Placed at the meeting of
Academic Council
held on 15.11.2023

APPENDIX – AJ
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 PROGRAME:

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 syndicated, 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 PROGRAME:

After the compilation 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 bought 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 Course – CC X	4	6.2 Core Course – CC XIV	4
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 / Discipline Specific	3	6.5 Elective VIII Generic/ Discipline Specific	3
1.6 Skill Enhancement Course SEC-1	2	2.6 Skill Enhancement Course SEC-2	2	3.6 Skill Enhancement Course SEC-4, (Entrepreneurial Skill)	1	4.6 Skill Enhancement Course SEC-6	2	5.5 Elective VI Generic / Discipline Specific	3	6.6 Extension Activity	1
		2.7 Skill	2	3.7 Skill	2	4.7 Skill	2	5.6	2	6.7	2

		Enhancement Course –SEC-3		Enhancement Course SEC-5		Enhancement Course SEC-7		Value Education		Professional Competency Skill	
1.7Ability Enhancement Compulsory Course (AECC) Soft Skill-1	2	2.8 Ability Enhancement Compulsory Course (AECC) Soft Skill-2	2	3.7 Ability Enhancement Compulsory Course (AECC) Soft Skill-3	2	4.7 7Ability Enhancement Compulsory Course (AECC) Soft Skill-4	2	5.5 Summer Internship /Industrial Training	2		
1.8 Skill Enhancement - (Foundation Course)	2			3.8 E.V.S	-	4.8 E.V.S	2				
	23		**23**		**22**		**25**		**26**		**21**
	Total Credit Points										**140**

CBCS - COURSE PATTERN

AND SYLLABUS

UG - BOTANY

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

SEMESTER II	NAME OF THE COURSE	Hours Per/ Week (Lecture/Tutorial	CREDIT
Part IPart II	Part -I - Language –Tamil Paper I	6	3
	Part - II - English– Paper II	*4	3
Part III Core III	Part - III - Core - Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	4 (3+1)	4
Core IV	Plant Diversity II - Fungi, Bacteria, Viruses, pathology and Lichens –	4 (3+1)	3

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

Ability Enhancement Compulsory CourseAECC	Soft Skill 3	2	2
Part IV	Environmental studies	1	-
Total		**30**	**21**

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

Electivecourse 5	1. Bio-Analytical Techniques 2. Aquatic Botany 3. Entrepreneurial Botany		
Elective Course 6	EC6	5 (4+1)	3
Project	Project with Viva-voce	4	2
Part IV	Value Education	1	1
Part V	Extension activity	-	1
	Total	**30**	**30**
SEMESTER VI	**NAME OF THE COURSE**	**Hours Per/ Week (Lecture/Tutorial**	**CREDIT**
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 **Practical Exam (Core X & XVII)**	6	3
ElectiveCourse	**EC 7** 1. Horticulture 2. Natural Resource Management 3. Forestry	5 (4+1)	3
ElectiveCourse	**EC 8** 1. Bionanotechnology 2. Computer application in Botany 3. Forensic Botany	5 (4+1)	2
Skill Enhancement Courses Professional Competency Enhancement	**SEC 8** 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
Part IV	Value Education	1	1
	Total	**30**	**23**
	TOTAL CREDITS	**----**	**140**

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

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(10x1=10)

SECTION – A

QUESTION No. 1 to 10 (Multiple choice)

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 npaper 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
2. http://www.fs.fed.us/wildflowers/ethnobotany/medicinal/index.shtml
3. 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
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

TitleoftheCourse		**PLANT DIVERSITY I ALGAE**					
PaperNumber		**COREI**					
Category	Core	**Year**	I	**Credits**	4	**Course Code**	
		Semester	I				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	2	--	5
Pre-requisite	Students should be familiar with the basics of different classes of algae.			
Learning Objectives				
C1	To provide a comprehensive knowledge on the biology of algae.			
C2	To provide a basis for better understanding of the evolution higher of plants.			
C3	To understand reproductive biology, ecology of plants by studying the simpler systems in algae.			
C4	To understand the role of algae in ecosystems as primary producers of nutrition.			
C5	To understand importance of algae to animals and humans.			
Course outcomes	On completion of this course, students will;			
CO1	Relate to the structural organization, reproduction and significance of algae.			K1
CO2	Demonstrate knowledge inunderstanding thevarious life cycle patterns and the fundamental concepts in algal growth			K2
CO3	Explain the benefits of various algal technologies on the ecosystem.			K3
CO4	Compare and contrast the thallus organization and modes of reproduction in algae.			K4
CO5	Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.			K5
UNIT	**CONTENTS**			
I	Classification (Fritsch-1935-1945), criteria for classification, algal distribution.			
II	Thallus organization (unicellular-*Chlorella*, Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum*, *Gracilaria*).			
III	Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*) (Examples may be changed according to the availability of the specimens).			
IV	Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.			
V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.			
Extended Professional	Questions related to the above topics,from various competitive			

Component (is a part ofinternal component only, Not to be included in the External Examination Question paper)	examinations UPSC/TRB/NET/UGC–CSIR /GATE/TNPSC /others to besolved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability,Professional Competency,Professional Communication and Transferrable Skill

Recommended Texts:

1	Dehradun. Edwardlee,R. 2018. Phycology,5th Ed.,Cambridge University Press, London.
2	Kumar,H.D.1999. IntroductoryPhycology. Affiliated East-WestPress, Delhi
3	Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4	Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
5	Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London.

References Books:

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

Web Resources:

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

7	https://www.kobo.com/in/en/ebook/algae-biotechnology
8	https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	2	`1	3	3
CO3	2	2	1	1	2	2	1	3	2	2
CO4	3	3	3	3	3	2	3	3	3	2
CO5	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

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

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	2	-	3	5

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

Learning Objectives	
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.
C2	To identify microalgae in a mixture.
C3	To develop skills to prepare the microslides of algae.
C4	To study the economic importance of few species.
C5	To understand importance of algae to animals and humans

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

EXPERIMENTS

1. Micro-preparation of the types prescribed in the syllabus.
2. Identifying the micro slides relevant to the syllabus.
3. Identifying types of algal mixture.
4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth.
5. Field visit to study fresh water/marine water algal habitats.
6. Visit to nearby industry actively engaged in algal technology.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination	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 theTutorial hour)

Question paper)	
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Kumar, H.D.1999. IntroductoryPhycology.Affiliated East-WestPress, Delhi. 2. Bendre, M.Ashok and Ashok Kumar, A. 2020.Text Book of Practical Botany-1(10th ed).Rastogi Publications, Meerut. 3. Round, FE. 1984. The Ecology of Algae. Cambridge University Press. 4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1. 5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
ReferenceBooks:	1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying 2. Manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London. 4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York. 5. Dehradun. Edwardlee, R.2018. Phycology, 5th Ed., Cambridge University Press, London.
Web resources:	1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ 5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

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

CO4	3	3	3	3	3	2	3	3	3	2
CO5	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

Title of the Course	**PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**							
Paper Number	CORE III							
Category	Core III	**Year**	I	**Credits**	4	**CourseCode**		
		Semester	II					
Instructional Hours Per week	**Lecture**		**Tutorial**		**LabPractice**		**Total**	
	3		2		--		5	
Pre-requisite	Students should be familiar with the basics of fungi, bacteria, viruses and lichens.							
Learning Objectives								
C1	To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.							
C2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles							

C3	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.
C4	To identify the main groups of plant pathogens, their symptoms.
C5	To understand the various types of plant diseases.
Course outcomes:On completion of this course, the students will be able to: **CO**	Programme outcomes
1. Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
2. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural 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	**FUNGI** Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (*Pilobolus*, *Mucor*, *Rhizopus*), Ascomycotina (*Aspergillus*, *Saccharomyces Peziza*), Basidiomycotina (*Agaricus, Pleurotus*, *Puccinia*) and Deuteromycotina (*Cercospora, Alternaria*). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association.
II	**ECONOMIC IMPORTANCE OF FUNGI:** Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins
III	**BACTERIA, VIRUS:** Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.

IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses. **Bacterial diseases** – Citrus canker and Bacterial wilt of Banana **Viral diseases** – Tobacco Mosaic and Vein clearing of Papaya **Fungal diseases** – Blast disease in rice and Tikka disease
V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*. **Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability,Professional Competency,Professional Communication and Transferrable Skill
Recommended Texts	1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology. 2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi. 3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India. 7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore. 2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge. 3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill

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

MappingwithProgrammeOutcomes:

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

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

CORE-IV

PLANT DIVERSITY II

FUNGI, BACTERIA, VIRUSES, PATHOLOGY AND LICHENS - PRACTICAL-II

Title of the Course	**PLANT DIVERSITY** – I: **FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS –Practical II**						
Paper Number	CORE IV						
Category	Core	**Year**	I	**Credits**	3	**Course Code**	
		Semester	II				
InstructionalHours perweek		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	-		3	5	
Pre-requisite	Students should be familiar with the basics of fungi and lichens.						
Learning Objectives							
C1	To enable students to identify microscopic and macroscopic fungi.						
C2	To prepare microslides of fungi and lichens.						
C3	To know the presence of pathogen inside the						

	plant tissues through microscopic sections.
C4	To identify the bryophytes based on the morphology, and microslides.
C5	To know the economic importance of the microbes studied.
Course outcomes On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Identify microbes, fungi and lichens using key identifying characters	K1
2. Develop Practical skills for culturing and cultivation of fungi.	K2
3. Identify and select suitable control measures for the common plant diseases.	K3
4. Analyze the characteristics of microbes, fungi and plant pathogens	K4
5. Access the useful role of fungi in agriculture and pharmaceutical industry.	K5

EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides.
2. Identifying the micro slides relevant to the syllabus.
3. Herbarium specimens of bacterial diseases/photograph.
3. Protocol for mushroom cultivation.
4. Inoculation techniques for fungal culture (Demonstration only).
5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
7. Visit to fungal biotechnology laboratories.
8. Ultrasturcture 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 andKrayesky,D. 2013.General Botany laboratory Manual.AuthorHouse, Bloomington, USA.
2. Das,Sand Saha,R.2020.MicrobiologyPracticalManual.CBSPublishersandDistributors (P) Ltd., New Delhi, India.
3. Webster,Jand Weber,R.2007.IntroductiontoFungi,3rdEd.CambridgeUniversityPress, 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.

ReferenceBooks:

1. Alexopoulos, JandMims, W. 1985. IntroductoryMycology, WileyEastern LimitedNewDelhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany1 (10th ed). Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.

Web resources:

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

Mapping with Programme Outcomes:

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

Title of the Course	**PLANT DIVERSITY-III BRYOPHYTES AND PTERIDOPHYT**					
Paper Number	CORE V					
Category	Core	**Year**	II	**Credits**	4	**CourseCode**
		Semester	III			

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**T**
	3	2	-	5
Pre-requisite	Students should be familiar with the basics of Bryophytes and			

Learning Objectives	
C1	To enable the students to have an overview of Non-vascular and Vascular cr
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.
C3	To know the evolution of Bryophytes and Pteridophytes.
C4	To understand the economic importance of the Bryophytes and Pteridophytes
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Recognize morphological variations of Bryophytes and Pteridophytes.	K1
2. Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2
3. Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and 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

UNIT	**EXPERIMENTS**
I	**BRYOPHYTES** General characters of Bryophytes, classification (Watson, 1971) (up to f importance of Bryophytes – Ecological importance (Pollution indicators Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a Hepaticopsida (*Riccia*/*Marchantia*); Anthocerotopsida (*Anthoceros*) (*Funaria*/*Polytrichum*). (Examples may be changed according to the a specimens). Evolution of Bryophytes
III	**PTERIDOPHYTES**

	General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy homospory and heterospory.
IV	Morphology, anatomy and reproduction of reproduction of the taxa belongi following classes: Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium/Selagine* (*Equisetum*), Pteropsida (*Adiantum*/*Marsilea*). (Examples may be changed availability of the specimens).
V	Origin and evolution of Pteridophytes. Stelar Evolution. Economic importance
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/ CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta, MacMillanIndiaLtd.Delhi. 2. Alam, A. 2020. Contemporary Research on Bryophytes Book Series: R Botanical Science. 10.2174/97898114337881200101. 3. Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cam Press. 4. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P India. 5. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. A Lucknow, India.
Reference Books	1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Che 2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodop depot, Allahabad. 3. Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chen 4. Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publica 5. Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & 6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad. 7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes.Cen Allahabad.
Web Resources:	1. http://www.bryoecol.mtu.edu/ 2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx 5. http://www.botany.ubc.ca/bryophyte/mossintro.html 6. aeTIUC&redir_esc=y

MappingwithProgrammeOutcomes:

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
CO4	3	3	3	3	3	2	3	3	2	3
CO5	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

