	1	1	2	3	1	2
<b>CO4</b>	3	3	2	2	3	2	3	3	2	3
<b>CO5</b>	3	3	2	3	1	2	3	3	2	3

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

## ELECTIVE-II

### 1. HORTICULTURE

<b>Title of the Course</b>	<b>HORTICULTURE</b>				
<b>Paper Number</b>	Elective-II				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	3		1		-
<b>Pre-requisite</b>		Students should know fundamental knowledge applications.			
<b>Learning Objectives</b>					
<b>C1</b>	To gain an understanding of the fundamentals of horticulture and to maintain plants.				
<b>C2</b>	To develop skills in students to work as gardeners, therapists, technical advisors in the food and non-food sectors of horticulture.				
<b>C3</b>	To know about hydroponic culture.				
<b>C4</b>	To develop the various horticultural crop protection.				
<b>C5</b>	To impart the knowledge on market preparation.				
<b>Course outcomes:</b>		<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO					
1. Enumerate the concepts in horticulture and nursery management.		K1			
2. Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.		K2			
3. Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.		K3			
4. Analyze different methods of weed control in horticultural crops.		K4			
5. Develop their competency on pre and post-harvest technology in horticultural crops.		K5 & K6			
<b>UNIT</b>		<b>CONTENTS</b>			
<b>I</b>	Importance and scope of horticulture. Classification of horticultural crops. Essentials of nursery Management - Soil management: Garden soil properties of soil, Organic matter, Compost, Cultural practices; Wa				

	quality, Irrigation, Mulching. Nursery structures: Protected culture environment controls.
<b>II</b>	Hydroponic culture-types of container. Use of manures and fertilizers in production. Principles of organic farming. Environmental factors influencing production.
<b>III</b>	Horticultural crop protection; physical control - pruning. Chemical control- propagation - cutting, layering, budding, grafting. Types of gardens: formal, Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
<b>IV</b>	A brief account of annual, biennials and perennials with reference to ornamental house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping basic components.
<b>V</b>	Technology of horticultural crops - market preparation: harvesting and transport, storage; chemical treatment. Economics of cultivation Crop protection. Food processing - freezing, bottling and canning, drying and chemical treatments.
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 like CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – Half of India. New Delhi.</li> <li>2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of horticultural crops. Naya Prakash.</li> <li>3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi.</li> <li>4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Kalyani.</li> <li>5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Calcutta.</li> <li>6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyani.</li> <li>7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants. Prentice Hall of India Pvt. Ltd., New Delhi</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca.</li> <li>2. Bailey, S. 1971. Perpetual flowering carnation, Fabner and Faber.</li> <li>3. Laurie, A., Kiplinger, D.D and Nelson, K.S. 1968. Commercial flowers. Hill Book, London.</li> <li>4. Cumming, R.W. 1964. The chrysanthemum Book. D. Van., Nost.</li> <li>5. Biswas, T.D. 1984. Rose growing – Principles and Practices New Delhi.</li> <li>6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printing.</li> <li>7. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trivandrum.</li> <li>8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash.</li> <li>9. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., VA.</li> <li>10. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening. New Jersey.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kopykitab.com/Precision-Horticulture-by-Archarya-S">https://www.kopykitab.com/Precision-Horticulture-by-Archarya-S</a></li> <li>2. <a href="https://www.ebooks.com/en-us/subjects/science-horticulture-ebook">https://www.ebooks.com/en-us/subjects/science-horticulture-ebook</a></li> </ol>

	3. <a href="http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/">http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/</a> 4. <a href="https://www.worldcat.org/title/handbook-of-horticulture/oclc/688">https://www.worldcat.org/title/handbook-of-horticulture/oclc/688</a> 5. <a href="https://cbseportal.com/ebook/vocational-books-horticulture">https://cbseportal.com/ebook/vocational-books-horticulture</a> 6. <a href="http://www.digitalbookindex.org/_search/search010agriculhortiga">http://www.digitalbookindex.org/_search/search010agriculhortiga</a>
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**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	1	1	2	1	2	2	2	1
<b>CO2</b>	3	3	2	1	1	3	1	3	1	3
<b>CO3</b>	2	2	3	3	1	2	2	3	1	2
<b>CO4</b>	3	3	2	2	3	2	3	1	3	2
<b>CO5</b>	3	3	2	3	1	3	2	3	1	3

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

## ELECTIVE-II

### 2. NATURAL RESOURCE MANAGEMENT

<b>Title of the Course</b>	<b>NATURAL RESOURCE MANAGEMENT</b>					
<b>Paper Number</b>	Elective-II					
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3	<b>CourseCode</b>
		<b>Semester</b>	VI			
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>		<b>LabPractice</b>
		3		1		-
<b>Pre-requisite</b>		To understand the concept of different natural resources and their utilization.				
<b>Learning Objectives</b>						
<b>C1</b>	To develop an appreciation for the natural resources and their ecological and economic impact.					
<b>C2</b>	To gain an understanding of various strategies of natural resource management.					
<b>C3</b>	To understand the concept of different natural resources and their utilization.					
<b>C4</b>	To create the models of natural resource conservation and maintenance.					
<b>C5</b>	To study the significance of natural resources pertaining to economy and environment.					
<b>Course outcomes:</b>	<b>Programme Outcomes</b>					
On completion of this course, the students will be able to: CO						
1. Relate to significance of natural resources pertaining to economy and environment	K1					
2. Understand the concept of different natural resources and their utilization.	K2					
3. Evaluate the management	K3					

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

	resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi.</li> <li>2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.</li> <li>3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi.</li> <li>4. United States Government Accountability Office. 2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition</li> <li>5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House</li> <li>6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Coastal Ecology &amp; Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition). Chap. 2-5, pp.18-78 &amp; Chap. 16, pp.280-303.</li> <li>2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.</li> <li>3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.</li> <li>4. Cunningham, W.P. Cooper, T.H. Gorhani, E &amp; Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.</li> <li>5. Heywood, V.H. &amp; Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.</li> <li>6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).</li> <li>7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.</li> <li>8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley &amp; Sons Ltd.</li> <li>9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&amp;redir_esc=y">https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&amp;redir_esc=y</a></li> </ol>

	<ol style="list-style-type: none"> <li>2. <a href="https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&amp;redir_esc=y">https://books.google.co.in/books/about/Natural Resource Conservation and Enviro.html?id=T2SRuhxpUW8C&amp;redir_esc=y</a></li> <li>3. <a href="https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE">https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE</a></li> <li>4. <a href="https://www.kobo.com/us/en/ebooks/natural-resources">https://www.kobo.com/us/en/ebooks/natural-resources</a></li> <li>5. <a href="https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y">https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y</a></li> <li>6. <a href="https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y">https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y</a></li> <li>7. <a href="https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&amp;redir_esc=y">https://books.google.co.in/books/about/Natural Resource Conservation and Enviro.html?id=T2SRuhxpUW8C&amp;redir_esc=y</a></li> <li>8. <a href="https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE">https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE</a></li> <li>9. <a href="https://www.kobo.com/us/en/ebooks/natural-resources">https://www.kobo.com/us/en/ebooks/natural-resources</a></li> <li>10. <a href="https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y">https://www.igi-global.com/chapter/natural-resources-management/1951836crLIC&amp;redir_esc=y</a></li> </ol>
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**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	1	2	1	2	1	2	2	2	1
<b>CO2</b>	3	1	2	1	3	3	2	3	3	3
<b>CO3</b>	2	2	3	3	1	2	1	2	1	2
<b>CO4</b>	3	3	3	2	3	2	2	1	3	2
<b>CO5</b>	3	3	2	1	1	3	3	3	1	3

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

## ELECTIVE-II

### 3.FORESTRY

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

3. Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
4. Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation	K4
5. Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	K5 &K6

