KAMARAJ COLLEGE

(AUTONOMOUS)

Accredited with A+ Grade by NAAC

Among Top 150 Colleges in India - NIRF Ranking 2025

இந்து நாடார் சங்கங்களால் 1966-ல் தொடங்கப்பட்ட கல்லூரி

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

THOOTHUKUDI - 628 003.

B.Sc., Botany

Semester – I to VI

(for the students those who joined from the academic year 2024-2025)

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Semester – I to VI

Syllabus

(for the students those who joined from the academic year 2024-2025)

Department profile

Name of the Programme : **B.Sc.,Botany**

Programme Code : **03009**

Year of establishment : **1985 - 86**

Vision:

- To prepare students for lifelong learning by introducing them to the vast world of plant knowledge and the methodology of academic inquiry.

Mission:

- To impart knowledge of science, develop scientific attitude, and make students aware of the importance of the environment and natural resources.

College Mail ID: **kamarajcoll@gmail.com**
College Website: **https://kamarajcollege.ac.in/**

Undergraduate degree programme

1. Introduction

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

Eligibility:

A pass in Higher Secondary examinations or its equivalent in Science stream with Biology/ Botany/Zoology/Microbiology as one of the course or a course from general stream course (Biotechnology, Biochemistry, and Microbiology) is eligible to apply.

Learning outcomes- Based curriculum frame work guidelines based Regulations For Under Graduate Programme	
Programme:	B.Sc.(Botany)
Programme Code:	03009
Duration:	3 Years (UG)
Programme Outcomes:	
PO1	**Disciplinary knowledge**: Capable of demonstrating comprehensive knowledge and understanding of one or more disciplines that for ma part of an undergraduate Programme of study.
PO2	**Communication Skills**: Ability to express thoughts and ideas effectively in writing and orally; Communicate with others using appropriate media; confidently share one's views and express herself/himself; demonstrate the ability to listen carefully, read and write analytically, and present complex information in a clear and concise manner to different groups.

PO3	**Critical thinking:** Capability to apply analytic thought to a body of knowledge; analyse and evaluate evidence, arguments, claims, beliefs on the basis of empirical evidence; identify relevant assumptions or implications; formulate coherent arguments; critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO4	**Problem solving:** Capacity to extrapolate from what one has learned and apply their competencies to solve different kinds of non-familiar problems, rather than replicate curriculum content knowledge; and apply one's learning to real life situations.
PO5	**Analytical reasoning**: Ability to evaluate the reliability and relevance of evidence; identify logical flaws and holes in the arguments of others; analyze and synthesize data from a variety of sources; draw valid conclusions and support them with evidence and examples, and addressing opposing viewpoints.
PO6	**Research-related skills:** A sense of inquiry and capability for asking relevant/appropriate questions, problem arising, synthesizing and articulating; Ability to recognize cause-and-effect relationships, define problems, formulate hypotheses, test hypotheses, analyses, interpret and draw conclusions from data, establish hypotheses, predict cause-and-effect relationships; ability to plan, execute and report the results of an experiment or investigation
PO7	**Cooperation/Team work:** Ability to work effectively and respectfully with diverse teams; facilitate cooperative or coordinated effort on the part of a group, and act to gather as a group or a team in the interests of a common cause and work efficiently as a member of a team
PO8	**Scientific reasoning:** Ability to analyses, interpret and draw conclusions from quantitative/qualitative data; and critically evaluate ideas, evidence and experiences from an open-minded and reasoned perspective.

Programme Specific Outcomes	
On successful completion of Bachelor of (chemistry) programme, the student should be able to:	
PSO1	Disciplinary Knowledge:
PSO2	Critical Thinking:
PSO3	Problem Solving
PSO4	Analytical & Scientific Reasoning:
PSO5	Research related skills:

Methods of Assessment	
Recall (K1)	Simple definitions, MCQ, Recall steps, Concept definitions
Understand/ Comprehend (K2)	MCQ, True/False, Short essays, Concept explanations, Short summary or Overview
Application (K3)	Suggest idea/concept with examples, Suggest formulae, Solve problems, Observe, Explain
Analyze (K4)	Problem- Solving questions, Finish a procedure in many steps, Differentiate Between various ideas, Map knowledge
Evaluate (K5)	Longer essay/Evaluation essay, Critique or justify with pros and cons