Title of the Course	**PLANT DIVERSITY III BRYOPHYTES AND PTERIDOPHYTES - PRACTICAL-III**						
Paper Number	CORE VI						
Category	Core	**Year**	II	**Credits**	3	**Course Code**	
		Semester	III				

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	2	-	3	5

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

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

EXPERIMENTS

Bryophytes

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

Pteridophytes

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

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthiscourse	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta,MacMillanIndia Ltd,NewDelhi. 2. Sharma,O.P.2012. Pteridophyta,Tata McGraw-Hills Ltd,NewDelhi. 3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany,

	Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication. 4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India. 5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.
ReferenceBooks	1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication. 2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual forBryophytes and Pteridophytes. Lambert Academic Publishing. 3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi. 4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai. 5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.
Web resources	1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4 2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html 4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual 5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

MappingwithProgrammeOutcomes:

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

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION**						
Paper Number	CORE VII						
Category	Core	**Year**	II	**Credits**	4	**Course Code**	
		Semester	IV				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		3	2		-	5	
Pre-requisite	Studentsshouldknowaboutthefundamentsof Gymnosperms, fossil records and evolution.						
Learning Objectives							
C1	To enable the students to understand thallus organization,						
C2	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.						
C3	to acquaint students with evidences of the past history of plant groups and significance of the fossilization.						
C4	To know the scope of pleobotany, types of fossils and geological time scale.						
C5	Understand the various fossil genera representing different fossil groups.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
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 the anatomy and reproduction Gymnosperms along with their ecologicaland economical importance.	K4
5. Determine the various fossilization methods and their significance in paleobotany.	K5

UNIT	CONTENTS
I	**GYMNOSPERMS** Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.
II	**GYMNOSPERMS** Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (*Cycas*), Coniferales (*Pinus*). Gnetales (*Gnetum*).
III	**PALEOBOTANY** Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni
IV	P**ALEOBOTANY** Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	**EVOLUTION** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

in theExternalExamination questionpaper)	
Skillsacquired fromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra. 2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi. 3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India. 4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Reference Books	1. Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi. 2. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi. 3. Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press. 4. Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Web Resources	1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false 2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y 3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC 4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 5. https://www.palaeontologyonline.com/

MappingwithProgrammeOutcomes:

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
CO4	3	3	3	3	3	2	3	3	3	3
CO5	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

Title of the Course	**PLANT DIVERSITY IV GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV**						
Paper Number	CORE VIII						
Category	Core	**Year**	II	**Credits**	3	**Course Code**	
		Semester	IV				
Instructional Hours		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
Per week		2	-	3	5		
Pre-requisite		Studentsshould be familiar withthefundamentalsofGymnosperms, Paleobotany.					
Learning Objectives							
C1	To enable students observe and record the morphological features of selected species of Gymnosperms.						
C2	To enable students observe and record the anatomical features of selected species of Gymnosperms.						
C3	To develop the skill of preparation of microslides of the gymnosperm samples.						
C4	To enable students to gain insights into the basics of paleobotany and methods of fossilization.						
C5	To understand the anatomy of the fossil plants through microscopy.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
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

EXPERIMENTS

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

2. Identifying the micro slides relevant to the syllabus.

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

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

2. Photograph of evolution scientists.

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfrom this course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. SharmaO.P and S, Dixit.2002.Gymnosperms.PragatiPrakashan. 2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
ReferenceBooks	1. Smith, G.M. 1955. CryptogamicBotanyVol.II.TataMcGrawHill. NewDelhi.

	2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford,SG137BX, United Kingdom. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.
Web resources	1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover 2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721 3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ 4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

MappingwithProgrammeOutcomes:

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

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY**						
Paper Number	CORE IX						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		3	-	2	5		
Pre-requisite		Prior knowledge on morphological, anatomical characteristics and uses of plants.					

Learning Objectives	
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
C2	Students will know about the basic concepts of classification of plants.
C3	Understand major evolutionary trends in Angiospermic plants.
C4	To know the characteristic features of the selected families.
C5	To know the economic importance of plants.
Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
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	K3

concepts of 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

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

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB /NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London. 4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Weslley Publicating Co. Ind USA. 5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. 6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey. 7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
Reference Books	1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London. 2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta 3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh. 4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York. 5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London. 6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA. 7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition).

	McGraw-HilI Book Co., New York.
Web Resources	1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=_px_WAwHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFnUC&redir_esc=y 3. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y 4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y 5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

MappingwithProgrammeOutcomes:

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

Title of the Course	**PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY-PRACTICAL-V**						
Paper Number	CORE X						
Category	Core	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		2	-	3	5		
Pre-requisite		Theoretical understanding of plant taxonomy as well as basic laboratory skills for the relevant core course.					

Learning Objectives	
C1	To study morphological characters of the families.
C2	Able to describe the plant technically using the floral characteristics.
C3	To preserve the plants and prepare herbarium sheets.
C4	To be able to identify the local flora.
C5	To understand the economic importance of the plants.
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the distinguishing plant morphological characters.	K1
2. Identify locally available plants to their respective families.	K2
3. Develop comprehensive skills in field identification, collection of specimens, 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.

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi. 2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of

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

MappingwithProgrammeOutcomes:

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

Title of the Course	**PLANT ANATOMY AND EMBRYOLOGY**						
Paper Number	CORE XI						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		3	2		-	5	
Pre-requisite		To acquire knowledge on the anatomical structure and reproductive phase of angiosperms.					
Learning Objectives							
C1	To know fundamental concepts of plant anatomy and embryology.						
C2	To understandthe internal tissue organization of various plant organs.						
C3	To differentiate normal and abnormal secondary growth.						
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.						
C5	To know embryology of plants.						
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**						
1. Relate to the fundamental concepts of plant anatomy and embryology.	K1						
2. Describe the internal tissue organization of various plant organs.	K2						
3. Elucidate the stages of normal and abnormal 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
UNIT	**CONTENTS**
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in oot and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- *Boerhaavia*, *Nyctanthes* and *Dracaena*. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.
IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule**,** types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (*Polygonum* type); Organization and ultra structure of mature embryo sac.
V	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

questionpaper)	
Skillsacquired fromthiscourse	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas. 2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge. 4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York. 5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi. 6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi. 7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi. 8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.
Reference Books	1. Esau, K. 1985. Anatomy of Seed Plants –John Willey. 2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co.. 3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd., 4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd. 5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA. 6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA. 7. Mauseth, J.D. 1988. Plant Anatomy. The Benjammin/Cummings Publisher, USA. 8. 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. 9. Swamy, B.G.L and Krishnamurthy,K.V.1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi
Web Resources	1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2 2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.worldcat.org/title/embryology-of-

	angiosperms/oclc/742342811 6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y.

MappingwithProgrammeOutcomes:

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

Title of the Course	**CELL BIOLOGY, GENETICS AND PLANT BREEDING**						
Paper Number	CORE XII						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	V				
InstructionalHours perweek		**Lecture**		**Tutorial**		**LabPractice**	**Total**
		3		2		-	5
Pre-requisite	To acquire knowledge on cell and expose the students a fundamental of the various techniques used in plant breeding.						

Learning Objectives	
C1	To enable students to gain insights into cell wall organization and its functions.
C2	To familiarize with various cell organelles and their functions.
C3	To gain knowledge in classical genetics.
C4	To know about sexlinked inheritance.
C5	To have knowledge about plantbreeding techniques for crop improvement.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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
UNIT	**CONTENTS**
I	Introduction- scope- cell organisation- Ultra structure of Prokaryotic cell and Eukaryotic cell. Plant cell structure and function. Cell boundaries- cell wall- gross layer i.e. middle lamella, primary wall, secondary wall- Structure, chemistry and functions of cell wall, pits- (simple and bordered), Plasmodesmata. Plasma membrane- occurrence, structure (fluid mosaic model) chemistry, function and origin. Properties of Cytoplasm Membrane transport – Passive, active and facilitated transport, endocytosis and exocytosis.
II	Occurrence, structure, function and origin of Endoplasmic reticulum, Golgi apparatus, Lysosomes, Ribosomes, Mitochondria, Chloroplast and Micro bodies. Semi genetic autonomy of Mitochondria and Chloroplast. Ultrastructure and functions of Nucleus, nuclear envelope, nuclear pore complex, nucleolus, chromosomes structure molecular organization of chromatin, Euchromatin, heterochromatin, Polytene and Lampbrush chromosomes-, Centromere: types. cell inclusion. Cell cycle, Cell division, Mitosis and Meiosis- their significance.
III	Mendeliangenetics–monohybrid,dihybridcrosses.LawsofMendel,Reciprocal cross - Back cross and Test cross. Incomplete dominance - *Mirabilisjalaba*.Interactionoffactors– Complementarygenes,Supplementarygenes,inhibitorygenes,epistasis (dominant and recessive),duplicategenes and multiple alleles. Multiple alleles. ABO Blood grouping in Human. Chromosome theory oflinkage, crossingover, recombinationsandmapping of genesonchromosomes.Sex determinationinplants.
IV	Sexlinkedinheritance– Haemophiliaandcolourblindness.Polyploidyorigin,typesandsignificance.Mutation-typesandsignificance.chromosomalaberration– addition,deletion,inversion,duplication andtranslocation . Extranuclearinheritanceanditssignificance- Malesterilityincorn,Maternalinheritance– PlastidInheritancein*Mirabilisjalaba*.Geneticsof*Neurospora*.Populationgeneti

	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.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Verma, P.S and V.K. Agarwal. 2002. Cytology. S. Chand & Co. Ltd., New Delhi-55. 2. Sinnott, EW., Dunn, L.L and Dobzhansky, T. 1997. Principles of Genetics, Tata Mc Graw Hill Publishing Co. New Delhi. 3. Cohn.N.S.1979, Elements of Cytology, Freeman Book Co. 4. Singh, R. J. 2016. Plant Cytogenetics, 3rd Edition. CRC Press, Boca Raton, Florida, USA. 5. Singh, R.J. 2017. Practical Mannual on Plant Cytogenetics. CRC Press, Boca Raton, Florida, USA.
Reference Books	1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8th Edn., New York. 3. Hackett, P.B., Fuchs, J.A and Messing, J.W. 1988. An Introduction to Recombinant. DNA Techniques: Basic Experiments in Gene Manipulation. The Benjamin/Cummings Publishing Co. Inc., Menlo Park, California. 4. Cooper, G.M and Hausman, R.E. 2009. The Cell: A Molecular Approach. 5th edition. ASM Press & Sunderland, Washington, D.C. Sinauer Associates, MA. 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. 6. Klug, W.S., Cummings, M.R., Spencer, C.A. 2009. Concepts of Genetics. 9th edition. Benjamin Cummings, U.S.A. 7. Lewin. 2007. Gene IX. Jones and Barlett Pub. ISBN. O 7637 52223. 8. Strickberger, M.W. 1999.Genetics.Prentice Hall of India Pvt Ltd, New Delhi.
Web Resources	1. http://www.freebookcentre.net/Biology/Cell-Biology-Books.html 2. https://www.us.elsevierhealth.com/medicine/cell-biology

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

MappingwithProgrammeOutcomes:

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	3	3	2	3	1	2	1	3	3	2
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)

CORE XIV PLANT ECOLOGY AND PHYTOGEOGRAPHY

Title of the Course	**PLANT ECOLOGY AND PHYTOGEOGRAPHY**						
Paper Number	CORE XIV						
Category	Core	**Year**	III	**Credits**	4	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**		**Tutorial**		**LabPractice**	**Total**
		3		2		-	5
Pre-requisite	Understanding the environmental factors impacting biodiversity is crucial after taking this course.						

Learning Objectives	
C1	To relate to the significance of the biotic and abiotic components of the ecosystems.
C2	To understand the energy flow in ecosystem.
C3	To conceptualize the biodiversity.
C4	To know implication of pollution on the environment.
C5	To familiarize with the phytogeography.

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1 Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1
2. Summarize the phytogeographical division of India.	K2
3. Explain the implication of pollution on the environment.	K3
4. Analyze the implications of functional and behavioral ecology in	K4

natural and man-made areas, biodiversity and conservation.	
5. Develop mitigations for the effective conservation of biodiversity and disaster management.	K5
Unit	**CONTENTS**
I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*).
IV	**Pollution:** Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil- causes and consequences. Remedial measures – Green building. Disaster management.
V	**Phytogeography Introduction**, continuous and discontinuous distribution, Phytogeography of India, Vegentational regions of India,. Plant indicators. 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 (*In situ* and *ex situ* methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExa	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

mination questionpaper)	
Skillsacquiredfr omthiscourse	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition. 3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd., 4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd., 5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 6.Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.
Reference Books	1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd., 4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems. 5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons. 6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA. 7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi. 8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK. 9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland. 10. Ambasht, R.S. 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.
Web Resources	1. https://www.kobo.com/us/en/ebook/plant-ecology-3. 2. https://www.worldcat.org/title/plant-ecology/oclc/613206385 3. https://books.google.co.in/books/about/Plant_Ecology.html? 4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP5. http://www.freebookcentre.net/Biology/Ecology-Books.html 6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X 7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity) 8. https://link.springer.com/journal/11258 (Plant Ecology)

MappingwithProgrammeOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	3	2	2	3	3	1	3	3	3
CO3	2	2	3	3	1	2	1	3	1	2
CO4	3	3	3	3	3	1	3	3	3	1
CO5	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

Title of the Course	**PLANT BIOTECHNOLOGY AND MOLECULAR BIOLOGY**				
Paper Number	CORE XV				
Category	Core	**Year**	III	**Credits**	4
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	2	-	
Pre-requisite		To empower students recognize and appreciate the basic principles tha an interdisciplinary domain of learning and research.			