UNIT	CONTENTS
I	<p><b>SILVICULTURE:</b></p> <p>Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu - revised classification - pure and mixed stands - even and uneven aged stands. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.</p>
II	<p><b>FOREST MENSURATION AND MANAGEMENT:</b></p> <p>Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees - methods and principles - tree stem form - form factor. Volume estimation of stand - age - basal area</p>

	determinations Stem and Stump Analysis. Forest inventory - sampling techniques and methods - measurement of crops - sample plots. Yield calculation - CAI and MAI - volume, yield and stand tables preparation.
<b>III</b>	<p><b>FOREST UTILIZATION AND WOOD TECHNOLOGY:</b></p> <p>Logging - extraction of timber - felling rules and methods - conversion methods - conversion season. Implements used - cross cutting system - sawing - different types - extraction methods. Grading of timbers. Transportation of timbers - major and minor transportation methods Storage and sales of logs - sales depot - management of depots. Recent trends in logging - Ergonomics and RIL. Forest products - Timber - timber, fuel, pulp, paper, rayon and match. Wood Composites - plywood, particle board, fiber boards, MDF, hardboard, insulation boards - production technology. Non timber forest products (NTFP) - collection - processing and storage of NTFP - fibres and flosses - bamboos and canes - katha and bidi leaves - essential oils and oil seeds - gums and resins - tans and dyes - drugs - insecticides - lac and shellac - tassar silk - role of tribal co-operative societies.</p>
<b>IV</b>	<p><b>FOREST BIOLOGY AND BOTANY:</b></p> <p>Forest ecology - definition - biotic and abiotic components - forest ecosystem - forest community - concepts - succession - primary productivity - nutrient cycling. Composition of forest types in India - classification of India's forests - species composition - association and diversity. Restoration ecology - global warming - green house effects - ozone layer depletion - acid rain - role of trees in environmental conservation. Biodiversity - Definition, origin, types - factors endangering biodiversity - biodiversity hotspots - endemism - Red Data Book. Biodiversity assessments - principles and methods.</p>
<b>V</b>	<p><b>FOREST BOTANY:</b></p> <p>Importance of botany - taxonomic classification of plant species - identification of species - composition and association. Dendrology - principles and establishment of herbaria and arboreta. Tree Improvement - Forest Genetics and Tree Breeding - Definition and concepts - Steps in tree improvement - Variation and selection - Progeny Evaluation Test (PET) - Candidate Tree, Plus Tree, Elite trees - use of provenances and seed sources - heritability and genetic gains - hybrids in tree improvement - heterosis exploitation. Seed production Area and seed orchards - types and establishment. In situ and ex situ gene conservation. Exotics - role of exotic forest trees in India - application of biotechnological methods in forestry.</p> <p><b>AGRO FORESTRY AND SOCIAL FORESTRY:</b></p> <p>Agro forestry - definition, concept and objectives. Classification of agro forestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of agro forestry - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry</p>

	practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.
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 UPS C/TRB/NET/UGC-CSIR/GATE/TNPSC/othersto be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros.</li> <li>2. Roger Sands. 2013. Forestry in a global context, CAB international.</li> <li>3. Balakathiresan. S. 1986. Essentials of Forest Management. Natraj Publishers, Dehradun.</li> <li>4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford &amp; IBH Publishing Co. New Delhi.</li> <li>5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.</li> <li>6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.</li> <li>7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.</li> <li>8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.</li> <li>9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.</li> <li>10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Donald L. Grebner, Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press</li> <li>2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.</li> <li>3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I &amp; II Springer Verlag, New York.</li> <li>4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford IBH Publishing Co., New Delhi.</li> <li>5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR)</li> </ol>

	<p>OR),Bogor,Indonesia.</p> <p>6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. WertzKanounnikoff.2007.Incentivesandconstraintsshapeforestoutcomes.In:Atloggerheads?Agricultural expansion, poverty reduction and environment in tropical forests. The WorldBank,Washington,DC.</p> <p>7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.</p>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_20061019150049/Rendered/PDF/367890Loggerheads0Report.pdf">http://www.wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_20061019150049/Rendered/PDF/367890Loggerheads0Report.pdf</a>.</li> <li>2. <a href="https://www.britannica.com/science/forestry">https://www.britannica.com/science/forestry</a></li> <li>3. <a href="https://en.wikipedia.org/wiki/Forestry">https://en.wikipedia.org/wiki/Forestry</a>.</li> <li>4. <a href="https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119">https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119</a></li> <li>5. <a href="https://academic.oop.com">https://academic.oop.com</a></li> <li>6. <a href="https://www.cbd.int/development/doc">https://www.cbd.int/development/doc</a>.</li> <li>7. <a href="https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product">https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product</a>.</li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	2	3	3	3	2	3	3	2
<b>CO2</b>	3	3	3	3	2	3	1	1	3	1
<b>CO3</b>	3	3	3	2	3	3	3	3	3	3
<b>CO4</b>	3	2	3	1	2	3	1	2	3	1
<b>CO5</b>	3	2	1	3	1	1	2	3	1	2

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

## ELECTIVE-III

### 1. BIONANOTECHNOLOGY

<b>Title of the Course</b>	BIONANOTECHNOLOGY				
<b>Paper Number</b>	Elective-III				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	3		1		-
<b>Pre-requisite</b>		To provide an insight into the principles of nanotechnology in medical research.			
<b>Learning Objectives</b>					
<b>C1</b>	To provide students with comprehensive knowledge of basics in nanotechnology.				
<b>C2</b>	To enable the students understand and appreciate the various applications of nanotechnology.				
<b>C3</b>	To give perspective to researchers and students who are interested in nanotechnology and biological systems and their applications in medicine.				
<b>C4</b>	To introduce the concepts in nanomaterials and their use with biotechnology and interact with larger systems.				
<b>C5</b>	To impart knowledge on the most recent molecular diagnostic and therapeutic applications and treat various diseases.				
<b>Course outcomes:</b>		<b>Programme Outcomes</b>			
On completion of this course, the students will be able to:					
CO					
1. Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology		K1			
2. Explain the synthesis of nanomaterials and their applications.		K2			
3. Apply the knowledge gained to develop nanomaterials		K3			
4. Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.		K4			
5. Construct various types of nanomaterial for application and evaluate the impact on environment.		K5 & K6			
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	<b>INTRODUCTION TO NANOTECHNOLOGY:</b> History, Concepts, Prospects and Challenges. Scope of nanotechnology from different perspectives. Definition - Nanoscience, Nanotechnology. Classification of nanotechnology - 0D, 1D, 2D and 3D nanomaterials. Basic understanding of 1D, 2D and 3D nanomaterials - nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biotechnology applications of nanotechnology.				

	nanocubes and hinges – smart glue, DNA as wire template.
<b>II</b>	<b>SYNTHESIS OF NANOPARTICLES:</b> Synthesis of nanoparticles - Top down and bottom up approach. Methods Chemical reduction – reducing agents, capping agents, stabilizing agents Biological – Novel synthetic methods using plant extracts, bacteria and fungi
<b>III</b>	<b>FOREST UTILIZATION AND WOOD TECHNOLOGY:</b> <b>PROPERTIES &amp; CHARACTERIZATION OF NANOPARTICLES</b> Nano size effects - optical, electrical, mechanical, magnetic Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, AFM, XPS, DLS, TGA, DSC, microspectroscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography
<b>IV</b>	<b>NANOCARRIERS:</b> Introduction. Nanocarriers for drug delivery (DDS) – Polymeric nanoparticles, Liposomes, Solid lipid nanoparticles (SLN) as carriers, controlled release, site specific drug delivery, Nanoparticles as drug carriers and its applications.
<b>V</b>	<b>APPLICATIONS OF NANOPARTICLES:</b> Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, wound dressing; Environment – green manufacturing. Agriculture - nanofertilizers, Smart biosensors – Components and its application.
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 like CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Charles, P. Poole, Jr. &amp; Frank J. Owens. 2003. Introduction to Nanotechnology, John Wiley &amp; Sons, INC., Publication.</li> <li>2. George, K. Knopf &amp; Amarjeet S. Bassi. 2006. Smart Biosensors. Wiley Publishers.</li> <li>3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscience, Wiley Publishers.</li> <li>4. Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Practice, Wiley Publishers.</li> <li>5. Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnology: Principles, applications and perspectives, Wiley VCH publishers.</li> <li>6. Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylor &amp; Francis Publishers.</li> <li>7. Sharma P.K. 2008. Understanding Nanotechnology. Vista International House, Delhi.</li> <li>8. Viswanathan B. 2009. Nano Materials. Narosa Publishing House.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Star Publishers.</li> <li>2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic Principles and Applications, Bioscience.</li> <li>3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions: making nanoparticles more biocompatible. Brookhaven National Laboratory.</li> <li>4. European Commission, SCENIHR. 2006. Potential risks associated with the adventitious products of nanotechnologies, European Union.</li> <li>5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ. of Queensland.</li> <li>6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textiles and Nanotechnology. Springer Publication.</li> <li>7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery. Springer.</li> </ol>