Methods of Evaluation		Marks	
Internal Evaluation	Continuous Internal Assessment Test	15	25
	Assignment (PPT) and Seminar	5	
	Group Discussion and Viva	5	
External Evaluation	End Semester Examination		75
Total			**100**

Extra Credits

Curricular Activities	Co-Curricular Activities	Extra-Curricular Activities
Paper Presentation	Cultural Competitions	NCC
Paper Publication	Domain Clubs	NSS
Placement Training		Sports
Quiz		YRC
Competitions		UBA
SWAYAM /NPTEL/MOOCs		

Level	Credit			
	Participation	III Prize	II Prize	I Prize
Intra college	1	2	3	4
Intercollegiate	2	3	4	5
District	3	4	5	6
University	4	5	6	7
State	5	6	7	8
National	6	7	8	9
International	7	8	9	10

****Paper Presentation for each paper: 1credit**

Total credits Under–Graduate Courses including Lab Hours -2024 to 2025

Semester	Hours	Credits	Additional Credits	Extra Credits
I	30	23	2	3
II	30	23	2	3
III	30	22	2	3
IV	30	23	2	3
V	30	25	3	3
VI	30	22	3	3
Total		**138**	**14**	**18**

****Extra Credit will be given on the basis of student's performances**

Written Examination: Theory Paper (Bloom's Taxonomy based) Question paper Model Assessment Pattern

Continuous Internal Assessment (CIA) & End Semester Examination (ESE)

- CIA: 25
- ESE:75

Theory Course:

For theory courses there shall be two tests conducted by the faculty concerned and the average of the best two can be taken as the Continuous Internal Assessment (CIA).CIAisfor50 marks max and will be converted in to 15 marks. The duration of each test shall be 2 Hrs.

Continuous Internal Assessment (Writing)	15 marks
Assignment (PPT) & Seminar	5 marks
Viva & Group Discussion	5marks

For theory Papers:

- Part A (10×1=10) Marks –Answer all questions (Multiple choice)
- Part B (5×5 =25) Marks – Choosing either (a) or (b)
- Part C (5×8=40) Marks – Choosing either (a) or (b)

Total =75 marks

Laboratory Courses Assessment

- CIA- 40 marks
- ESE-60 marks
- Mandatory Record submission, attendance and class participation.
- Two CIA for 40 marks max. The average of the best two can be taken as the Continuous Internal Assessment.
- The duration of each test shall be 3hours

In order to avoid pull the scored own of each PO, it is suggested that the usage – Low (1) to the minimum. The S, M, Lis based on the Course out comes. The mapping is based on their vised Bloom's Taxonomy Verbs used to describe your Course outcomes.

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

Pedagogy:

- Technology Based Learning (PPT)
- Peer Teaching (Chalk & Talk)
- Virtual Lab
- Blended Learning (Online & Offline)
- Group Learning
- Self - Study
- Games Based Learning

Course Structure for Science Stream
First Year – Semester I
B.Sc., Botany
(With effect from the academic year 2024 to 2025 onwards)

Semester I	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part I	24ULTL11	தமிழ் இலக்கிய வரலாறு - I	6	3	3	25	75	100
Part II	24ULEN11	General English - I	6	3	3	25	75	100
Part III Core I	24UMBO11	Plant Diversity - I	5	5	3	25	75	100
Core II– Lab- I	24UMBOL1	Plant Diversity Practical - I	3	3	3	40	60	100
EC 1 Discipline /Generic	24UEZO11	Allied Zoology Paper–I	4	3	3	25	75	100
	24UEZOL1	Lab on Allied Zoology -I	2	2	3	40	60	100
Part-IV SEC 1 (Select anyone)	24USBO11 24USBO12 24USBO13	1.Organic farming 2.Environmental Biotechnology 3.Nurseryand Landscaping	2	2	3	25	75	100
FC	24UFBO11	Basics of Botany	2	2	3	25	75	100
		Total	**30**	**23**				