Learning Objectives

C1	To know various aspects of biotechnology
C2	To know the concept and techniques of plant tissue culture.
C3	To familiarize with the gene transfer techniques.
C4	To know about DNA replication and repair.
C5	To familiarize with gene regulation.

Course outcomes: On the completion of the course the students will be able to: **CO:**	**Programme Outcomes**
1. Recognize the 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

UNIT	**CONTENTS**
I	Biotechnology – definition, history and scope. Application of plant b fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Recombinant vaccines, insulin and interferons. Environment – Bior Industry – ethanol production (yeast), citric acid production (*Aspergi* production (*Bacillus sps*).
	Plant tissue culture - introduction, scope and importance, concept techniques in plant tissue culture. Composition of media, types of me

II	preparation and inoculation. Callus induction and micropropogation. A culture in agriculture, horticulture and forestry. Synthetic seed technolo
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction DNA technology, gene transfer – indirect method, *Agrobacterium* medi method – Biolistic method. Development of transgenic plants with refe Pros and cons of GM food.
IV	Nature and function of genetic materials, Nucleic acid – base paring – structure. Types, denaturation - renaturation. Replication of DNA in pr and types. DNA repair mechanism.
V	Transcription – Enzymology – RNA polymerase – classes of RNA mole prokaryotes. Protein synthesis – Genetic code – characters – codons and regulation in Prokaryotes – *lac* operon and *trp* operon
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice. 2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers. 3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New D 4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier Indi 5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur. 6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Sprin
Reference Books	1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-prin recombinant DNA, (2nd Edition), ASM Press, Washington, D.C. 2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Del 3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technol 1. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman a 5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II Laboratory Press, New York. 6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an in engineering, Black Well Science Ltd., New York. 7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum 8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabo – Springer – Verlag, Berlin. 9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin. 10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac millio 11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springe
Web Resources	1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html 2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.ht 3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183 6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html 7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook

MappingwithProgrammeOutcomes:

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

Title of the Course	**PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY**				
Paper Number	CORE XVI				
Category	Core	**Year**	III	**Credits**	4
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	2	-	
Pre-requisite	Basic knowledge on physiological processes in plants and plant metabolites and enzymes.				
Learning Objectives					
C1	To relate to water relation of plants with respect to various physiologi				
C2	To know the pathways of photosynthesis.				
C3	To familiarize with respiration and nitrogen metabolism.				
C4	To know about plant growth regulators.				
C5	To familiarize with plant biochemistry.				

Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**
1. Relate to water relation of plants with respect to various physiological phenomenon.	K1
2. Explain the process and significance of photosynthesis and respiration.	K2
3. Elucidate properties of nutrients and their deficiency symptoms in plants.	K3
4. Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	K4
5. Decipher the phenomenon of seed dormancy and germination in plants.	K5

UNIT	**CONTENTS**
I	**WATER RELATIONS:** Properties of water—imbibition, diffusion, osmosis and plasmolysis- as of water absorption – active and passive, apoplast and symplast pathwa and factors affecting transpiration and significance. Opening an mechanisms and theories of transpiration.
	PHOTOSYNTHESIS: Radiant energy,Photosynthetic unit, photosynthetic pigments and their r

II	of carbon in photosynthesis - Light reaction, electron transport syste Scheme). Dark reaction - C3 cycle, C4 cycle, CAM pathway, Photorespi
III	**RESPIRATION** Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxi respiratory quotient, Anaerobic- fermentation - Respiratory quotient. **NITROGEN METABOLISM** Biological nitrogen fixation, nitrogen cycle.
IV	**GROWTH:** Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethy Practical applications - Photo morphogenesis – photoperiodism – ver phytochromes. **Stress Physiology:** Concepts of plant responses to temperature).
V	**PLANT BIOCHEMISTRY:** Classification, properties and biological role of carbohydrates, proteins, Enzyme – properties – classification – nomenclature of enzymes – m factors influencing enzyme action.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Ha 2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publi Delhi. 3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New D 4. Westhoff, P. 1998. Molecular Plant Development from Gene to Pla Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Delhi. 5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand an Delhi. 6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Ni Delhi. 7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bom 8. Verma,V. 2008. Textbook of plant Physiology, Ane's student editio
Reference Books	1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Plants, American Society of Plant Physiologists, Maryland, USA. 2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1 (second edition). Longman Essex, England.

	3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Li New York, USA. 4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochen Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands. 5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & USA. 6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer-Verlag, NewYork, USA. 7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiolo Academic Press, San Diego, USA. 8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Co., California, USA. 9. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee Photobiology: Photosynthesis and Photo morphogenesis. Narosa Pub Delhi. 10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Publishers, Massachusetts, USA. 11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (seco Press, San Diego. USA.
Web Resources	1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biolo 2.https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/ 3. https://www.kobo.com/us/en/ebook/plant-biochemistry 4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1 5.https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/d 6.https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/97 7.https://www.amazon.com/Introduction-Plant-Physiology-William-Hop ebook/dp/B006R6I850

MappingwithProgrammeOutcomes:

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

Title of the Course	**PRACTICAL-VI**				
Paper Number	CORE XIII				
Category	**Year**	III	**Credits**	3	**Cou**
	Semester	V			
InstructionalHours perweek	**Lecture**		**Tutorial**	**LabPractice**	**To**
	2		-	3	
Pre-requisite	Theoretical understanding of anatomy, embryology, cell biology, genetics a well as basic laboratory skills for the relevant core course.				
Learning Objectives					
C1	To study the anatomy of the plant organs using various techniques.				
C2	To study the embryology of the plant.				
C3	To identify the structure of various cell organelles.				
C4	To understand genetics through problem solving.				
C5	To study various plant breeding techniques.				
Course outcomes: On completion of this course, the students will be able to: **CO**	**Programme Outcomes**				
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				
EXPERIMENTS					

Anatomy

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

Embryology

1. T.S of (young and mature) anther (section from *Datura* or *Cassia* flower).
2. Observation of pollinia (slide only).
3. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent
4. Types of Endosperm - Nuclear, cellular and helobial.

Dissection and display of any two stages of embryo in *Tridax*

Cell biology

1. Study of the photomicrographs of cell organelles.
2. Ergastic substances - starch grains, aleurone grains, crystals – cystolith and raphide.
3. Study the polytene and lamp brush chromosome structure through photograph.
4. Identification of different stages of mitosis by using squash and smear techniques – Onion root tip.

Genetics

2. Genetic problems – test cross, back cross and allelic interaction.
3. Construction of chromosome map – three point test cross
4. Multiple alleles problems.

Plant Breeding

1. Emasculation technique.
2. To test the viability of seeds using Tetrazolium chloride.
3. Genetic models of heterosis.
4. Phenotype of heterosis (Maize).

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPS CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryolog LTD, New Delhi. 2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Str and uses of the commercial woods of the United States and Canada. York: McGraw-Hill Book Company. 3. Sharma, H.P. 2009. Plant Embryology: Classical and Experiment Prakashan, ISBN-8173199698, 9788173199691.

	4. Gupta P.K. 2017. Cell and Molecular Biology (5th ed.), Rastogi Public 5. Krebs J.E., Goldstein E.S and Kilpatrick S.T. 2017. Lewin's GENES X Bartlett Learning. 6. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp New York.
Reference Books	1. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Anmol Publications, ISBN-812610668. 2. Katherine Esau. 2006. Anatomy of Seed Plants. 2nd edition, John Wile 3. Allen, Sarah et al., 2016. Plant Anatomy Lab Manual, Fall. 4. Gardener, J, Simmons, H.J and Snustad, D.P. 2006. Principle of Ger Sons, New York. 5. De Robertis E.D.P. and De Robertis E.M.P. 2017. Cell and Molecu (South Asian Edition), Lea and Febiger, Philadelphia, USA. 6. Jackson, S.A., Kianian, S.F., Hossain, K.G., and Walling, J. G. 2012 exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp New York, NY.
Web resources	1. https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/ 2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Ana Em.html?id =Cq1KPwAACAAJ&redir_esc=y 3. https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219 4. https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932 5. https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9

MappingwithProgrammeOutcomes:

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

Title of the Course					**PRA**
Paper Number	CORE XVII				
Category	Core	**Year**	III	**Credits**	
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**		
		2	-		
Pre-requisite		Practicals pertaining to above subjects is important to get			

Learning Objectives	
C1	To study morphological and anatomical adaptations of plants of various
C2	To demonstrate techniques of plant tissue culture.
C3	To familiarize with the structure of DNA, RNA.
C4	To carryout experiments related with plant physiology.
C5	To perform biochemistry experiments.
Course outcomes: On completion of this course, the students will be able to: CO	**Program**
1. Relate to the distribution and adaptions 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.	

EXPERIMENTS

Plant Ecology and Phytogeography

1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophy

   Hydrophytes : *Nymphaea, Hydrilla*

Xerophytes : *Nerium, Casuarina*

Mesophytes : *Tridax, Vernonia*

Halophytes : *Avicennia, Rhizophora*

Epiphytes : *Vanda*

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

ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPS (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthiscourse	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Me 2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory an 3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Cytogenetics (pp. 323-333). Springer, New York. 4 Plummer,D.1988.AnintroductiontoPracticalBiochemistry,TataMcGraw– 5 Palanivelu,P.2004.LaboratoryManualforanalyticalbiochemistryandsepar 6. Jayaraman.J.1981.Laboratory Manual in Biochemistry.Whiley Eastern L 7. Bendre,A.M.andAshokKumar,2009.AtextbookofpracticalBotany.Vol.I&
Reference Books	1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell. 2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and orga 3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biol 4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in 5. Wilson,KandJ.Walker(Eds).1994.PrinciplesandTechniquesofPracticalB 6. Bendre,A.MandAshokKumar.2009.AtextbookofpracticalBotany.Vol.I& 7. ManjuBala,SunitaGupta,Gupta,N.K.2012.PracticalsinPlantPhysiologya
Web resources	1. https://www.amazon.com/Practical-plant-ecology-beginners-communiti 2. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/d 3. https://www.elsevier.com/books/molecular-biology-techniques/carson/9 4. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sang 5. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslo

MappingwithProgrammeOutcomes:

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

Title of the Course	**ALLIED BOTANY-I**				
Paper Number	Core-Allied-I				
Category	Core	**Year**	I	**Credits**	2
		Semester	I		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite	To study the basics of botany.				

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
2.Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
3.Develop critical understanding on morphology, anatomy and reproduction of 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	**Algae:** General characters of algae - Structure, reproduction and life cycle of *Anabaena* and *Sargassum* and economic importance of algae.
II	**Fungi, Bacteria and Virus:** General characters of fungi, structure, reproduction and life cycle of *Penicillium* and *Agaricus* and economic importance of fungi. Bacteria - general characters, structure and reproduction of *Escheric* importance of bacteria. Virus - general characters, structure of TMV, stru

III	**Bryophytes, Pteridophytes and Gymnosperms:** General characters of Bryophytes, Structure and life cycle of *Funaria*. General characters of Pteridophytes, Structure and life cycle of *Lycopodi* General characters of Gymnosperms, Structure and life cycle of *Cycas*.
IV	**Cell Biology:** Prokaryotic and Eukaryotic cell- structure /organization. Cell organell function of chloroplast, mitochondria and nucleus. Cell division - mitosis
V	**Genetics and Plant Biotechnology:** Mendelism - Law of dominance, Law of segregation, Incomp ofindependent assortment. Monohybrid and dihybrid cross - Test cross - culture - *In vitro* culture methods. Plant tissue culture and its application
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY-II

Title of the Course	ALLIED BOTANY-II				
Paper Number	Coree-Allied-II				
Category	Core	**Year**	I	**Credits**	2
		Semester	II		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite	To study basics of botany.				