	Lung Cancer. Academic Press. An imprint of Elsevier.
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453">https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453</a></li> <li>2. <a href="https://www.elsevier.com/books/nanobiotechnology/ghosh/978-">https://www.elsevier.com/books/nanobiotechnology/ghosh/978-</a></li> <li>3. <a href="https://www.routledge.com/Nanobiotechnology-Concepts-and-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179">https://www.routledge.com/Nanobiotechnology-Concepts-and-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179</a></li> <li>4. <a href="https://www.nanowerk.com/nanotechnology/periodicals/ebook_">https://www.nanowerk.com/nanotechnology/periodicals/ebook_</a></li> <li>5. <a href="https://phys.org/news/2014-10-endless-possibilities-bio-nanotec">https://phys.org/news/2014-10-endless-possibilities-bio-nanotec</a></li> <li>6. <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/</a></li> <li>7. <a href="https://phys.org/news/2014-10-endless-possibilities-bio-nanotec">https://phys.org/news/2014-10-endless-possibilities-bio-nanotec</a></li> <li>8. <a href="http://www.particle-works.com/applications/controlled-drug-rel">http://www.particle-works.com/applications/controlled-drug-rel</a></li> </ol>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	3	3	3	3	3	3	3	3	3
<b>CO2</b>	3	3	3	3	3	3	2	1	2	1
<b>CO3</b>	3	3	3	2	3	3	3	2	3	2
<b>CO4</b>	3	3	3	3	3	3	3	3	3	3
<b>CO5</b>	3	3	3	3	3	3	3	3	3	3

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

## ELECTIVE-III

### 2. COMPUTER APPLICATIONS IN BOTANY

<b>Title of the Course</b>	<b>COMPUTER APPLICATIONS IN BOTANY</b>				
<b>Paper Number</b>	Elective-III				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	3		1		-
<b>Pre-requisite</b>		To equip students with computational skills for drug design			
<b>Learning Objectives</b>					
<b>C1</b>	To familiarize the student with the fundamentals concepts of bioinform				
<b>C2</b>	To equip students with computational skills for drug design.				
<b>C3</b>	To learn about the bioinformatics database, data format and data retrieval from				
<b>C4</b>	To develop interdisciplinary skills in using computers in botany to lea				
<b>C5</b>	Student is aware with the most recent technologies for sequencing and				
<b>Course outcomes:</b>		<b>Programme Outcomes</b>			
On completion of this course, the students will be able to:					
CO					
1. Recognize advanced resources for accessing scholarly literature from the internet.		K1			
2. Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.		K2			
3. Apply various software resources with advanced functions to carry out analysis of data procured through research.		K3			
4. Decipher the effective utilization of bibliography management software while typing and downloading citations.		K4			
5. Determine how the knowledge gained can be used for designing experiments and data interpretation.		K5 & K6			
<b>UNIT</b>		<b>CONTENTS</b>			
		Introduction to computers and Bioinformatics. Introduction to Com			

I	computer generation, low, medium and high level languages, software systems personal, mini, main frame and super computers, character computer memory and its types, data representation and storage. Micrographs, aggregate functions, formulas and functions, number systems secondary storage media
II	Biological Research on the web: Using search engines, finding scientific of networking, internet, intranet, search engines- yahoo, Google, etc. te
III	Computer fundamentals - programming languages in bioinformatics, r biology. Historical background. Scope of bioinformatics - Gen Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug and ligand based approaches), Systems Biology and Functional Bio Limitations of bioinformatics.
IV	Introduction to databases. Biological databases- NCBI, EMBL and DD Data Retrieval Generation of data (Gene sequencing, Protein sequenc Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequ FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence an systems (SRS, Entrez) DNA sequencing methods. protein sequenc Similarity, identity and homology, Alignment – local and global a multiple sequence alignments, alignment algorithms. Methods of A Dynamic Programming, BLAST and FASTA); Phylogenetic ana phylogenetic tree, dendrograms, methods of construction of phylogen
V	<b>Applications:</b> Application of Taxonomic Software for preparation of Dichotomous Key Make line drawing of Plants for description. Usage of plant identifi phones. Computer application in biostatistics - MS Excel and SPSS.Co (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Compu
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 CSIR/GATE/TNPSC/otherstobesolved (Tobediscussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi (1st Edition.</li> <li>2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and New Delhi, Delhi: Oxford University Press.</li> <li>3. Baxevanis, A.D. and Ouellette, B.F., John. 2005. Bioinformatics: Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: W</li> <li>4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Nar</li> <li>5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinform the analysis of genes and proteins, 3rd edition. New Jersey, U.S.:</li> <li>6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd e Wiley Blackwell.</li> <li>7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Camb University Press.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Publishers and Distributors Pvt, Ltd., New York, US.</li> </ol>

	<ol style="list-style-type: none"> <li>2. David W. Mount. 2004. Bioinformatics Sequence and Genom Cold Spring Harbor Laboratory Press, New York, US.</li> <li>3. Harshitha, D. 2006. Techniques of Teaching Computer Sci Distributor, Dehradun.</li> <li>4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer netw CRC Press.</li> <li>5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. B Springer-Verlag Berlin Heidelberg.</li> <li>6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practic Analysis. Chapman and Hall/CRC; 1st edition.</li> <li>7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Mole III2nd Edn. Horizontal Scientific Press, Norwich, UK.</li> </ol>
<b>Web Resources:</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.agrimoon.com/introduction-to-computer-applications-po">http://www.agrimoon.com/introduction-to-computer-applications-po</a></li> <li>2. <a href="https://www.ebooks.com/en-us/subjects/computers/">https://www.ebooks.com/en-us/subjects/computers/</a></li> <li>3. <a href="https://it.careers360.com/download/ebooks">https://it.careers360.com/download/ebooks</a></li> <li>4. <a href="http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinforma 2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20">http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinforma 2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%20</a></li> <li>5. <a href="http://www.freebookcentre.net/Biology/BioInformatics-Books.html">http://www.freebookcentre.net/Biology/BioInformatics-Books.html</a></li> <li>6. <a href="https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf">https://courses.cs.ut.ee/MTAT.03.242/2017_fall/uploads/Main/Basics_of_Bioinformatics.pdf</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	1	3	3		
<b>CO2</b>	3	3	3	2	1	3	3	2		
<b>CO3</b>	3	3	3	1	2	1	3	2		
<b>CO4</b>	3	3	3	1	2	1	3	2		
<b>CO5</b>	3	3	3	1	2	1	3	2		

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

**ELECTIVE-III**  
**3. FORENSIC BOTANY**

<b>Title of the Course</b>	<b>FORENSIC BOTANY</b>						
<b>Paper Number</b>	Elective-III						
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	3	<b>Course Code</b>	
		<b>Semester</b>	VI				
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>	<b>Total</b>	
	3		1		-	4	
<b>Pre-requisite</b>	The course will provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.						
<b>Learning Objectives</b>							
<b>C1</b>	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.						
<b>C2</b>	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.						
<b>C3</b>	To learn classification of plants from forensic point of view.						
<b>C4</b>	To understand forensic importance of different parts of plants.						
<b>C5</b>	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.						
<b>Course outcomes:</b>  On completion of this course, the students will be able to: CO	<b>Programme Outcomes</b>						
1. Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1						
2. Summarize the forensic importance of different parts of plants.	K2						
3. Apply techniques for	K3						

the collection and preserve of botanical evidences of crime.	
4. Analyze and decipher the significance of classic and DNA based forensic botany cases.	K4
5. Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.
<b>II</b>	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man-made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
<b>III</b>	Various types of poisonous plants: <i>Abrus precatorius</i> , <i>Aconitum napellus</i> , <i>Anacardium occidentale</i> , <i>Argemone mexicana</i> , <i>Cannabis sativa</i> , <i>Claviceps purpuria</i> , <i>Croton tiglium</i> , <i>Atropa belladonna</i> , <i>Gloriosa superba</i> , <i>Jatropha curcas</i> , <i>Lathyrus sativus</i> , <i>Nerium indicum</i> , <i>Nicotiana tabacum</i> , <i>Strychnos nux vomica</i> , <i>Thevetia nerifolia</i> . Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, <i>Psilocybin</i> mushrooms.
<b>IV</b>	Collection and preservation of botanical evidences: Botanical samples, outdoor crime sceneconsideration.
<b>V</b>	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.
Extended Professional Component (is a part of internal component)	Questions related to the above topics, from various competitive examinations UP SC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press.</li> <li>2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition.</li> <li>3. <u>David W. Hall, Dr. Jason H. Byrd</u>. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom.</li> <li>4. Jane H Bock, David Norris. 2015. Forensic Plant Science. Elsevier.</li> <li>5. <u>Patricia E. J. Wiltshire</u>. 2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation. <u>Criminal and Environmental Soil Forensics</u> pp 129–149</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1 edition.</li> <li>2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press.</li> <li>3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell.</li> <li>4. <u>David W. Hall, Jason Byrd</u>. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell.</li> <li>5. Heather Miller Coyle. 2007. Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/us/en/ebook/forensic-botany">https://www.kobo.com/us/en/ebook/forensic-botany</a></li> <li>2. <a href="https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574">https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574</a></li> <li>3. <a href="https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/">https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/</a></li> <li>4. <a href="https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299">https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299</a></li> <li>5. <a href="http://docshare02.docshare.tips/files/25818/258183613.pdf">http://docshare02.docshare.tips/files/25818/258183613.pdf</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	1
CO2	3	3	2	1	1	3	2	3	1	3