****SEC-Skill Enhancement Course** ****CIA-Continuous Internal Assessment**
****EC–Elective Course** ****ESE-End Semester Examination**
****FC-Foundation course**

Course Structure for Science Stream
First Year – Semester II
B.Sc., Botany
(With effect from the academic year 2024 to 2025 onwards)

Semester II	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part - I	24ULTL21	தமிழ் இலக்கிய வரலாறு - II	6	3	3	25	75	100
Part - II	24ULEN21	General English – II	6	3	3	25	75	100
Part - III Core - III	24UMBO21	Plant Diversity - II	5	5	3	25	75	100
Core - IV Lab -2	24UMBOL2	Plant Diversity II – Practical - 2	3	2	3	40	60	100
EC - II Discipline /Generic	24UEZO21	Allied Zoology Paper – II	4	3	3	25	75	100
	24UEZOL2	Allied Zoology - Practical	2	2	3	40	60	100
Part - IV SEC - II (Select any one)	24USBO21 24USBO22 24USBO23	1. Mushroom cultivation 2. Herbal Medicine 3. Global Climate change	2	2	3	25	75	100
SEC - III	24USBO24	Botanical garden & Land scaping	2	2	3	25	75	100
		Total	**30**	**23**				

****SEC-Skill Enhancement Course** ****CIA-Continuous Internal Assessment**
****EC–Elective Course** ****ESE-End Semester Examination**
****FC-Foundation course**

Course Structure for Science Stream
Second Year – Semester III
B.Sc., Botany
(With effect from the academic year 2024 to 2025 onwards)

Semester III	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part- I	24ULTL31	தமிழக வரலாறும் பண்பாடும்	6	3	3	25	75	100
Part- II	24ULEN31	General English - III	6	3	3	25	75	100
Part -III Core- V	24UMBO31	Plant Diversity III	5	5	3	25	75	100
Core VI Lab - III	24UMBOL3	Plant Diversity III Practical-III	3	2	3	40	60	100
EC -III Discipline /Generic	24UECH31	Allied Chemistry Paper – I	4	3	3	25	75	100
	24UECHL1	Allied Chemistry Practical - I	2	2	3	40	60	100
Part-IV SEC- IV	24USBO31 24USBO32 24USBO33	1. Cell & Molecular Biology 2. Herbal Technology 3. Silviculture and Agroforestry	2	2	3	25	75	100
Part - IV	24UYOG31	Yoga, Culture & Heritage	2	2	3	25	75	100
		Total	**30**	**22**				

****SEC-Skill Enhancement Course** ****CIA-Continuous Internal Assessment**
****EC–Elective Course** ****ESE-End Semester Examination**
****FC-Foundation course**

Course Structure for Science Stream
Second Year – Semester IV
B.Sc., Botany
(With effect from the academic year 2024 to 2025 onwards)

Semester IV	Course Code	Name of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Part - I	24ULTL41	தமிழும் அறிவியலும்	6	3	3	25	75	100
Part - II	24ULEN41	General English - IV	6	3	3	25	75	100
Part - III Core - VII	24UMBO41	Plant Diversity - IV	5	5	3	25	75	100
Core - VIII Lab - 4	24UMBOL4	Plant Diversity – IV Practical - 4	3	2	3	40	60	100
EC - IV Discipline /Generic	24UECH41	Allied Chemistry Paper – II	4	3	3	25	75	100
	24UECHL2	Allied Chemistry - Practical - 2	2	2	3	40	60	100
Part - IV SEC - V	24USBO41 24USBO42 24USBO43	1. Post-Harvest Technology 2. Fermentation technology 3. Vermicomposting	2	2	3	25	75	100
Part - IV	24UEVS41	Environmental Studies	2	2	3	25	75	100
Part - V	24UEA41	NCC/ NSS/ YRC/ SPORTS	-	1	-	-	-	100
		Total	**30**	**23**				

****SEC-Skill Enhancement Course** ****CIA-Continuous Internal Assessment**
****EC–Elective Course** ****ESE-End Semester Examination**
****FC-Foundation course**

Course Structure for Science Stream
Third Year – Semester V
B.Sc., Botany
(With effect from the academic year 2024 – 2025 onwards)