Learning Objectives	
C1	To be familiar with the basic concepts and principles of plant systematics.
C2	Learn the importance of plant anatomy in plant production systems.
C3	Understand the mechanism underling the shift from vegetative to reproductive ph
C4	To learn about the physiological processes that underlie plant metabolism.
C5	To know the energy production and its utilization in plants.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Understand the fundamental concepts of plant anatomy and embryology.	**K1**
2. Analyze and recognize the different organs of plants and secondary growth.	**K2**
3. Understand water relation of plants with respect to various physiological processes.	**K3**
4. Classify aerobic and anaerobic respiration.	**K4**
5. Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	**K5**

UNIT	**CONTENTS**
I	**MORPHOLOGY OF FLOWERING PLANTS:** Plant and its parts. Structure and function of root and stem. Leaf an compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose a reference to flower description.

II	**TAXONOMY:** Study of the range of characters and plants of economic importance i Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae
III	**ANATOMY** Tissue and tissue systems: Simple and complex tissues. Anatomy of mo monocot and dicot stems - anatomy of dicot and monocot leaves.
IV	**EMBRYOLOGY** Structure of mature anther and ovule - Types of ovules, structure o fertilization, structure of dicotyledonous and monocotyledonous seeds.
V	**PLANT PHYSIOLOGY** Absorption of water, photosynthesis - light reaction - Calvin cycle; resp electron transport system. Growth hormones - auxins and cytokinins and
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Com 2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryolog enlarged edition). Vikas Publishing House, New Delhi. 3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Delhi. 4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. 5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
Reference books	1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central B 2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiospe edition). Vikas Publishing House, New Delhi. 3. Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing. 4. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Comp 5. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams 6. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Comp 7. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co.,
Web Resources	1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-e 5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/978

MappingwithProgrammeOutcomes:

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

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

ELECTIVE ALLIED BOTANY PRACTICALS

Title of the Course	**ALLIED BOTANY PRACTICALS**			
Paper Number	Core-Allied Practicals-I			
Category	Core	**Year**	I	**Credits**
		Semester	II	
InstructionalHours perweek		**Lecture**	**Tutorial**	
		1	-	
Pre-requisite		Practicals pertaining to above subjects is important to ge		

Learning Objectives	
C1	To enhance information on the identification of each taxono morphology and microstructure of microorganisms, algae, and fu
C2	To comprehend the fundamental concepts and methods used to i morphological changes and evolution, anatomy and reproduction.
C3	To be familiar with the basic concepts and principles of plant syst
C4	Understandingoflawsofinheritance,geneticbasisoflociand alleles.
C5	To learn about the physiological processes that underlie plant met

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

EXPERIMENTS

1. Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.

2. Micro photographs of the cell organelles ultra structure.
3. Simple genetic problems.
4. To describe in technical terms, plants belonging to any of the family prescribes and to identify the f
5. To dissect a flower, construct floral diagram and write floral formula.
6. Demonstration experiments
    1. Ganong's Light screen
    2. Ganong's respiroscope

7. To make suitable micro preparations of anatomy materials prescribed in the syllabus. 8. Spotters - Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms and Angiosperm anato	
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma,O.P.2017. Bryophyta,MacMillanIndia Ltd,NewDelhi. 2. Sharma,O.P.2012. Pteridophyta,Tata McGraw-Hills Ltd,NewDelhi. 3. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vil 4. Benjamin, A. Pierce. 2012. Genetics- A conceptual Approach. W.H. Fr 5.Noggle G.R and G.J. Fritz. 2002. Introductory Plant Physiology. Prentic
Reference Books	1. Strickberger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delh 2. Nancy Serediak and M. Huynh. 2011. Algae identification lab Gu Ottawa Agriculture and Agri food Canada publisher. 3. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012 Academic Publishing. 4. Aler Gingauz.2001. MedicinalChemistry.OxfordUniversityPress&W 5. Steward, F.C. 2012. Plant Physiology Academic Press, US
Web sources	1. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sunda 2. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm 3. https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarke 4. https://medlineplus.gov/genetocs/understanding/basics/cell/ 5. https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf 6. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica. 7. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/

MappingwithProgrammeOutcomes:

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

Title of the Course	**ORGANIC FARMING**						
Paper Number	Non-Major Elective-I						
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**	
		Semester	I				
Instructional Hours Per week		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		2	-		-	2	
Pre-requisite	Students to gain knowledge on the scope of organic farming and its significance.						

Learning Objectives	
C1	To enable students to gain knowledge on the scope of organic farming and its significance.
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.
C3	To understand the physical and chemical properties of soil.
C4	To study sustainable agriculture.
C5	To know about the importance of biofertilizers.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the different forms of biofertilizers and their uses.	**K1**
2. Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.	**K2**
3. Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	**K3**
4. Analyze and decipher the significance of biofertilizers in soil fertility.	**K4**
5. Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	**K5**

UNIT	**CONTENTS**
I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.

II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost-methods, production and utilization.
IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla* and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/ GATE/ TNPSC / others to be solved (To be discussed during theTutorial hour)
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability,Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organicfarming. 2nd Edition. NIIR Project Consultancy Services. 2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. 3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech. 4. Vayas, S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
Reference Books	1. Vayas, S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers. 3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi. 4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani Publications, Uttar Pradesh 5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi
Web Resources	1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY 2. https://www.e-booksdirectory.com/listing.php?category=323 3. http://www.freebookcentre.net/Biology/Agriculture-Books.html 4.https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-downloads/TOFG-all.pdf 5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-

	21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

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

Title of the Course	**ENVIRONMENTAL BIOTECHNOLOGY**						
Paper Number	Non-Major Elective-I						
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**	
		Semester	I				
Instructional Hours Per week		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		2	-		-	2	
Pre-requisite	To understand the various applications of environmental biotechnology.						

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

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

UNIT	**CONTENTS**
I	**Introduction:** The environment-soil, water and air, Pollution and its causes (outline only)

II	**Source and treatment of polluted waters and effluents:** Pollution of water bodies by heavy metals and pesticides – removal of heavy metals and pesticides by Biosorption. Removal of oil spills by using microbes. Biological treatment of sewage – characteristics of sewage and objectives in sewage treatment – Anaerobic digestion.
III	**Soil and air pollution and their treatment:** Soil pollution by Xenobiotics. Degradation of Xenobiotics – pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.
IV	**Bioremediation:** Introduction to bioremediation, *ex situ* and *in situ* bioremediation.
V	**Biometallurgy and related topics:** Biomineralization – bioleaching - Biofilms and biocorrosion.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics,from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability,Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Alan Scragg. 1999. Environmental Biotechnology. Pearson Education Limited. 2. Dubey R.C. 2004. A text book of Biotechnology aspects of microbiology, British Sun Publication. 3. Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication. 4. Keeshav Thehan. 1997. Biotechnology, New age international Pvt New Delhi. 5. Chandra, A.M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Narosa Publishing House Pvt. Ltd. New Delhi.
Reference Books:	1. Sharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi. 2. Raina Maier M. Iran Pepper L., Charles P. Gerba, 2000, Environmental Microbiology, Academic press, U.K. 3. Alexander N. Glazer and Hiroshi Nikaido. 1994. Microbial Biotechnology. 4. Special issue on Bioremediation and biodegradation. Indian Journal of Experimental Biology, September 2003. Vol. 41(9). National Institute of

	Science Communication and Information Resources, CSIR New Delhi. 5. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
Web Resources	1. https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-407776-8 2. http://www.freebookcentre.net/biology-books-download/Environmental-Biotechnology.html 3. https://www.amazon.in/INTRODUCTION-ENVIRONMENTAL-BIOTECHNOLOGY-K-Chatterji-ebook/dp/B00K7YGIWI 4. https://books.google.co.in/books/about/Textbook_of_Environmental_Biotechnology.html?id=Q2ROFx0WtBQC&redir_esc=y 5. http://library.umac.mo/ebooks/b28045907.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	2	1	3
CO2	3	3	2	2	2	3	2	3	2	2
CO3	2	2	3	3	1	2	1	3	3	3
CO4	3	3	3	3	3	2	3	3	3	3
CO5	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					
InstructionalHours perweek	**Lecture**		**Tutorial**		**LabPractice**		**Total**	
	2		-		-		2	
Pre-requisite	Students should know about the fundamental concepts of nursery and landscaping.							

Learning Objectives	
C1	To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
C2	To be able to design gardens and become entrepreneur in Horticulture.
C3	To study the methods of propagation.
C4	To know about nursery structure.
C5	To learn about gardening.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the basic principles and components of gardening.	K1
2. Explain about bio-aesthetic planning and conceptualize flower arrangement.	K2
3. Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3 & K6
4. Compare and contrast different garden styles and landscaping patterns.	K4
5. Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5 & K6

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

V	Manures, composting – vermicomposting.
Extended Professional Component (is a part ofinternal component only,Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/ NET/ UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge,Problem Solving,Analytical ability,Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi. 2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People, Plans and Plants. Dundurn Group Ltd.
Reference Books	1. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi. 2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788 3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

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

CO3	2	2	3	1	1	1	1	3	3	1
CO4	3	2	2	1	3	2	1	3	2	1
CO5	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

Title of the Course	**MUSHROOM CULTIVATION**					
Paper Number	Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**
		Semester	II			
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**		
	2	-	-	2		
Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.					

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

UNIT	**CONTENTS**
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.

II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
III	Life cycle of *Pleurotus spp* and *Agaricus spp.*
IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.
Extended Professional Component (is a part of internal component only,Not to be included in the External Examination Question paper)	Questions related to the above topics,from various competitive examinationsUPSC/TRB/NET/UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991.Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu AgriculturalUniversity, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing andPublishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovementwith their marketing.Daya Publishing House.
Reference Books	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991.Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing andPublishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. 5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web Resources	1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/ 5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

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

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

NON-MAJOR ELECTIVE-II
2. HERBAL MEDICINE

Title of the Course	**HERBAL MEDICINE**					
Paper Number	Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**
		Semester	II			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		2	-	-	2	
Pre-requisite	To understand the importance of herbal medicine.					

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

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Define and describe the principle of cultivation of herbal products.	K1
2. 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

UNIT	**CONTENTS**
I	Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognosy – Aim and scope.

II	Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening – Poisonous plants – Types of plant poison; action of poisons; treatment for poisons, some poisonous plants; their toxicity and action.
III	Adulteration of crude drugs and its detection – methods of adulteration; types of adulteration. Medicinal plants of export values; rejuvenating herbs; Medicinal uses of Non-flowering plants.
IV	Botanical description and active principles of Root drugs; Rhizomes woods and bark drugs (Two examples for each plant organs).
V	Botanical description and active principles of leaves; Flowers; Fruits seed and entire plants as drugs. Taxonomic study of some selected herbals (Two examples for each plant organs).
Extended Professional Component (is a part of internal component only,Not to be included in the External Examination Question paper)	Questions related to the above topics,from various competitive examinations UPSC/TRB/NET/UGC–CSIR/ GATE/ TNPSC/ others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Somasundaram, S. 1997. Medicinal botany (Maruthuvar Thavaraviyal) – (Tamil Medium Book). 2. Wallis, T.E. 1967. Text Books of Pharmacognosy. J. & A. Churchill Ltd., London, 3. Jains, S.K... 1996. Medicinal Plants. Deep Publications, New Delhi. 4. Srivastava, A.K. 2006, Medicinal Plants, International Book Distributors, Dehradun. 5. Agarwal, O.P. 1985, Vol. II, Chemistry of organic – natural products. S Chand & Company, New Delhi. 6. Gamble, J.S. and Fisher, 1921, CEC I, II, III Flora of the Presidency, Madras Volumes. 7. Mathew K.M., 1988, Flora of the Tamilnadu and Carnatic.\
Reference Books	1. Nair, N.C and Henrry, A.N. 1983, Flora of Tamil Nadu, India, Botanical Survey of India. 2. Chopra, R.N., Nagar S.L., and Chopra, I.C. 1956, Glossary of Indian Medicinal Plants. 3. Chopra, R.N., Chopra, I.C., Handa, K.L., and Kapur L.D., 1994, Indigenous drugs of India. 4. Chopra, R.N., Badhuvar R.L and Gosh, G. 1965. Poisonous

	plants in India. 5. Miller, L and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. *Motilal Banarsidass, Fourth edition.* 6. Patri, F and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.
Web Resources	1. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/N-ry0Z8qaZ11iu 2. https://www.springer.com/gp/book/9783540791157 3. https://www.gpatonline.com/gpat/book-reference-pharmacognosy 4. https://www.researchgate.net/publication/334670695_Book_review-_Herbal_Drug_Technology 5. http://www.eurekaselect.com/node/173492/herbal-medicine-back-to-the-future

Mapping with Programme Outcomes:

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

Title of the Course	**GLOBAL CLIMATE CHANGE**					
Paper Number	Non-Major Elective-II					
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**
		Semester	II			

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	2	-	-	2

Pre-requisite	To understand the implications of carbon and ecological footprint.