<b>CO3</b>	2	1	2	3	1	2	1	3	1	2
<b>CO4</b>	3	3	3	3	2	1	3	3	2	1
<b>CO5</b>	3	3	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

<b>Title of the Course</b>	<b>BOTANICAL GARDEN AND LANDSCAPING</b>					
<b>Paper Number</b>	Skill Enhancement-3					
<b>Category</b>	Elective	<b>Year</b>	<b>I</b>	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	<b>II</b>			
<b>InstructionalHours perweek</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>
		2		-	-	2
<b>Pre-requisite</b>		Students should know about the fundamental concepts of gardening and landscaping.				
<b>Learning Objectives</b>						
<b>C1</b>		To know about the fundamental concepts of gardening and landscaping.				
<b>C2</b>		To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.				
<b>C3</b>		To illustrate the significance of garden adornments and propagation structures.				
<b>C4</b>		To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.				
<b>C5</b>		To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.				
<b>Course outcomes:</b>		<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: CO						
1. Recognize fundamental concepts of gardening and landscaping.		K1				
2. Explain about significance of garden adornments and propagation structures.		K2				
3. Apply techniques of landscaping for aesthetic purposes and gardening for recreation.		K3 & K6				
4. Distinguish between formal, informal and free style gardens and their applications.		K4				
6. Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.		K5 & K6				
<b>UNIT</b>		<b>CONTENTS</b>				
<b>I</b>		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.
<b>II</b>	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.
<b>III</b>	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.
<b>IV</b>	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
<b>V</b>	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/otherstobesolved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.</li> <li>2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd.</li> <li>3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency</li> <li>4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.</li> <li>5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books.</li> <li>2. Butts, E. and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.</li> <li>3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides).</li> <li>4. Acquaah, J. 2009. Horticulture – principles and practices, 4th</li> </ol>

	edition, PHI learning Pvt. Ltd. 5. Edment Senn Andrews. 1994. Fundamentals of Horticulture. Tata. McGraw Hill Publishing Co., Ltd., Delhi.
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden">https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden</a></li> <li>2. <a href="https://www.overdrive.com/subjects/gardening">https://www.overdrive.com/subjects/gardening</a></li> <li>3. <a href="https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers">https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers</a></li> <li>4. <a href="https://www.scribd.com/book/305542619/Botanic-Gardens">https://www.scribd.com/book/305542619/Botanic-Gardens</a></li> <li>5. <a href="https://www.overdrive.com/subjects/gardening">https://www.overdrive.com/subjects/gardening</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	1	2	3	1
<b>CO2</b>	3	3	2	2	1	3	2	3	3	2
<b>CO3</b>	2	2	3	2	1	2	1	3	2	3
<b>CO4</b>	3	3	2	3	1	2	3	3	3	2
<b>CO5</b>	3	3	2	3	2	3	1	3	3	2

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

**SKILL ENHANCEMENT COURSES SEC 4**

**HERBAL TECHNOLOGY**

<b>Title of the Course</b>	<b>HERBAL TECHNOLOGY</b>				
<b>Paper Number</b>	Skill Enhancement-4				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	1
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	2		-		-
<b>Pre-requisite</b>	To understand the importance of herbal technology.				
<b>Learning Objectives</b>					
<b>C1</b>	To provide students with knowledge of herbal drug industry, the quality guidelines for quality maintenance.				
<b>C2</b>	To gain an insight into the commercially important secondary products bioprospecting.				
<b>C3</b>	To understand various plants based drugs used in ayurvedha, unani, hor				
<b>C4</b>	To apply the knowledge to cultivate medical plants.				
<b>C5</b>	To know the pharmacological importance of medicinal plants.				
<b>Course outcomes:</b>	<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: CO					
1. Define and describe the principle of cultivation of herbal products.	K1				
2. List the major herbs, their botanical name and chemical constituents.	K2				
3. Apply techniques for monitoring drug adulteration through the biological testing.	K3				
4. Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4				
5. Develop the skills for cultivation of plants and their value added processing / storage	K5 & K6				
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	Herbal Technology: Definition and scope; Herbal medicines: history systems of medicine, and overview of AYUSH (Traditional Indian Cultivation - harvesting - processing - storage of herbs and herbal prod				
<b>II</b>	Value added plant products: Herbs and herbal products recognized in In herbal medicines, nutraceuticals, cosmetics and biopesticides, their				

	parts used, major chemical constituents.
<b>III</b>	Pharmacognosy - Systematic position, botany of the plant part used and following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalme, Saravar. Herbal foods, future of pharmacognosy.
<b>IV</b>	Analytical pharmacognosy: Morphological and microscopic examination of drug adulteration - types, methods of drug evaluation - Biological tests. Phytochemical screening tests for secondary metabolites (alkaloids, terpenoids, triterpenoids, phenolic compounds).
<b>V</b>	Plant gene banks, Cultivation of Plants and their value added processes, quality control for use in herbal formulations, Introductory knowledge of Tissue Culture and propagation of some medicinal plants ( <i>Withania somnifera</i> , neem and turmeric).
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 like CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Health and Family Welfare, Government of India.</li> <li>2. Evans, W.C. 2009: Trease and Evans PHARMACOGNOSY. 16th Edition. Elsevier.</li> <li>3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources. Orient Black Swan Publishing Company, 1994 - Herbs - 570 pages.</li> <li>4. Miller, L. and Miller, B. 2017. Ayurveda &amp; Aromatherapy: The Earth's Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .</li> <li>5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Patna.</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Herbal Plants and Drugs. Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-4115.</li> <li>2. Arber, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur.</li> <li>3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Functional Groups in Nutraceuticals and Functional Foods. Foods 5 : 88.</li> <li>4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17: 1000.</li> <li>5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and their uses as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-4.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kopykitab.com/Herbal-Science">https://www.kopykitab.com/Herbal-Science</a></li> <li>2. <a href="https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9o1Ko9TbyAh4fsoFqPYWGs5qBTbytD22z7l0">https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9o1Ko9TbyAh4fsoFqPYWGs5qBTbytD22z7l0</a></li> <li>3. <a href="https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-herbal-healing/herbal-medicine/">https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-herbal-healing/herbal-medicine/</a> / N-ry0Z8</li> <li>4. <a href="http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.htm">http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.htm</a> 1579066352&amp;signature=1dd0d5aef818b19bcdcd6c063a78e404</li> <li>5. <a href="https://www.dattanibookagency.com/books-herbs-science.html">https://www.dattanibookagency.com/books-herbs-science.html</a></li> <li>6. <a href="https://www.springer.com/gp/book/9783540791157">https://www.springer.com/gp/book/9783540791157</a></li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	3	3	3	3	3	2	3	2
<b>CO2</b>	3	3	3	3	3	3	3	1	3	1
<b>CO3</b>	3	3	3	3	3	3	3	2	3	2
<b>CO4</b>	3	3	3	3	3	3	3	1	3	1
<b>CO5</b>	3	3	3	3	3	3	3	1	3	1

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

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

**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**

<b>Title of the Course</b>	<b>ENTREPRENEURIAL OPPORTUNITIES IN BOTANY</b>					
<b>Paper Number</b>	Skill Enhancement-5					
<b>Category</b>	<b>Elective</b>	<b>Year</b>	<b>III</b>	<b>Credits</b>	1	<b>CourseCode</b>
		<b>Semester</b>	<b>VI</b>			
<b>InstructionalHours perweek</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>LabPractice</b>	<b>Total</b>	
		1	-	-	1	
<b>Pre-requisite</b>		To understand the concept of Entrepreneurial Opportunities in Botany.				
<b>C1</b>	To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.					
<b>C2</b>	To create a mindset among students to start their own companies for income generation.					
<b>C3</b>	The students may understand about various fields of botany.					
<b>C4</b>	To develop the concept of Entrepreneurial Opportunities in Botany.					
<b>C5</b>	Describe the new strategies to describe marketing and business management strategy.					
<b>Course outcomes:</b>  On completion of this course, the students will be able to: CO	<b>Programme Outcomes</b>					
1. Relate to how various fields of botany could be understood with an entrepreneurial approach.	K1					
2. Explain the concept of Entrepreneurial Opportunities in Botany.	K2					
3. Make of the knowledge gained to start	K3					

new venture using Plant tissue culture and plant products for commercial exploitations	
4. Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
5. Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	K5 & K6
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	<b>INTRODUCTION TO ENTREPRENEURSHIP</b> Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.
<b>II</b>	<b>TOOLS AND TECHNIQUES</b> Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.
<b>III</b>	<b>NEW VENTURE CREATION</b> Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
<b>IV</b>	<b>PRODUCT DEVELOPMENT AND COMMERCIALIZATION</b> Product commercialization and business strategy, Dyes, Cosmetics and Perfumes,

	Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
<b>V</b>	<b>BIO-BUSINESS PLANS, IPR AND BIOETHICS</b> Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India.</li> <li>2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India.</li> <li>3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA.</li> <li>4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.</li> <li>5. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.</li> </ol>
<b>Reference books</b>	<ol style="list-style-type: none"> <li>1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.</li> <li>2. Peter F. Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.</li> <li>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.</li> <li>4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.</li> <li>5.</li> </ol>

	Webster, J and Weber, R. 2007. Introduction to Fungi, 3 <sup>rd</sup> Ed. Cambridge University Press, Cambridge
<b>Web sources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.brainkart.com/article/Entrepreneurial-Botany_38321/">https://www.brainkart.com/article/Entrepreneurial-Botany_38321/</a></li> <li>2. <a href="https://www.youtube.com/watch?v=hnBla1FfcLo">https://www.youtube.com/watch?v=hnBla1FfcLo</a></li> <li>3. <a href="https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation">https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation</a></li> <li>4. <a href="http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301">http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301</a></li> <li>4. <a href="https://www.ebooks.com/en-us/subjects/gardening/">https://www.ebooks.com/en-us/subjects/gardening/</a></li> <li>5. <a href="https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q">https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q</a></li> </ol>

**Mapping with Programme Outcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	1	2	1	2	2	1	2
<b>CO2</b>	3	3	2	2	3	1	2	3	1	2
<b>CO3</b>	2	2	3	1	2	2	1	3	2	1
<b>CO4</b>	3	3	1	2	3	2	3	3	2	3
<b>CO5</b>	3	3	2	3	1	3	3	3	3	3

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

**ELECTIVE – INDUSTRY MODULE**

**CULTIVATION OF ALGAE**

<b>Title of the Course</b>	<b>INDUSTRY MODULE- CULTIVATION OF ALGAE</b>					
<b>Paper Number</b>	<b>INDUSTRY MODULE</b>					
<b>Category</b>	<b>Elective</b>	<b>Year</b>	<b>III</b>	<b>Credits</b>	2	<b>Course Code</b>
		<b>Semester</b>	<b>VI</b>			
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	<b>Total</b>	
		3	1	-	4	
<b>Pre-requisite</b>		Students should know fundamental knowledge on algae and its biotechnological applications.				
<b>Learning Objectives</b>						
<b>C1</b>	To impart sufficient information about the culture and cultivation of algae under laboratory and outdoor conditions..					
<b>C2</b>	To study the media composition for algae cultivation and high value products and its applications.					
<b>C3</b>	To know about the important seaweeds and its cultivation practices.					
<b>C4</b>	To study the SLF production and applications in agriculture crops.					
<b>C5</b>	To understand about the Environment Impact Assessment of algal cultivation.					
<b>Course outcomes:</b>	<b>Programme Outcomes</b>					
On completion of this course, the students will be able to: CO						
1. Obtain an in-depth knowledge on culture and mass cultivation of algae and its different methods.	K1					
2. Exploration and recommendation of the commercial potential of algal products.	K2					
3. Understand the applied facet of algology and acquire a complete knowledge about the cultivation method	K3					

s in algae.	
4. Describe the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	K4
5. Acquiring the information about algal applications in different industries and agriculture fields in the current scenario.	K5 & K6
<b>UNIT</b>	<b>CONTENTS</b>
<b>I</b>	Morphology, life history and mass culture of microalgae: <i>Spirulina, Chlorella, Dunaliella</i> and <i>Botryococcus</i> .
<b>II</b>	High value products: Single Cell Protein (SCP), phycocyanin, $\beta$ -carotene, astaxanthin – biofuel, media composition – scale up – lab to land – raceway ponds and photobioreactor.
<b>III</b>	Marine macroalgae: Morphology, life history and mass cultivation of <i>Gracilaria, Kappaphycus, Sargassum</i> and <i>Ulva</i> .
<b>IV</b>	Polysaccharides: agar, carrageen, alginate – economic importance – seaweed as food, feed and Seaweed Liquid Fertilizer (SLF).
<b>V</b>	Role of seaweeds in aquaculture: Environment Impact Assessment of algal cultivation.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations U PSC/TRB/NET/UGC – CSIR/GATE/TNPSC/other 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
<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Kumar H.D. and Singh, H.N. 1976. A Text Book of Algae Affiliated East West Press Pvt. Ltd., New Delhi, Madras.</li> <li>2. Kumar, H.D. 1990. Introductory Phycology, Affiliated East West Press (P) Ltd., New Delhi, Madras, Hyderabad, Bangalore.</li> <li>3. Pandey, B.P. 1993. A Text book of Botany - Algae S. Chand &amp; Co., (P) Ltd., New Delhi.</li> <li>4. Sharma, O.P. 1990. Text Book of Algae Tata McGraw Hill Publishing Co., Ltd., New Delhi.</li> <li>5. Vashista, B.R. 1988. Botany for degree students - Algae. S. Chand &amp;</li> </ol>

	Co.,(P)Ltd., NewDelhi
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Bilgrami,K.S.,andL.C.Saha.1996.ATextBookofAlgae,CBSPublishers&amp; Distributors(P)Ltd.,New Delhi.</li> <li>2. Chapman,V.J. and Chapman, D.J., 1973. TheAlgae. 2<sup>nd</sup>Ed. ELBS&amp; MacMillan, 498 pp.,</li> <li>3. FritschF.E.1935.TheStructureandReproductionofAlgae1945.Cambridge UniversityPress,Cambridge,U.K. Vol.I-791 pp., Vol. II-939 pp.,</li> <li>4. Round,F.E. 1973.Biology ofthe Algae. 2<sup>nd</sup>Ed.Edward Arnold, London. 278pp.,</li> <li>5. Sharma,O.P.1990.TextBookofAlgae.TataMcGrawHillPublishingCo.,Ltd., NewDelhi,396</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production">https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production</a></li> <li>2.<a href="https://link.springer.com/article/10.1007/s10811-013-9983-9">https://link.springer.com/article/10.1007/s10811-013-9983-9</a></li> <li>3. <a href="https://www.nrel.gov/docs/legosti/old/2360.pdf">https://www.nrel.gov/docs/legosti/old/2360.pdf</a></li> <li>4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf</li> <li>5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed_aquaculture_Cultivation_technologies_ch all.pdf</li> </ol>

**MappingwithProgrammeOutcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	1
CO2	3	2	1	2	1	3	2	3	1	3
CO3	2	1	1	3	2	1	2	3	2	1
CO4	3	3	3	3	1	2	1	3	1	2
CO5	3	3	2	2	1	1	3	3	1	1

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

**SKILL ENHANCEMENT COURSES SEC 6**

**FERMENTATION TECHNOLOGY**

<b>Title of the Course</b>	<b>FERMENTATION TECHNOLOGY</b>						
<b>Paper Number</b>	Skill Enhancement						
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	1	<b>Cour</b>	<b>seCo</b>
		<b>Semester</b>	VI				