Learning Objectives	
C1	To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.
C2	To understand the implications of carbon and ecological footprint.
C3	To apply the knowledge to green house effects.
C4	To know the rain and its effects on plants.
C5	To know about Global Environmental change issues.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the anthropogenic pressure on the environment and carbon footprint.	K1
2. Explain about the physical basis of natural green gas house effect on man and materials.	K2
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

UNIT	**CONTENTS**
I	Global Environmental change issues. UNFCC, IPCC, Koyoto protocol, CDM, Carbon footprint and ecological footprint.
II	Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants,

	microbes, animals, human health and materials; Globalefforts for mitigation ozone layer depletion.
III	Climate change: Green house effects; causes; Green house gases and their sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.
IV	Atmospheric deposition: Past and present scenario; Causes and consequences of excessiveatmospheric deposition of nutrients and trace elements; Eutrophication.
V	Acid rain and its effects on plants, animals, microbes and ecosystems.
Extended Professional Component (is a part ofinternal component only,Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/ GATE/ TNPSC/ others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving,Analytical ability,Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Adger, N. Brown, K and Conway, D. 2012. Global Environmental Change: Understanding the Human Dimensions. The National Academic Press. 2. Turekian. K. K. 1996. Global Environmental Change-Past, Present, and Future. Prentice-Hall. 3. Eugene Odum, 2017. Fundamentals of Ecology 5th Ed. Cengage, Bengaluru. 4. Sharma P.D. 2019. Plant ecology and phytogeography, Rastogi Publications, Meerut. 5. Neeraj Nachiketa. 2018 Environmental & Ecology A Dynamic approach. 2nd Edition GKP Access Publishing.
Reference Books	1. Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA. 2. Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry. 3. Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234. 6. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi. 7. Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
Web Resources	1. https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/ 2. http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html 3. https://www.smashwords.com/books/category/4727/newest/0/free/any 4. https://www.free-ebooks.net/environmental-studies-

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

Mapping with Programme Outcomes:

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

Title of the Course	**BIO-ANALYTICAL TECHNIQUES**			
Paper Number	Elective-I			
Category	Elective	**Year**	III	**Credits**

		Semester	V
InstructionalHours perweek		**Lecture**	**Tutorial**
		3	1
Pre-requisite		To impart expertise about analysis and resear	
Learning Objectives			
C1	To understand the principle, operation and maintenan		
C2	Perform experiments using the laboratory instrument 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 t research careers and/or start entrepreneurial ventures.		
Course outcomes: On completion of this course, the students will be able to: CO	**Progr**		
1. Relate to the various biological techniques and its importance.			
2. Explain the principles of Light microscopy, compound microscopy, Fluorescencemicroscopy 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.			
UNIT	**CONTEN**		
I	**I MICROSCOPY:** Principles of microscopy; Light microscopy; compound microscopy, microscope, Fluorescence microscopy; Transmission and Scanning Microscopy drawing: Camera Lucida.		
II	**CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS:** Principle; Paper chromatography, Thin Layer Chromatography (TI spectrometry (GCMS), High Performance Liquid Chromatography (HPI		
III	**ELECTROPHORESIS ANDPH METER:** Basic principle, construction and operation of pH meter. Polyacrylamid		
IV	**IVSPECTROPHOTOMETRY AND CENTRIFUGATION TECHN** Principle and law of absorption, construction, UV–Visible spectrophotometer, Principles, methods of centrifugation, ty		
V	**BIOSTATISTICS:** Data collection methods, population, samples, parameters; Representati Bar diagram–measures of central tendency – Mean, Median and Mode; of fit –t–test.		
ExtendedProfessionalComponent (is a part ofinternal component	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations (TobediscussedduringtheTutorialhour)		

only,Not to be included in theExternalExamination questionpaper)	
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata M 2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochem 3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publication 4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Cha 5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications. 6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques
Reference Books	1.Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publica 2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. 3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics an 4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book 5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill pu 6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, L 7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia P 8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Ed 9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, Engla
Web Resources	1. https://www.kobo.com/in/en/ebook/bioinstrumentation-1 2. https://www.worldcat.org/title/bioinstrumentation/oclc/74848857 3. https://www.amazon.in/Bioinstrumentation-M-H-Fulekar-Bhawana-Pa 4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-K 21&tag=kindlecontentin50- 21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaW BwE 5. https://www.kobo.com/us/en/ebooks/biostatistics 6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07

MappingwithProgrammeOutcomes:

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

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

ELECTIVE I
2. AQUATIC BOTANY

Title of the Course	**AQUATIC BOTANY**				
Paper Number	Elective-I				
Category	Elective	**Year**	III	**Credits**	3
		Semester	V		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite	To understand ecological functions and economic uses of				

Learning Objectives	
C1	To give an overview of the distribution of lower plants forms and its e
C2	To enable students to understand the ecological functions and econom plants.
C3	To equip students to collect, analyze and identify the planktons.
C4	To give an exposure to various forms seaweeds.
C5	To know about the values and uses of aquatic plants..

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize aquatic plants and their ecological importance.	K1
2. Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
3. Apply techniques for conservation of aquatic plants for value addition.	K3
4. Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
5. Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.	K5 & K6

UNIT	**CONTENTS**
I	**MARINE AND LIMNETIC MACRO ALGAE:** Common seaweeds of Indian subcontinent: *Ulva, Caulerpa, Sarg* Common terrestrial algae, including cyanobacteria and lichen photobion and its life cycle, ecology and taxonomy: *Anabaena, Chlorella, Scenede*
II	**MANGROVES:** Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves. Common species of mangroves and mangrove assoc *Avicennia, Rhizophora, Acanthus* and *Aegiceras*. Ecological significance

III	**PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATE** Common marine microalgae of India, including phytoplanktons and diatoms and dinoflagellates of Indian Ocean, Common limnetic and ter India.
IV	**AQUATIC ANGIOSPERMS:** Common aquatic angiosperms of India, including Lotus, Water Lilly, W life cycle, taxonomy and economic importance of aquatic angiosperms.
V	**VALUES AND USES OF AQUATIC PLANTS:** Economic importance of aquatic plants, Ecosystem services of aq biogeochemical cycles, oxygen production and carbon sequestration an and algal resources of India, aesthetic, cultural, spiritual importance of a
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University 2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013.. Presco Edition. Mc Graw Hill International. 3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-W 4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambri 5. Daubenmire, R.F.1973. Plant and Environment. John Willey. 6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications 7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich div 19(2) 1032-1043 *ISSN*: 0971-8044.
Reference Books	1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Lever Limited. 2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Netherlands. 3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, Mann,eds.), Blackwell Sci. Publ., London, 229 pp. 4. Bennet, G.W. 1971 Management of Lakes and Ponds. v Co.,NY.375 pp. 5. Goldman, C.R. & A.J. Horne 1983. Lim Internat.Book.Co.Tokyo,464 pp. 6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-sc 2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-sc 3. https://www.springer.com/gp/book/9788132221777 4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-s 5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebo

MappingwithProgrammeOutcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	3	3	1	3	2	1	2	2	2	1
CO2	3	2	1	1	2	3	2	3	2	3
CO3	2	2	3	1	1	2	1	3	1	2
CO4	3	3	3	3	3	2	1	2	3	2
CO5	3	2	1	1	2	3	3	3	2	3

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

ELECTIVE I

3. ENTREPRENEURIAL BOTANY

Title of the Course	**ENTREPRENEURIAL BOTANY**				
Paper Number	Elective-I				
Category	Elective	**Year**	III	**Credits**	3
		Semester	V		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite	To develop innovative ideas to exploit the economically commercial purposes.				

Learning Objectives	
C1	To enable students to develop innovative ideas to exploit the economica for commercial purposes.
C2	To inculcate entrepreneurial values to start a new business.To enlighten pe
C3	To comprehend the molecular processes.
C4	To expose the students a fundamental of the various value added products
C5	To introduce the entrepreneurial opportunities.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

UNIT	**CONTENTS**
I	**INTRODUCTION:** Need - definition and concept - Types and characterization - entreprene and barriers-entrepreneurship as innovation, risk assessment and solution
II	**BIOVENTURE:** Industry - overview of *Spirulina*, *Pleurotus*, Natural dyes, Banana fib Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant marketing - fresh and dry flowers for aesthetics.

III	**VALUE ADDED PRODUCTS:** Canning of fruits - process and equipment, fruit and vegetable based pro serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jan Palm products, Perfumes from Rose/Jasmine - Bamboo and cane based oil, jasmine oil production, nutraceuticals, standards and quality manage
IV	**ORGANIZATIONS AND AGENCIES:** TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya - and Medium Enterprises – support structure for promoting entre government schemes.
V	**ENTREPRENEURIAL OPPORTUNITIES:** Understanding a market and assessment, selection of an enterpr mobilization of resources, Break Even Analysis, project proposal (g information and preparation of project report), steps in filing patents, tr Intellectual Property Rights, export and import license.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Taneja,S.and Gupta,S.L.2015. Entrepreneurship development, New v publication company, New Delhi.ISSN: 2321-8916. 2. Desai,V.,2015. Entrepreneurship development, First edition.Himalaya Mumbai. ISBN:9789350973837. 3. Khanna,S.S. 2016. Entrepreneurial development.S.Chand company li Delhi.ISBN:9788121918015. 4. Bendre,M.AshokandAshokKumar,A. 2020.TextBookofPra (10th ed).RastogiPublications, Meerut. 5. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Jodhpur.
Reference Books	1. Manohar,D.1989. Entrepreneurship of small scale industries,vol.III.De New Delhi. ISSN: 09735925. 2. Lal,G.,Siddhapa,G.S.andTandon,G.L.,1988.Preservation of fruits and Council of Agricultural Research (ICAR). ISSN:0101-2061. 3. Ranganna,S.,2001.Handbook of analysis and quality control of fruits Second edition, Tata Mc Graw hill, New Delhi.ISBN: 780074518519 4. Gupta. P.K.,1998. Elements of Biotechnology. Rastogi publications, 5. Edmond Musser and Andres, Fundamentals of Horticulture, McG Delhi.
Web resources	1. https://store.pothi.com/book/ebook-priya-lokare-botanical-entreprene 2. https://www.taylorfrancis.com/chapters/mono/10.1201/b14920-15/va microalgae-faizal-bux 3. https://www.amazon.in/Microalgae-Biotechnology-Health-Value-Pro ebook/dp/B0845QXPY3 4. https://www.elsevier.com/books/value-addition-in-food-products-and enzyme-technology/kuddus/978-0-323-89929-1 5. https://www.oreilly.com/library/view/selling-today-partnering/9780134477404/xhtml/fileP700101194000000000000000

MappingwithProgrammeOutcomes:

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

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

ELECTIVE-II

1. HORTICULTURE

Title of the Course	**HORTICULTURE**				
Paper Number	Elective-II				
Category	Elective	**Year**	III	**Credits**	3
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite		Students should know fundamental knowledge applications.			

Learning Objectives	
C1	To gain an understanding of the fundamentals of horticulture and tec and maintain plants.
C2	To develop skills in students to work as gardeners, therapists, technical advisors in the food and non-food sectors of horticulture.
C3	To know about hydroponic culture.
C4	To develop the various horticultural crop protection.
C5	To impart the knowledge on market preparation.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

UNIT	**CONTENTS**
I	Importance and scope of horticulture. Classification of horticultural crop Essentials of nursery Management - Soil management: Garden soil, properties of soil, Organic matter, Compost, Cultural practices; Wa

	quality, Irrigation, Mulching. Nursery structures**:** Protected cul environment controls.
II	Hydroponic culture-types of container. Use of manures and fertilize production. Principles of organic farming. Environmental factors influen production.
III	Horticultural crop protection; physical control - pruning. Chemical control- p propagation - cutting, layering, budding, grafting. Types of gardens: form Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.
IV	A brief account of annual, biennials and perennials with reference to or house, terrarium, water garden, rockery plants, bonsai techniques. Lan basic components.
V	Technology of horticultural crops - market preparation: harvesting and transport, storage; chemical treatment. Economics of cultivation Cro clove. Food processing - freezing, bottling and canning, drying and chem
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – Half of India. New Delhi. 2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of horticultural crops. Naya Prakash. 3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., Nev 4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Kr 5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. O Calcutta. 6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kal 7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Pl Prentice Hall of India Pvt. Ltd., New Delhi
Reference Books	1.Arditti, A. 1977. Orchid biology, Gornell Univ., Press. Ithaca. 2. Bailey, S. 1971. Perpectual flowering carnation, Fabner and Fabr 3. Laurie, A., Kiplingr, D.D and Nelson, K.S. 1968. Commercial f Hill Book, London. 4. Cumming, R.W. 1964. The chrysanthemum Book. D.Van., Nost 5. Biswas, T.D. 1984. Rose growing – Principles and Practices - Delhi. 6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printic 7. Abraham, A and Vatsala, P. 1981. Introduction to Orch Trivandrum. 8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Pr 9. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., I 10. Helleyer, A. 1976. The Collingridge Encyclopedia of gardeni New Jercy.
Web Resources	1.https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK 2. https://www.ebooks.com/en-us/subjects/science-horticulture-ebook

	3. http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/ 4. https://www.worldcat.org/title/handbook-of-horticulture/oclc/6886 5. https://cbseportal.com/ebook/vocational-books-horticulture 6. http://www.digitalbookindex.org/_search/search010agriculhortigarc

MappingwithProgrammeOutcomes:

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

Title of the Course	**NATURAL RESOURCE MANAGEMENT**					
Paper Number	Elective-II					
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**
		Semester	VI			

InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**	**Total**
	3	1	-	4

Pre-requisite	To understand the concept of different natural resources and their utilization.