InstructionalHours perweek	Lecture	Tutorial	LabPractice	Total
		2	-	-
<b>Pre-requisite</b>	To students to know about the various fermentation technology.			
<b>Learning Objectives</b>				
<b>C1</b>	To appreciate the significance of microbes synthesizing fermented products.			
<b>C2</b>	To gain insights on safety and quality control in large scale production of fermentative products.			
<b>C3</b>	To design and operation of industrial practices in mass production of fermented products.			
<b>C4</b>	To know about the various fermentation technology.			
<b>C5</b>	To learn about the bioproduct recovery.			
<b>Course outcomes:</b>  On completion of this course, the students will be able to: CO	<b>Programme Outcomes</b>			
1. Enumerate the significance of industrially useful microbes.	K1			
2. Explain the design and operation of industrial practices in mass production of fermented products.	K2			
3. Explain the process of maintenance and preservation of microorganisms.	K3			
4. Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4			
5. Validate the experimental	K5 & K6			

techniques for microbial production of enzymes: amylase and protease, bio product recover.	
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UNIT	CONTENTS
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.
IV	Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TR B/NET/UGC-CSIR/GATE/TNPSC/other 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 Transferable Skill

<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.</li> <li>2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott &amp; Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.</li> <li>3. Reed G. 2004. Prescott &amp; Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA.</li> <li>4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P)</li> </ol>
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	<p>Limited Publishers, New Delhi, India.</p> <p>5. Waites M.J., Morgan N.L., Rockey J.S. and Higon G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.</p> <p>6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.</p>
<b>Reference Books</b>	<p>1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.</p> <p>2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.</p> <p>3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.</p> <p>4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.</p> <p>5. John E. Smith. Biotechnology. 2009. Cambridge University Press. UK.</p> <p>6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY.</p> <p>7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.</p>
<b>Web resources</b>	<p>1. <a href="https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html">https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html</a></p> <p>2. <a href="https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ">https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ</a></p> <p>3. <a href="https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W">https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W</a></p> <p>4. <a href="https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html">https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html</a></p> <p>5. <a href="https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/">https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/</a></p>

**Mapping with Programme Outcomes:**

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	2	1	3	2	1	2	2	1	2
<b>CO2</b>	3	3	2	2	1	2	3	2	2	3
<b>CO3</b>	2	2	3	1	1	1	2	3	1	2
<b>CO4</b>	3	3	2	1	3	2	1	3	2	1
<b>CO5</b>	3	3	2	1	2	2	3	3	2	3

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



**SKILL ENHANCEMENT COURSES SEC 7**

**ENVIRONMENTAL IMPACT ANALYSIS**

<b>Title of the Course</b>	<b>ENVIRONMENTAL IMPACT ANALYSIS</b>				
<b>Paper Number</b>	Skill Enhancement				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	1
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>	<b>Lecture</b>		<b>Tutorial</b>		<b>Lab Practice</b>
	2		-		-
<b>Pre-requisite</b>	To students to know about the environmental impact asse				
<b>Learning Objectives</b>					
<b>C1</b>	To understand about the theory and practice of environmental impac				
<b>C2</b>	To develop skills in identifying and solving problems of environmen				
<b>C3</b>	Define and classify Environmental Impacts and the terminology.				
<b>C4</b>	Understands the environmental Impact assessment procedure.				
<b>C5</b>	List and describe environmental audits.				
<b>Course outcomes:</b>	<b>Programme Outcomes</b>				
On completion of this course, the students will be able to: CO					
1. Enumerate the fundamental concepts and significance of environmental impact assessment.	K1				
2. Explain the important steps of EIA process.	K2				
3. Interpret the environmental appraisal and procedures in India.	K3				
4. Decipher how to prepare the various documents required by state and federal regulations.	K4				
5. Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6				
<b>UNIT</b>	<b>CONTENTS</b>				
<b>I</b>	Origin and Development Purpose and aim, core values and prin development, Environmental Management Plan, Environmental Impact in Project planning and Implementation.				
<b>II</b>	EIA Process Components of EIA, EIA Methodology- Screening, Scopin Identification, Prediction, Evaluation and Mitigation, Appendices and I				
<b>III</b>	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checkli Environmental component: air, noise, water, land, biological, social an EIA Document.				

<b>IV</b>	Main participants in EIA Process Role of Project proponent, environmental PCCs, public and IAA. Public participation.
<b>V</b>	Environmental Appraisal and Procedures in India and EIA Methods mitigation, Environmental Audit of different environmental resources, environmental assessment, ecological impact assessment: legislation.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations CSIR/GATE/TNPSC/other 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
	<ol style="list-style-type: none"> <li>1. Morris, P. and Therivel, R. 1995. Methods of Environmental Assessment. Blackwell Science, Oxford.</li> <li>2. Petts, J. 1999. Handbook of Environmental Impact Assessment. Blackwell Science, Oxford.</li> <li>3. Therivel, R. and Partidario, M.R. 1996. The Practice of Environmental Assessment, Earthscan, London.</li> <li>4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social Impact Assessment. Wiley &amp; Sons, Chichester.</li> <li>5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment. McGraw-Hill, New York, 1996</li> </ol>
<b>Reference Books</b>	<ol style="list-style-type: none"> <li>1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental Impact Assessment. Co. New Delhi.</li> <li>2. Petts, J. 2005. Handbook of Environmental Impact Assessment. Blackwell Publishers, UK.</li> <li>3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction to Environmental Assessment. Routledge, London.</li> <li>4. Canter, W.L. 1995. Environmental Impact Assessment, Engineering/ Math, New York.</li> <li>5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Assessment. Reinhold Co., New York, 1991.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.amazon.in/Environmental-Impact-Assessment-Khandeshwar-ebook/dp/B06XTNQ5PW">https://www.amazon.in/Environmental-Impact-Assessment-Khandeshwar-ebook/dp/B06XTNQ5PW</a></li> <li>2. <a href="https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-assessment/9789382332322">https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-assessment/9789382332322</a></li> <li>3. <a href="https://www.elsevier.com/books/environmental-impact-assessment/12-811139-0">https://www.elsevier.com/books/environmental-impact-assessment/12-811139-0</a></li> <li>4. <a href="https://link.springer.com/book/10.1007/978-3-030-80942-1">https://link.springer.com/book/10.1007/978-3-030-80942-1</a></li> <li>5. <a href="https://onlinelibrary.wiley.com/doi/book/10.1002/047177">https://onlinelibrary.wiley.com/doi/book/10.1002/047177</a></li> </ol>

#### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
<b>CO1</b>	3	2	1	3	2	1	2	2	2	2
<b>CO2</b>	3	3	2	2	3	3	2	3	2	3

<b>CO3</b>	2	2	1	3	1	1	2	3	2	3
<b>CO4</b>	3	3	3	3	2	2	3	3	3	3
<b>CO5</b>	3	2	2	3	1	3	3	3	3	3

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

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

**BOTANY FOR COMPETITIVE EXAMINATIONS (2 hours)**

<b>Title of the Course</b>		<b>BOTANY FOR COMPETITIVE EXAMINATIONS</b>			
<b>Paper Number</b>		Skill Enhancement			
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	2
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>		<b>Lecture</b>	<b>Tutorial</b>	<b>Lab Practice</b>	
		2	-	-	
<b>Pre-requisite</b>		To develop the students for preparing various competitive			
<b>Learning Objectives</b>					
<b>C1</b>		To develop the student for competitive examination.			
<b>C2</b>		To select the important topics as far as possible, with reference to t view. It gives a comprehensive account of botany.			
<b>C3</b>		To understand not only the basics of botany and also gives the broad for the competitive examinations.			
<b>C4</b>		The essays give a detailed account of each aspect of botany to hel IAS, IFS and state civil services.			
<b>C5</b>		General understanding of plants around us, the different bioph processes that occur within them and their importance to human life			
<b>Course outcomes:</b>		<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO					
1. Identify and define different groups of plants with their taxonomic position Compare the different groups of plants and evaluate their economic importance		K1,K2 &K5			
2.List down the general characters of Bryophytes, Pteridophytes and Gymnosperms Classify the types of fossils and recognize the fossil beds of Tamil		K1,K3&K5			



	concepts) -Cell division and its significance -Mitosis and Meiosis Monohybrid and Dihybrid cross, Sex linked inheritance
V	<b>ECOLOGY AND BIODIVERSITY:</b> Ecosystem – abiotic and biotic components. Energy flow in an ecosystem Deforestation- Chipko movement –Forest Conservation act- Pollution Eutrophication, Global warming ,Ozone depletion, Climate change. Biodiversity and types- Hot spots, Mega diversity countries, Conservation methods. Endangered plants and Red data Book. Rio -Earth summit. Biodiversity Policies - IUCN, UNEP, WWF, ICSU, WCMC.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations CSIR/GATE/TNPSC/other 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 Transferable Skill
<b>Recommended Texts</b>	1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, CSIR - NET, ICAR-NET and Other Competitive Exams.) Anand 2. Mitra, S. 2016. Botany for competitive examinations, Anand 3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Edition 4. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Delhi. 5. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The Taxonomy: Nair Datta 6. Thieman. 2014. Introduction to Biotechnology 3rd Edition India.
<b>Reference Books</b>	1. De Robertis and De Robertis. 1990. Cell and Molecular Biology College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Wiley Sons Inc., 8 <sup>th</sup> Edn., New York. 3. Salisbury, F. B.C.W. Ross. 1991. Plant Physiology. Washington 4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publications 5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup New Delhi. 6. Power, C.B and Dagainawa, H.F. 2010. General Botany Publishing House Pvt Ltd, 7. Rangasamy, G. 2006. Disease of crop plants in India (4th Edition) Hill New Delhi. 8. Singh, V., Pande, P. C. and Jain, D.K. A Text Book of Botany. Rastogi Publications, Meerut. 9. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2009. Botany Angiosperms (6th revised and enlarged edition). Vikas Delhi.
<b>Web resources</b>	1. <a href="https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-MITRA/dp/9383420898">https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-MITRA/dp/9383420898</a> 2. <a href="https://www.amazon.in/Botany-Competitive-Examinations-Competitive/dp/B08VWB64BC">https://www.amazon.in/Botany-Competitive-Examinations-Competitive/dp/B08VWB64BC</a> 3. <a href="https://www.ssclatestnews.com/botany-book-pdf-free-download-exams/">https://www.ssclatestnews.com/botany-book-pdf-free-download-exams/</a>

	4. <a href="https://sscstudy.com/botany-for-competitive-exams-pd">https://sscstudy.com/botany-for-competitive-exams-pd</a> 5. <a href="https://www.amazon.in/Botany-Entrance-Examination-ebook/dp/B089S1GLMP">https://www.amazon.in/Botany-Entrance-Examination-ebook/dp/B089S1GLMP</a>
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**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	1	2	3	1
<b>CO2</b>	3	2	1	2	3	3	2	3	2	1
<b>CO3</b>	2	2	3	3	1	2	1	3	2	3
<b>CO4</b>	3	3	3	3	3	2	3	3	3	3
<b>CO5</b>	3	3	2	3	2	1	3	3	3	2

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

## BOTANY FOR ADVANCED STUDIES (4 hours)

<b>Title of the Course</b>	<b>BOTANY FOR ADVANCED STUDIES</b>				
<b>Paper Number</b>	Skill Enhancement				
<b>Category</b>	Elective	<b>Year</b>	III	<b>Credits</b>	2
		<b>Semester</b>	VI		
<b>Instructional Hours per week</b>		<b>Lecture</b>		<b>Tutorial</b>	<b>Lab Practice</b>
		4		-	-
<b>Pre-requisite</b>		To develop the botany students for preparing advanced st			
<b>Learning Objectives</b>					
<b>C1</b>	To be familiar with the basic concepts and principles of plant system				
<b>C2</b>	Learn the importance of plant anatomy in plant production systems.				
<b>C3</b>	To expose the students a fundamental of the various techniques used				
<b>C4</b>	To learn about the physiological processes that underlie plant metabo				
<b>C5</b>	To know the energy production and its utilization in plants.				
<b>Course outcomes:</b>		<b>Programme Outcomes</b>			
On completion of this course, the students will be able to: CO					
1. Understand of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data		K1,K2 &K5			
2. Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth.		K1,K3&K5			
3. Understand the organization of nuclear genome		K3&K5			
4. Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.		K2,K3 &K5			
5. Gain awareness about the various processes involved in the energy production in plants and metabolic pathways.		K1,K5 &K6			
<b>UNIT</b>	<b>CONTENTS</b>				
	<b>MOLECULAR GENETICS</b>				
	(i) Molecular Biology of gene expression: Brief overview of t Teminism. Transcription in prokaryotes and eukaryotes. Type polymerase, Different types of RNA, Regulatory sequences a involved. Mechanism: Initiation, elongation and termination splicing in eukaryotes. Translation in prokaryotes and eukar exceptions, tRNA-suppressor mutations. Mechanism of trans				

<p style="text-align: center;"><b>I</b></p>	<p>elongation and termination, proteins involved, factors affecting</p> <p>Molecular mechanism of mutation, cancer biology, human cytochrome P-450</p> <p>(ii) Molecular mechanism of Gene Regulation: Regulation in prokaryotes and eukaryotes, Epigenetic mechanisms: methylation and transposons, gene silencing through RNA interference, genome imprinting, X-chromosome inactivation, cosuppression through transcriptional silencing, genome imprinting, alternative splicing, RNA stability, RNA interference. Transcription factor activation, amplification, mating type interconversion.</p> <p>Genomics: Structural genomics, Genetic and physical mapping ( RFLP, FISH, cytogenetic maps, physical maps, positional cloning, chromosome walking, DNA sequencing, genome databases, human genome sequencing project, transcriptome, proteome and metabolome, Microarrays and gene-chips. Functional and evolutionary relationships prokaryotes, organelles and nuclear genes and paralogues. Metabolomics: Identification and quantification of metabolites in biological samples. Pharmacogenomics and drug designing.</p>
<p style="text-align: center;"><b>II</b></p>	<p><b>ADVANCED TRENDS IN SYSTEMATICS</b></p> <p>(i) <b>Basic concepts of:</b></p> <p>a. Morphology - History, general morphology, types of data, methods of gathering data;</p> <p>b. Anatomy - History, general anatomy, types of data, methods of gathering data;</p> <p>c. Embryology – History, types of data, methods of gathering data;</p> <p>d. Palynology: History, general palynological characters, types of data, methods of gathering data;</p> <p>e. Cytology and Cytogenetics: History, general cytological and cytogenetic characters, types of data, methods of gathering data;</p> <p>f. Ecology, History, general ecology, types of data, methods of gathering data;</p> <p>(At least two examples from each section should be studied to substantiate their significance)</p> <p>(ii) <b>Chemotaxonomy:</b></p> <p>a. History, general chemical and chemotaxonomic characters, types of data, methods of gathering data.</p> <p>b. Identification of the major classes of the pharmaceutically important secondary metabolites from natural sources 8 (phenolics, steroids, terpenoids glycosides and alkaloids)</p> <p>c. Applications: Phytochemicals in cosmetics, aromatherapy, disease prevention and treatment in the production of phytochemicals. Phytochemical databases</p> <p>(iii) Molecular trends in Biosystematics</p> <p>a. Molecules and genomes in plant systematics, techniques used in molecular systematics in crop evolution</p> <p>b. Serology in relation to plant taxonomy- Methods, role of serology in plant taxonomy</p> <p>c. Cladistics and Phenetics (iv) Molecular trends in Reproductive Biology</p> <p>Types, cytogenetic basis and induction of apomixes, applications.</p> <p>(i) Biochemistry and genetics of incompatibility, methods to overcome incompatibility, viability tests, molecular basis of incompatibility</p> <p>(ii) Sterility – Male sterility, CMS, GMS, CGMS, temperature sensitive sterility, transgenic male sterility, female sterility and zygotic sterility</p>
	<p><b>PLANT PHYSIOLOGY</b></p> <p>(i) Modern concepts Photosynthesis – Environmental and agricultural aspects – Biochemical control of respiration</p> <p>(ii) Photomorphogenesis Phytochrome genes and their expression</p>