Learning Objectives	
C1	To develop an appreciation for the natural resources and their ecological and economic impact.
C2	To gain an understanding of various strategies of natural resource management.
C3	To understand theconcept of different natural resources and their utilization.
C4	To create the models of natural resource conservation and maintenance.
C5	To study thesignificance of natural resources pertaining to economy and environment.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

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

	resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
ExtendedProfessionalComponent (is a part of internal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi. 2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi. 3. Rogers, P.P., Jalal, K.F. and Boyd, J.A. 2008. An Introduction to Sustainable Development. Prentice Hall of India Private Limited, New Delhi. 4. United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition 5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House 6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.
Reference Books	1. Coastal Ecology & Management, Mann, K.H. 2000. Ecology of Coastal Waters with Implications for Management (2nd Edition).Chap. 2-5, pp.18-78 & Chap. 16, pp.280-303. 2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876. 3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner. 4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House. 5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press. 6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB). 7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science. 8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd. 9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.
Web resources	1. https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&redir_esc=y

	2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE 4. https://www.kobo.com/us/en/ebooks/natural-resources 5. https://www.igi-global.com/chapter/natural-resources-management/195183 6. 6crLIC&redir_esc=y 7. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 8. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE 9. https://www.kobo.com/us/en/ebooks/natural-resources 10. https://www.igi-global.com/chapter/natural-resources-management/195183

MappingwithProgrammeOutcomes:

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

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

ELECTIVE-II

3.FORESTRY

Title of the Course	**FORESTRY**					
Paper Number	Elective-II					
Category	Elective	**Year**	II	**Credits**	3	**CourseCode**
		Semester	VI			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		3	1	-	4	
Pre-requisite	Prior knowledge on trees, forests and their importance.					
Learning Objectives						
C1	To study the distribution pattern, composition and diversity of forest ecosystem					
C2	To understand the method of forest management principles and conservation.					
C3	To enable them to meaningfully contribute in the forest conservation.					
C4	To raise student awareness of the need to create a sustainable way of living and the current global issues with forestry caused by human interference.					
C5	To provide a platform to appreciate biodiversity and the importance.					
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**					
1. Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	K1					
2. Understand complex interactions of humans and 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	**SILVICULTURE:** 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.
II	**FOREST MENSURATION AND MANAGEMENT:** Forest Mensuration - Definition and objectives. Measurement of diameter, girth, height, crown and volume of trees - methods and principles - tree stem form - form factor. Volume estimation of stand - age - basal area

	determinations Stem and Stump Analysis. Forest inventory - sampling techniques and methods - measurement of crops - sample plots. Yield calculation - CAI and MAI - volume, yield and stand tables preparation.
III	**FOREST UTILIZATION AND WOOD TECHNOLOGY:** 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.
IV	**FOREST BIOLOGY AND BOTANY:** 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.
V	**FOREST BOTANY:** 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. **AGRO FORESTRY AND SOCIAL FORESTRY:** Agro forestry - definition, concept and objectives. Classification of agro forestry systems - primary systems and subsystems - inheritance effects. Tree-crop interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of agro forestry - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry

	practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros. 2. Roger Sands. 2013. Forestry in a global context, CAB international. 3. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun. 4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi. 5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi. 6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat. 7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun. 8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun. 9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi. 10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
ReferenceBooks	1. Donald L. Grebner.Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press 2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland. 3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York. 4. Agarwala,V.P.1990.ForestsinIndia,EnvironmentalandProtectionFrontiers.OxfordIBHPublishingCo.,New Delhi. 5. Belcher,B.M. 1998.Aproduction-to-consumptionsystemsapproach:LessonsfromthebambooandrattansectorsinAsia.In:Wollenberg,EandA.Ingles(Eds.).Incomesfrom theforest:methodsforthedevelopmentandconservationofforestproductsforlocalcommunities.CenterforInternationalForestryResearch(CIF

	OR),Bogor,Indonesia. 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. 7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p.
Web resources	1. http://wwwwds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf. 2. https://www.britannica.com/science/forestry 3. https://en.wikipedia.org/wiki/Forestry. 4. https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119 5. https://academic.oop.com 6. https://www.cbd.int> development> doc. 7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product.

MappingwithProgrammeOutcomes:

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

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

ELECTIVE-III

1. BIONANOTECHNOLOGY

Title of the Course	BIONANOTECHNOLOGY				
Paper Number	Elective-III				
Category	Elective	**Year**	III	**Credits**	3
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		3	1	-	
Pre-requisite	To provide an insight into the principles of nanotech medical research.				

Learning Objectives	
C1	To provide students with comprehensive knowledge of basics in na
C2	To enable the students understand and appreciate the various appli
C3	To give perspective to researchers and students who are interested and biological systems and their applications in medicine.
C4	To introduce the concepts in nanomaterials and their use with bioc and interact with larger systems.
C5	To impart knowledge on the most recent molecular diagnostic and treat various diseases.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology	K1
2. Explain the synthesis of nanomaterials and their applications.	K2
3. Apply the knowledge gained to develop nanomaterials	K3
4. Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.	K4
5. Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6

UNIT	**CONTENTS**
I	**INTRODUCTION TO NANOTECHNOLOGY:** History, Concepts, Prospects and Challenges. Scope of nanotechnolo perspectives. Definition - Nanoscience, Nanotechnology. Classif dimensionality- basic understanding of 1D, 2D and 3D nanost nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biote

	nanocubes and hinges – smart glue, DNA as wire template.
II	**SYNTHESIS OF NANOPARTICLES:** Synthesis of nanoparticles - Top down and bottom up approach. Metho Chemical reduction – reducing agents, capping agents, stabilizing Biological – Novel synthetic methods using plant extracts, bacteria and f
III	**FOREST UTILIZATION AND WOOD TECHNOLOGY:** **PROPERTIES & CHARACTERIZATION OF NANOPARTICLES** Nano size effects - optical, electrical, mechanical, magnetic Characterization of nanoparticles using UV-Visible spectroscopy, SE microscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography
IV	**NANOCARRIERS:** Introduction. Nanocarriers for drug delivery (DDS) – Polimeric na nanoparticles (SLN) as carriers, controlled release, site specif nanoparticles as drug carriers and its applications.
V	**APPLICATIONS OF NANOPARTICLES:** Textiles, Food industry - nutraceutical, Medicine - antimicrobial activ dressing; Environment – green manufacturing. Agriculture - nanofertili Smart biosensors – Components and its application.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction to Na John Wiley & Sons, INC., Publication. 2. George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. 3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscie 4. Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Prac 5. Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnolog applications and perspectives, Wiley VCH publishers. 6. Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylo 7. Sharma P.K. 2008. Understanding Nanotechnology. Vista Interna House, Delhi. 8. Viswanathan B. 2009. Nano Materials. Narosa Publishing House,
ReferenceBooks	1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stan 2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Ba Bioscience. 3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparti nanoparticles more biocompatible. Brookhaven National Laborat 4. European Commission, SCENIHR. 2006. Potential risks associa adventitious products of nanotechnologies, European Union. 5. Gysell Mortimer, 2011. The interaction of synthetic nanop systems PhD Thesis, School of Biomedical Sciences, Univ.of Qu 6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. T and Nanotechnology. Spirnger Publication. 7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Dr

	Lung Cancer. Academic Press. An imprint of Elsevier.
Web resources	1. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453 2. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0 3. https://www.routledge.com/Nanobiotechnology-Concepts-and-Ap Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179 4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a 5. https://phys.org/news/2014-10-endless-possibilities-bio-nanotech 6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/ 7. https://phys.org/news/2014-10-endless-possibilities-bio-nanotech 8. http://www.particle-works.com/applications/controlled-drug-relea

MappingwithProgrammeOutcomes:

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

Title of the Course	**COMPUTER APPLICATIONS IN BOTANY**				
Paper Number	Elective-III				
Category	Elective	**Year**	III	**Credits**	3
		Semester	VI		
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**		
	3	1	-		
Pre-requisite	To equip students with computational skills for drug design.				
Learning Objectives					
C1	To familiarize the student with the fundamentals concepts of bioinforma				
C2	To equip students with computational skills for drug design.				
C3	Tolearnaboutthebioinformaticsdatabase,dataformatanddataretrievalfrom				
C4	To develop interdisciplinary skills in using computers in botany to lea database.				
C5	Studentisawarewith the most recent technologies for sequencing and and is able to apply them to the structural and functional genomics of pla				
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**				
1. Recognize advanced resources for accessing scholarly literature from the internet.	K1				
2. Explain the concept of databases and use of 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				
UNIT	**CONTENTS**				
	Introduction to computers and Bioinformatics. Introduction to Cor				

I	computer generation, low, medium and high level languages, software systems personal, mini, main frame and super computers, characte computer memory and its types, data representation and storage. Mic graphs, aggregate functions, formulas and functions, number syster secondary storage media
II	Biological Research on the web: Using search engines, finding scientifi of networking, internet, intranet, search engines- yahoo, Google, etc. tel
III	Computer fundamentals - programming languages in bioinformatics, ro biology. Historical background. Scope of bioinformatics - Geno 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); Seque FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence an systems (SRS, Entrez) DNA sequencing methods. protein sequencin 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 phylogeneti
V	**Applications:** Application of Taxonomic Software for preparation of Dichotomous Ke Make line drawing of Plants for description. Usage of plant identif phones. Computer application in biostatistics - MS Excel and SPSS.Co (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Compu
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi (1st Edition. 2. Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and New Delhi, Delhi: Oxford University Press. 3. Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wi 4. Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narc 5. Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinform the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: 6. Pevsner J. 2009. Bioinformatics and Functional Genomics, 2nd e Wiley Blackwell. 7. Xiong J. 2006. Essential Bioinformatics, 1st edition. Camb University Press.
Reference Books	1. Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Publishers and Distributors Pvt, Ltd., New York, US.

	2. David W. Mount. 2004. Bioinformatics Sequence and Genom Cold Spring Harbor Laboratory Press, New York, US. 3. Harshitha, D. 2006. Techniques of Teaching Computer Scie Distributor, Dehradun. 4. Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer netw CRC Press. 5. Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. E Springer-Verlag Berlin Heidelberg. 6. Ron Wehrens and Reza Salek. 2019. Metabolomics: Practica Analysis. Chapman and Hall/CRC; 1st edition. 7. Simon, R. Miller and S.A. Garry. 1998. Internet for the Mole III2nd Edn. Horizontal Scientific Press, Norwich, UK.
Web Resources:	1. http://www.agrimoon.com/introduction-to-computer-applications-pdf 2. https://www.ebooks.com/en-us/subjects/computers/ 3. https://it.careers360.com/download/ebooks 4. http://www.aun.edu.eg/molecular_biology/Procedure%20Bioinformat 2015/Xiong%20-%20Essential%20Bioinformatics%20send%20by%2 5. http://www.freebookcentre.net/Biology/BioInformatics-Books.html 6. https://courses.cs.ut.ee/MTAT.03.242/2017_fall/ uploads/Main/Basics_of_Bioinformatics.pdf

MappingwithProgrammeOutcomes:

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

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

ELECTIVE-III
3. FORENSIC BOTANY

Title of the Course	**FORENSIC BOTANY**						
Paper Number	Elective-III						
Category	Elective	**Year**	III	**Credits**	3	**CourseCode**	
		Semester	VI				
InstructionalHours perweek		**Lecture**	**Tutorial**		**LabPractice**	**Total**	
		3	1		-	4	
Pre-requisite		The course will provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.					