<p style="text-align: center;"><b>III</b></p>	<p>morphogenic responses. Dose-response relations in photomorphogenesis, chloroplast differentiation, effect of photoreceptors.</p> <p>(iii) Biological clock: Circadian rhythms, rhythm responses to environment</p> <p>(iv) Photoperiodism General principles , florigen concept</p> <p>(v) Plant growth and development Patterns of growth and differentiation and mutations regulating meristem function, embryogenesis, flower development. Homeotic genes, ABCD model in Arabidopsis, control of plant tissue development, effect of auxins on root growth, gibberellin promoted growth of plants, ethylene and tripartite interaction, brassinosteroids and photomorphogenesis.</p>
<p style="text-align: center;"><b>IV</b></p>	<p><b>PLANT PHYSIOLOGY</b></p> <p>(i) Enzymes: General account: Importance and properties of enzymes in biological sciences, the classification and nomenclature of enzymes. Mechanism of enzyme action role of enzyme in chemical action, variation of enzyme activity. Molecular genetics in plant physiology, Environmental Stress physiology .</p>
<p style="text-align: center;"><b>V</b></p>	<p><b>ECONOMIC BOTANY</b></p> <p>Economic importance of Cereals, Tuber Crops, Fibre yielding plants, Oil yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Fruits</p>
<p>Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)</p>	<p>Questions related to the above topics, from various competitive examinations like CSIR/GATE/TNPSC/other to be solved (To be discussed during the Tutorial hour)</p>
<p>Skills acquired from this course</p>	<p>Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferable Skill</p>
<p><b>Recommended Texts</b></p>	<ol style="list-style-type: none"> <li>1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition). The McGraw-Hill Education, New Delhi.</li> <li>2. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Plant Morphologists, New Delhi.</li> <li>3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publications, New Delhi.</li> <li>4. Jain, V.K. 2017. Plant Physiology, S.Chand &amp; Company Limited, New Delhi.</li> <li>5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 2011. Plant Physiology. Sinauer Associates Inc., US.</li> <li>6. Becker, W.M., Kleinsmith L.J. &amp; Hardin J. 2005. The Principles of Plant Physiology (6th edition). Benjamin/Cummings Pub. Co. New York.</li> <li>7. Brooker, R. J. 1999. Genetics Analysis and Principles. Addison Wesley Longman Inc., New York.</li> <li>8. Bruce, A. et. al. 2002. Molecular Biology of the Cell. Garland Science, New York.</li> </ol>
<p><b>Reference books</b></p>	<ol style="list-style-type: none"> <li>1. Mabberley, J.D. 2014. Mabberley's Plant-Book: A portable field guide to their classification and uses, 3rd ed. Cambridge University Press, 1021pp.</li> <li>2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, New Delhi.</li> <li>3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the evolution of angiosperms. Springer Science &amp; Business Media, Germany.</li> <li>4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant Anatomy: A Practical Approach. Blackwell Publishing, Malden, USA.</li> </ol>

	<ol style="list-style-type: none"> <li>5. Steward, F.C. 2012. Plant Physiology Academic Press, U.S.A.</li> <li>6. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology John Wiley &amp; Sons. U.S.A.</li> <li>7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology India, New Delhi.</li> <li>8. Anthony J . F. G .2000. An Introduction to Genetic Analysis New York.</li> <li>9. Hartl, .D.L &amp; Jones E. W. 2000. Genetic analysis of Genes Bartlett Pub, Boston.</li> <li>10. Klug .S.W. &amp; Cummings, M.R. 2003. Concepts of Genetics Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA American Society for Cell Biology, New York.</li> <li>11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman</li> <li>12. Russell, P.J. 2005. Genetics: A Molecular Approach Pearson/Benjamin Cumming, San Francisco.</li> <li>13. Snustad, D. P. &amp; Simmons M.J. 2003.Principles of Genetics Inc. U.S.A.</li> <li>14. Mabberley, J.D. 2014. Mabberley's Plant-Book: A portable their classification and uses, 3rd ed. Cambridge University 1021pp.</li> <li>15. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, India.</li> <li>16. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the angiosperms. Springer Science &amp; Business Media, Germany.</li> <li>17. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant A Approach. Blackwell Publishing, Malden, USA.</li> <li>18. Steward, F.C. 2012. Plant Physiology Academic Press, U.S.A.</li> <li>19. Hopkins, W.G and Huner, N.P. 2009. Introduction to Plant Physiology John Wiley &amp; Sons. U.S.A.</li> <li>20. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology India, New Delhi.</li> <li>21. Anthony J . F. G .2000. An Introduction to Genetic Analysis New York.</li> <li>22. Hartl, .D.L &amp; Jones E. W. 2000. Genetic analysis of Genes Bartlett Pub, Boston.</li> <li>23. Klug .S.W. &amp; Cummings, M.R. 2003. Concepts of Genetics Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant DNA American Society for Cell Biology, New York.</li> <li>24. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Freeman</li> <li>25. Russell, P.J. 2005. Genetics: A Molecular Approach Pearson/Benjamin Cumming, San Francisco.</li> <li>26. Snustad, D. P. &amp; Simmons M.J. 2003.Principles of Genetics Inc. U.S.A.</li> </ol>
<b>Web resources</b>	<ol style="list-style-type: none"> <li>1. <a href="http://www.ornl.gov">http:// www.ornl.gov</a>.</li> <li>2. <a href="http://ash.gene.ncl.ac.uk">http:// ash.gene.ncl.ac.uk</a>.</li> <li>3. <a href="http://tor.cshl.org">http://tor.cshl.org</a>. <a href="http://www.gdb.org">http://www.gdb.org</a>.</li> <li>4. <a href="http://www.neg.r.org">http://www.neg.r.org</a>.</li> <li>5. <a href="http://www.genetics.wustl.edu">http:// www.genetics.wustl.edu</a>.</li> <li>6. <a href="http://genome.imb-jena.de">http:// genome.imb-jena.de</a>.</li> </ol>

**MappingwithProgrammeOutcomes:**

<b>COs</b>	<b>PO1</b>	<b>PO2</b>	<b>PO3</b>	<b>PO4</b>	<b>PO5</b>	<b>PSO1</b>	<b>PSO2</b>	<b>PSO3</b>	<b>PSO4</b>	<b>PSO5</b>
<b>CO1</b>	3	3	1	3	2	1	2	2	1	2
<b>CO2</b>	3	3	2	2	3	3	2	3	3	2
<b>CO3</b>	2	2	3	2	1	2	1	3	2	1
<b>CO4</b>	3	3	3	3	3	2	3	3	2	3
<b>CO5</b>	3	3	2	3	2	2	2	2	2	2

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

## FOUNDATION COURSE FOR BOTANY

### BASICS OF BOTANY

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

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

UNIT	CONTENTS
I	<u>BIODIVERSITY</u> <u>Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.</u>
II	<u>CELL BIOLOGY</u> <u>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.</u>
III	<u>PLANT MORPHOLOGY</u> <u>Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.</u>
IV	<u>GENETICS</u> <u>Concept of Heredity and Variation - Mendel's Laws of Inheritance.</u>
V	<u>PLANT PHYSIOLOGY</u> <u>Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition - Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition</u>

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/other 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 Transferable Skill

<b>Recommended Texts</b>	<ol style="list-style-type: none"> <li>1. Singh, V., Pande, P.C. and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.</li> <li>2. Bhatnagar, S.P. and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.</li> <li>3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.</li> <li>4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.</li> <li>5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi.</li> <li>6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.</li> </ol>
<b>Reference books</b>	<ol style="list-style-type: none"> <li>1. Parihar, N.S. 2012. An introduction to Embryophyta – Pteridophytes - Surjeet Publications, Delhi.</li> <li>2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.</li> <li>3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand &amp; Company Ltd, Delhi.</li> <li>4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.</li> <li>6. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand &amp; Company Ltd, Delhi.</li> <li>7. Parihar, N.S. 2013. An introduction to Embryophyta – Bryophytes -, Surjeet Publications, Delhi.</li> </ol>
<b>Web Resources</b>	<ol style="list-style-type: none"> <li>1. <a href="https://www.kobo.com/us/en/ebook/the-algae-world">https://www.kobo.com/us/en/ebook/the-algae-world</a></li> <li>2. <a href="http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html">http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html</a></li> <li>3. <a href="http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm">http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm</a></li> <li>4. <a href="https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/">https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/</a></li> <li>5. <a href="https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf">https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf</a></li> <li>6. <a href="https://www.us.elsevierhealth.com/medicine/cell-biology">https://www.us.elsevierhealth.com/medicine/cell-biology</a></li> <li>7. <a href="https://www.us.elsevierhealth.com/medicine/genetics">https://www.us.elsevierhealth.com/medicine/genetics</a></li> <li>8. <a href="https://www.kobo.com/us/en/ebook/plant-biotechnology-1">https://www.kobo.com/us/en/ebook/plant-biotechnology-1</a></li> </ol>

### Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
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