Learning Objectives	
C1	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.
C3	To learn classification of plants from forensic point of view.
C4	To understand forensic importance of different parts of plants.
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1
2. Summarize the forensic 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

UNIT	CONTENTS
I	General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.
II	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man–made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.
III	Various types of poisonous plants: *Abrus precatorius*, *Aconitum napellus*, *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Claviceps purpuria*, *Croton tiglium*, *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana tabacum*, *Strychnos nux vomica*, *Thevetia nerifolia*. Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, *Psilocybin* mushrooms.
IV	Collection and preservation of botanical evidences: Botanical samples, outdoor crime sceneconsideration.
V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.
ExtendedProfessionalComponent (is a part ofinternal component	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)

only,Not to be included in theExternalExamination questionpaper)	
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Coyle, H.M. 2005. Forensic Botany: Principles and Applications to Criminal Casework. CRC Press. 2. James, S.H., Nordby J.J., Bell, S. 2015. Forensic Science: An Introduction to Scientific and Investigative Techniques. CRC Press; 4 edition. 3. David W. Hall, Dr. Jason H. Byrd. 2012. Forensic Botany. Wiley-Blackwell; United Kingdom. 4. Jane H Bock, David Norris.2015. Forensic Plant Science. Elesvier. 5. Patricia E. J. Wiltshire.2012. Forensic Ecology,Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation. Criminal and Environmental Soil Forensics pp 129–149
Reference Books	1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition. 2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press. 3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell. 4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell. 5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.
Web Resources	1. https://www.kobo.com/us/en/ebook/forensic-botany 2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574 3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/ 4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299 5. http://docshare02.docshare.tips/files/25818/258183613.pdf

M**appingwithProgrammeOutcomes:**

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

CO3	2	1	2	3	1	2	1	3	1	2
CO4	3	3	3	3	2	1	3	3	2	1
CO5	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

Title of the Course	**BOTANICAL GARDEN AND LANDSCAPING**						
Paper Number	Skill Enhancement-3						
Category	Elective	**Year**	I	**Credits**	1	**CourseCode**	
		Semester	II				
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**		
		2	-	-	2		
Pre-requisite	Students should know about the fundamental concepts of gardening and landscaping.						

Learning Objectives	
C1	To know about the fundamental concepts of gardening and landscaping.
C2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.
C3	To illustrate the significance of garden adornments and propagation structures.
C4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.
C5	To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize fundamental concepts of gardening and landscaping.	K1
2. Explain about significance of garden adornments and propagation structures.	K2
3. Apply techniques of 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

UNIT	**CONTENTS**
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special

	types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.
II	Flower arrangement: importance, production EXPERIMENTS and cultural operations, constraints, postharvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.
III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.
IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd. 3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency 4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd. 5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
Reference Books	1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books. 2. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). 4. Acquaah, J. 2009. Horticulture – principles and practices, 4th

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

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 4

HERBAL TECHNOLOGY

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

	parts used, major chemical constituents.
III	Pharmacognosy - Systematic position, botany of the plant part used and following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseber Withania somnifera, Centella asiatica, Achyranthes aspera, Kalme Saravar. Herbal foods, future of pharmacognosy.
IV	Analytical pharmacognosy: Morphological and microscopic examinatio drug adulteration - types, methods of drug evaluation - Biological t Phytochemical screening tests for secondary metabolites (alkaloid triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added proces control for use in herbal formulations, Introductory knowledge of T propagation of some medicinal plants (*Withania somnifera*, neem and tu
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. AYUSH (www.indianmedicine.nic.in). About the systems—An ov and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Departm Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Minis Government of India. 2. Evans, W.C. 2009: Trease and Evans PHARMACOGNOSY. 16 Elsevier. 3. Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Pla Publishing Company, 1994 - Herbs - 570 pages. 4. Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition . 5. Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pu
Reference Books	1.Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. C Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105 2. Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publica 3. Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant F Nutraceuticals and Functional Foods. Foods 5 : 88. 4. Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phyt 1000. 5. Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0
Web resources	1. https://www.kopykitab.com/Herbal-Science 2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7 iS5t8yenurClUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7l 3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alterna healing/herbal-medicine/_/ N-ry0Z8qa 4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html 1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404 5. https://www.dattanibookagency.com/books-herbs-science.html 6. https://www.springer.com/gp/book/9783540791157

MappingwithProgrammeOutcomes:

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

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

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

ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

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

UNIT	CONTENTS
I	**INTRODUCTION TO ENTREPRENEURSHIP** Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.
II	**TOOLS AND TECHNIQUES** Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.
III	**NEW VENTURE CREATION** Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
IV	**PRODUCT DEVELOPMENT AND COMMERCIALIZATION** Product commercialization and business strategy, Dyes, Cosmetics and Perfumes,

	Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
V	**BIO-BUSINESS PLANS, IPR AND BIOETHICS** Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
Extended ProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India. 2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India. 3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA. 4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture. 5. Sathe,T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
Reference books	1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK. 2. Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5.

	Webster,JandWeber,R.2007.IntroductiontoFungi,3rdEd.CambridgeUniversityPress, Cambridge
Web sources	1.https://www.brainkart.com/article/Entrepreneurial-Botany_38321/ 2.https://www.youtube.com/watch?v=hnBla1FfcLo 3.https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation 4.http://www.brainkart.com/article/Economically-Useful-Plants-andEntrepreneurial-Botany_38301 4. https://www.ebooks.com/en-us/subjects/gardening/ 5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

MappingwithProgrammeOutcomes:

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

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

ELECTIVE – INDUSTRY MODULE

CULTIVATION OF ALGAE

Title of the Course	**INDUSTRY MODULE-CULTIVATION OF ALGAE**					
Paper Number	**INDUSTRY MODULE**					
Category	Elective	**Year**	III	**Credits**	2	**CourseCode**
		Semester	VI			
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	**Total**	
		3	1	-	4	
Pre-requisite		Studentsshould know fundamental knowledge on algae and itsbiotechnologicalapplications.				

Learning Objectives	
C1	Toimpartsufficientinformationabouttheculture andcultivationofalgaeunderlaboratoryandoutdoorconditions..
C2	Tostudy themediacomposition foralgaecultivation and high valueproducts and itsapplications.
C3	Toknowabouttheimportantseaweedsanditscultivationpractices.
C4	TostudytheSLFproduction andapplicationsinagriculturecrops.
C5	Tounderstandabout the EnvironmentImpact Assessmentof algalcultivation.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Obtainanin-depthknowledgeonculture andmasscultivationofalgaeanditsdifferentmethods.	K1
2. Explorationandrecommendationofthecommercialpotential of algalproducts.	K2
3. Understandtheappliedfacetofalgologyandacquireacompleteknowledgeaboutthecultivationmethod	K3

s in algae.	
4. Describethepreparationofseaweedliquidfertilizersandtheirapplicationsinagriculture andhorticulture.	K4
5. Acquiringtheinformationaboutalgalapplicationsindifferentindustriesandagriculturefieldsin the current scenario.	K5 & K6

UNIT	CONTENTS
I	Morphology, life history and mass culture of microalgae: *Spirulina*, *Chlorella*,*Dunaliella*and *Botryococcus.*
II	High value products: Single Cell Protein (SCP), phycocyanin, β-carotene, astaxanthin –biofuel,mediacomposition-scaleup- labtoland-racewaypondsandphotobioreactor.
III	Marine macroalgae: Morphology, life history and mass cultivation of *Gracilaria*,*Kappaphycus*,*Sargassum*and*Ulva.*
IV	Polysaccharides:agar,carrageen,alginate-economicimportance-seaweedasfood,feedandSeaweed Liquid Fertilizer (SLF).
V	Roleofseaweedsin aquaculture: Environment ImpactAssessmentofalgalcultivation.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved(TobediscussedduringtheTutorialhour)
Skillsacquiredfrom this course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. KumarH.D.andSingh,H.N.1976.ATextBookofAlgaeAffiliatedEastWestPressPvt.Ltd.,New Delhi,Madras. 2. Kumar,H.D.1990.IntroductoryPhycology,AffiliatedEastWestPress(P)Ltd.,NewDelhi,Madras,Hyderabad, Bangalore. 3. Pandey,B.P.1993.AText bookofBotany-Algae S. Chand&Co.,(P) Ltd.,NewDelhi. 4. Sharma,O.P.1990.TextBookofAlgaeTataMcGrawHill PublishingCo.,Ltd., NewDelhi. 5. Vashista,B.R.1988.Botany fordegreestudents-Algae. S.Chand&

	Co.,(P)Ltd., NewDelhi
Reference Books	1. Bilgrami,K.S.,andL.C.Saha.1996.ATextBookofAlgae,CBSPublishers& Distributors(P)Ltd.,New Delhi. 2. Chapman,V.J. and Chapman, D.J., 1973. TheAlgae. 2nd Ed. ELBS& MacMillan, 498 pp., 3. FritschF.E.1935.TheStructureandReproductionofAlgae1945.Cambridge UniversityPress,Cambridge,U.K. Vol.I-791 pp., Vol. II-939 pp., 4. Round,F.E. 1973.Biology ofthe Algae. 2nd Ed.Edward Arnold, London. 278pp., 5. Sharma,O.P.1990.TextBookofAlgae.TataMcGrawHillPublishingCo.,Ltd., NewDelhi,396
Web Resources	1. https://www.aiche.org/academy/videos/conference-presentations/study-culture-strategies-microalgae-continuous-photobioreactor-system-biofuel-production 2.https://link.springer.com/article/10.1007/s10811-013-9983-9 3. https://www.nrel.gov/docs/legosti/old/2360.pdf 4. file:///C:/Users/Lenovo/AppData/Local/Temp/alba2018.pdf 5. file:///C:/Users/Lenovo/AppData/Local/Temp/Seaweed_aquaculture_Cultivation_technologies_ch all.pdf

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

Title of the Course	**FERMENTATION TECHNOLOGY**						
Paper Number	Skill Enhancement						
Category	Elective	**Year**	III	**Credits**	1	**CourseCode**	
		Semester	VI				

InstructionalHours perweek	Lecture	Tutorial	LabPractice	Total
	2	-	-	2
Pre-requisite	To students to know about the various fermentation technology.			

Learning Objectives	
C1	To appreciate the significance of microbes synthesizing fermented products.
C2	To gain insights on safety and quality control in large scale production of fermentative products.
C3	To design and operation of industrial practices in mass production of fermented products.
C4	To know about the various fermentation technology.
C5	To learn about the bioproduct recovery.
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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.	

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 ProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

Recommended Texts	1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK. 2. Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA. 3. Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co., USA. 4. JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P)

	Limited Publishers, New Delhi, India. 5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK. 6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.
Reference Books	1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK. 2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press. 3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA. 4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany. 5. John E. Smith. Biotechnology. 2009. Cambridge University Press.UK. 6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY. 7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.
Web resources	1. https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html 2. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ 3. https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W 4. https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html 5. https://www.ebooks.com/en-us/book/2698294/principles-of-fermentation-technology/peter-f-stanbury/

MappingwithProgrammeOutcomes:

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

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

SKILL ENHANCEMENT COURSES SEC 7

ENVIRONMENTAL IMPACT ANALYSIS

Title of the Course	**ENVIRONMENTAL IMPACT ANALYSIS**				
Paper Number	Skill Enhancement				
Category	Elective	**Year**	III	**Credits**	1
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		2	-	-	
Pre-requisite	To students to know about the environmental impact asses				

Learning Objectives	
C1	To understand about the theory and practice of environmental impact
C2	To develop skills in identifying and solving problems of environment
C3	Define and classify Environmental Impacts and the terminology.
C4	Understands the environmental Impact assessment procedure.
C5	List and describe environmental audits.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

UNIT	**CONTENTS**
I	Origin and Development Purpose and aim, core values and prin development, Environmental Management Plan, Environmental Impact in Project planning and Implementation.
II	EIA Process Components of EIA, EIA Methodology- Screening, Scopir Identification, Prediction, Evaluation and Mitigation, Appendices and Fo
III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklis Environmental component: air, noise, water, land, biological, social an EIA Document.

IV	Main participants in EIA Process Role of Project proponent, environm PCCs, public and IAA. Public participation.
V	Environmental Appraisal and Procedures in India and EIA Metho mitigation, Environmental Audit of different environmental resources, environmental assessment, ecological impact assessment: legislation.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
	1 Morris, P. and Therivel, R. 1995. Methods of Environmental Press, London. 2. Petts, J. 1999. Handbook of Environmental Impact Asses Blackwell Science, Oxford. 3. Therivel, R. and Partidario, M.R. 1996. The Practice of Assessment, Earthscan, London. 4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and S Wiley & Sons, Chichester. 5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessmer New York, 1996
Reference Books	1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental M Co. New Delhi. 2. Petts, J. 2005. Handbook of Environmental Impact Assess Blackwell Publishers, UK. 3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction Assessment. Routledge, London. 4. Canter, W.L. 1995. Environmental Impact Assessment, Engineering/ Math, New York. 5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact A Reinhold Co., New York, 1991.
Web resources	1. https://www.amazon.in/Environmental-Impact-Assessmer Khandeshwar-ebook/dp/B06XTNQ5PW 2. https://www.ikbooks.com/books/book/earth-environmenta sciences/environmental-impact-assessment/97893823329 3. https://www.elsevier.com/books/environmental-impact-as 12-811139-0 4. https://link.springer.com/book/10.1007/978-3-030-80942- 5. https://onlinelibrary.wiley.com/doi/book/10.1002/047172

MappingwithProgrammeOutcomes:

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

CO3	2	2	1	3	1	1	2	3	2	3
CO4	3	3	3	3	2	2	3	3	3	3
CO5	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)

Title of the Course	**BOTANY FOR COMPETITIVE EXAMINATIONS**					
Paper Number	Skill Enhancement					
Category	Elective	**Year**	III	**Credits**	2	
		Semester	VI			
InstructionalHours perweek	**Lecture**	**Tutorial**	**LabPractice**			
	2	-	-			
Pre-requisite	To develop the students for preparing various competitive					
Learning Objectives						
C1	To develop the student for competitive examination.					
C2	To select the important topics as far as possible, with reference to t view. It gives a comprehensive account of botany.					
C3	To understand not only the basics of botany and also gives the broad for the competitive examinations.					
C4	The essays give a detailed account of each aspect of botany to hel IAS, IFS and state civil services.					
C5	General understanding of plants around us, the different bioph processes that occur within them and their importance to human life.					
Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**					
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	K1,K3&K5					

recognize the fossil beds of Tamil Nadu Analyse and trace the origin of different plant groups using Geological Time scale	
3.Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.	K3& K5
4.Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked inheritance. Tabulate the different cell organelles with their functions.	K2,K3 &K5
5. Define and appreciates biodiversity. Identify the cause and solve environmental related issues . Design eco friendly approaches to protect earth and generate new conservation strategies.	K1,K5 &K6
	GENERAL STUDIES FOR COMPETITIVE EXAMINA Physical Geography Indian and World Geography Indian and World History International Organizations Everyday Science Awards and Honors Indian Economy Indian Polity

UNIT	CONTENTS
I	**PLANT WORLD:** Plant science and its branches . Five kingdom classification. Outli General characters and Economic importance of Algae,Fungi and Liche
II	**GENERAL CHARACTERS OF PLANT GROUPS:** General characters and Economic importance of Bryophytes, Pteridopl .Palaeobotany- Types of fossils,Geological time scale ,Fossil beds of Ta
III	**PLANT MORPHOLOGY AND TAXONOMY:** Root system and shoot system. Modifications (Pneumatophore, Sti Cladode, Phylloclade ,Pitcher and Phyllode) Parts of a flower Parthenocarpy- Pollination – types, Seed dispersal – types, Seed Germi –definition. Types of classification- Taxonomic hierarchy, ICN, Bin BSI. Herbarium and Major Herbaria of the world.

IV	**CYTOLOGY AND GENETICS:** Cell –Prokaryotic and Eukaryotic – Cell organelles with functions . concepts) -Cell division and its significance -Mitosis and Meiosis Monohybrid and Dihybrid cross, Sex linked inheritance
V	**ECOLOGY AND BIODIVERSITY:** Ecosystem – abiotic and biotic components. Energy flow in an e Deforestation- Chipko movement –-Forest Conservation act- Pollu Eutrophication, Global warming ,Ozone depletion, Climate change. Biodiversity and types- Hot spots, Mega diversity countries, Conserva methods. Endangered plants and Red data Book. Rio -Earth summit. E Policies - IUCN, UNEP, WWF, ICSU, WCMC.
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	QuestionsrelatedtotheabovetopicsfromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021 Examinations:(Useful for UPSC-Indian Forest Service, Civ CSIR - NET, ICAR-NET and Other Competitive Exams.) A 2. Mitra, S. 2016.Botany for competitive examinations, Acad 3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany,Library B 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 Ed India.
Reference Books	1. De Robertis and De Robertis. 1990. Cell and Mole College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Pri Wiley Sons Inc., 8th Edn., New York. 3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wass 4. Sharma, P.D. 2017. Ecology and Environment- Rastogi 5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup New Delhi. 6. Power, C.B and Daginawa, H.F. 2010. General M Publishing House Pvt Ltd, 7. Rangasamy, G. 2006. Disease of crop plants in India (4t Hill New Delhi. 8. Singh,V.,Pande,P.CandJain,D.K. ATextBookofBotany.RastogiPublications,Meerut. 9. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 20 Angiosperms (6th revised and enlarged edition). Vikas Delhi.
Web resources	1. https://www.amazon.in/BOTANY-COMPETITIVE-EX MITRA/dp/9383420898 2. https://www.amazon.in/Botany-Competitive-Examinatio Competive/dp/B08VWB64BC

	3. https://www.ssclatestnews.com/botany-book-pdf-free-do exams/ 4. https://sscstudy.com/botany-for-competitive-exams-pdf/ 5. https://www.amazon.in/Botany-Entrance-Examination-A ebook/dp/B089S1GLMP

MappingwithProgrammeOutcomes:

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

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

BOTANY FOR ADVANCED STUDIES (4 hours)

Title of the Course	**BOTANY FOR ADVANCED STUDIES**				
Paper Number	Skill Enhancement				
Category	Elective	**Year**	III	**Credits**	2
		Semester	VI		
InstructionalHours perweek		**Lecture**	**Tutorial**	**LabPractice**	
		4	-	-	
Pre-requisite	To develop the botany students for preparing advanced stu				
Learning Objectives					
C1	To be familiar with the basic concepts and principles of plant systema				
C2	Learn the importance of plant anatomy in plant production systems.				
C3	To expose the students a fundamental of the various techniques used				
C4	To learn about the physiological processes that underlie plant metabol				
C5	To know the energy production and its utilization in plants.				

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
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

UNIT	**CONTENTS**
	MOLECULAR GENETICS (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 euka exceptions, tRNA-suppressor mutations. Mechanism of trans

I	elongation and termination, proteins involved, factors affecti Molecular mechanism of mutation, cancer biology, human cytog (ii) Molecular mechanism of Gene Regulation: Regulation in pro Eukaryotes, Epigenetic mechanisms: methylation and tran cosuppression through transcriptional silencing, genome impri >alternative splicing, RNA stability, RNA interference. Transl amplification, mating type interconversion. Genomics: Structural genomics, Genetic and physical mapping (RFL cyotogenetic maps, physical maps, positional cloning, chromosome wa sequencing, genome databases, human genome sequencing project transcriptome, proteome and metabolome, Microarrays and gene-chips. Functional and evolutionary relationships prokaryotes, organelles and and paralogues. Metabolomics: Identification and quantification of biological samples. Pharmacogenomics and drug designing.
II	**ADVANCED TRENDS IN SYSTEMATICS** **(i) Basic concepts of:** a. Morphology - History, general morphology, types of data, methods of b. Anatomy - History, general anatomy, types of data, methods of gather c. Embryology – History, types of data, methods of gathering data; d. Palynology: History, general palynological characters, types of dat data; e. Cytology and Cytogenetics: History, general cytological and cytoger data, methods of gathering data; f. Ecology, History, general ecology, types of data, methods of gathering (At least two examples from each section should be studied to sub significance) **(ii) Chemotaxonomy:** a. History, general chemical and chemotaxonomic characters, typ gathering data. b. Identification of the major classes of the pharmaceutically importan from natural sources 8 (phenolics, steroids, terpenoids glycosides and all c. Applications: Phytochemicals in cosmetics, aromatherapy, disease pr in the production of phytochemicals. Phytochemical databases (iii) Molecular trends in Biosystematics a. Molecules and genomes in plant systematics, techniques used i molecular systematics in crop evolution b. Serology in relation to plant taxonomy- Methods, role of serology in t c. Cladistics and Phenetics (iv) Molecular trends in Reproductive B Types, cytogenetic basis and induction of apomixes, applications.) Biochemistry and genetics of incompatibility, methods to overcom viability tests, molecular basis of incompatibility) Sterility – Male sterility, CMS, GMS, CGMS, temperature sensitive sterility, transgenic male sterility, female sterility and zygotic st
	PLANT PHYSIOLOGY (i) Modern concepts Photosynthesis – Environmental and agricultur – Biochemical control of respiration (ii) Photomorphogenesis Phytochrome genes and their express

III	morphogenic responses. Dose-response relations in photomorp chloroplast differentiation, effect of photoreceptors. (iii) Biological clock: Circadian rhythms, rhythm responses to enviro (iv) Photoperiodism General principles , florigen concept (v) Plant growth and development Patterns of growth and differen and mutations regulating meristem function, embryogenesis, flower development. Homeotic genes, ABCD model in Arabi control of plant tissue development, effect of auxins on ro gibberellin promoted growth of plants, ethylene and tri brassinosteroids and photomorphogenesis.
IV	**PLANT PHYSIOLOGY** **(i)** Enzymes: General account: Importance and properties of enz biological sciences, the classification and nomenclature of en Mechanism of enzyme action role of enzyme in chemical action, var enzyme activity.Molecular genetics in plant physiology, Environm Stress physiology .
V	**ECONOMC BOTANY** Economic importance of Cereals, Tuber Crops, Fibre yielding plants, yielding plants, Narcotics, Vegetables, Oil yielding plants, Pulses and Be
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsU CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill
Recommended Texts	1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The Mc 2. Maheshwari, P. 1963. Recent Advances in Embryology o Plant Morphologists, New Delhi. 3. Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Delhi. 4. Jain, V.K. 2017. Plant Physiology, S.Chand & Company L 5. Lincoln, T, Eduardo, Z, Ian Max, M, and Angus, M. 201 Physiology. Sinauer Associates Inc., US. 6. Becker, W.M., Kleinsmith L.J. & Hardin J. 2005. The edition). Benjamin/Cummings Pub. Co. New York. 7. Brooker, R. J. 1999. Genetics Analysis and Principles. A Inc., New York. 8. Bruce, A. et. al. 2002. Molecular Biology of the Cell. York.
Reference books	1. Mabberley, J.D. 2014. Mebberley's Plant-Book: A port their classification and uses, 3rd ed. Cambridge Universit 1021pp. 2. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, N 3. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the angiosperms. Springer Science & Business Media, Germa 4. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant A Approach. Blackwell Publishing, Malden, USA.

	5. Steward, F.C. 2012. Plant Physiology Academic Press, US 6. Hopkins, W.G and Huner, N.P. 2009. Introduction to Pl John Wiley & Sons. U.S.A. 7. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Phy India, New Delhi. 8. Anthony J . F. G .2000. An Introduction to Genetic Analy New York. 9. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Gene Bartlett Pub, Boston. 10. Klug .S.W. & Cummings, M.R. 2003. Concepts of Gen Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant American Society for Cell Biology, New York. 11. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Free 12. Russell, P.J. 2005. Genetics: A Molecular Ap Pearson/Benjamin Cumming, San Francisco. 13. Snustad, D. P. & Simmons M.J. 2003.Principles of Gene Inc. U.S.A. 14. Mabberley, J.D. 2014. Mebberley's Plant-Book: A port their classification and uses, 3rd ed. Cambridge Universit 1021pp. 15. Pandey.B.P. 1999. Economic Botany. S. Chand Limited, N 16. Bhojwani, S.S. and Soh, W.Y. 2013. Current trends in the angiosperms. Springer Science & Business Media, Germa 17. Cutler, D. F., Botha, T and Stevenson, D.W. 2008. Plant A Approach. Blackwell Publishing, Malden, USA. 18. Steward, F.C. 2012. Plant Physiology Academic Press, US 19. Hopkins, W.G and Huner, N.P. 2009. Introduction to Pl John Wiley & Sons. U.S.A. 20. Noggle G.R and G.J. Fritz. 2002. Introductory Plant Phy India, New Delhi. 21. Anthony J . F. G .2000. An Introduction to Genetic Analy New York. 22. Hartl, .D.L & Jones E. W. 2000. Genetic analysis of Gene Bartlett Pub, Boston. 23. Klug .S.W. & Cummings, M.R. 2003. Concepts of Gen Pvt. Ltd., Singapore. Kreezer et al . 2001. Recombinant American Society for Cell Biology, New York. 24. Lodish Harvey. 1999. Molecular Cell Biology. W.H. Free 25. Russell, P.J. 2005. Genetics: A Molecular Ap Pearson/Benjamin Cumming, San Francisco. 26. Snustad, D. P. & Simmons M.J. 2003.Principles of Gene Inc. U.S.A.
Web resources	1. http:// www.ornl.gov. 2. http:// ash. gene. ncl. ac .nk.. 3. http://tor. cshl. org. http:www. gdb. org. 4. http: //www. neg r. org. 5. http: // www. genetics. wustl. edu. 6. http: // genome. imb- jena. dc.

MappingwithProgrammeOutcomes:

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

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

FOUNDATION COURSE FOR BOTANY

BASICS OF BOTANY

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

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

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

	and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
ExtendedProfessionalComponent (is a part ofinternal component only,Not to be included in theExternalExamination questionpaper)	Questionsrelatedtotheabovetopics,fromvariouscompetitiveexaminationsUPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/otherstobesolved (TobediscussedduringtheTutorialhour)
Skillsacquiredfromthis course	Knowledge,ProblemSolving,Analyticalability,Professional Competency,ProfessionalCommunicationandTransferrableSkill

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

MappingwithProgrammeOutcomes:

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

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