Semester V	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core - IX	24UMBO51	Taxonomy of Angiosperms and Economic Botany	5	4	3	25	75	100
Core - X	24UMBO52	Plant Anatomy, and Embryology of Angiosperms	5	4	3	25	75	100
Core - XI Lab - 5	24UMBOL5	Taxonomy of Angiosperms and Economic Botany – Practical - V	3	2	3	40	60	100
Core - XII- Lab - 6	24UMBOL6	Plant Anatomy, and Embryology of Angiosperms – Practical - VI	3	2	3	40	60	100
Project - 1	24UMBOP1	Project with Viva Voce	4	3	-	50	50	100
EC - V (Select any one)	24UEBO51 24UEBO52 24UEBO53	1. Entrepreneurial botany 2. Bio-Analytical Techniques 3. Aquatic Botany	4	3	3	25	75	100
EC - VI (Select any one)	24UEBO54 24UEBO55 24UEBO56	1. Computer application in Botany 2. Plant Bio resources 3. Seed Biology	4	3	3	25	75	100
Part - IV	24UPDT51	Personality Development	2	2	3	25	75	100
Training	24UINT51	Internship	-	2	-	50	50	100
	Total		**30**	**25**				

****SEC- Skill Enhancement Course** ****CIA- Continuous Internal Assessment**

****EC– Elective Course** ****ESE- End Semester Examination**

Course Structure for Science
Stream Third Year –VI
B.Sc., Botany
(With effect from the academic year 2024 – 2025 onwards)

Semester VI	Course Code	Title of the Course	Hours / Week	Credit	Duration of ESE (Hrs.)	Marks Allotted		
						CIA	ESE	Total
Core - XIII	24UMBO61	Plant Physiology and Biochemistry	6	5	3	25	75	100
Core - XIV	24UMBO62	Genetics and Plant Ecology	6	5	3	25	75	100
Core - XV Lab - 7	24UMBOL7	Plant Physiology and Biochemistry – Practical	4	3	3	40	60	100
Core - XVI Lab- 8	24UMBOL8	Genetics and Plant Ecology – Practical	4	3	3	40	60	100
EC - VII (Select any one)	24UEBO61 24UEBO62 24UEBO63	1. Horticulture and Plant Breeding 2. Natural Resource Management 3. Forensic Botany	5	3	3	25	75	100
EC - VIII (Select any one)	24UEBO64 24UEBO65 24UEBO66	1. Plant Biotechnology 2. Forestry 3. Pomology	5	3	3	25	75	100
		Total	**30**	**22**				

****SEC- Skill Enhancement Course** ****CIA- Continuous Internal Assessment**

****EC– Elective Course** ****ESE- End Semester Examination**

Semester - I
Plant Diversity - I

Title of the Course		**Plant Diversity - I**					
Course Type		**Core - I**					
Year	**I**	**Semester**	**I**	**Credits**	**3**	**Course Code**	**24UMBO11**
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		3	**2**		**--**	**5**	

Learning Objectives	
LO1	To provide a comprehensive knowledge on the biology of algae.
LO2	To provide a basis for better understanding of the all us organization in various algal groups
LO3	To understand methods of reproduction and life histories of different algae groups
LO4	To understand the methods of large scale cultivation algae
LO5	To comprehend the beneficial role of algae.

Unit	**Contents**
I	Introduction of algae, general characters, distribution, pigmentation, Classification (Fritsch-1935-1945), Pattern of Lifecycle (Haplontic, Diplontic and Haplodiplontic)
II	Thallus organization (Unicellular- Chlorella, colonial-Volvox, filamentous-Spirogyra, siphonous- Caulerpa, parenchymatous- Gracilaria).
III	Internal and External structure, reproduction and life cycle of Chara, Sargassum and Ulva
IV	Algal cultivation methods - Cultivation Methods of Gracilaria and Sargassum -Floating Raft System, Longline System, Off-bottom Method , Net Method.
V	Algae as food and feed: Agar-agar, Alginic acid, Application of algae as fuel, bio fertilizer and pharmaceutical. Role of algae as indicator of water pollution.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Dehradun. Edward lee, R.2018. Phycology, 5thEd.CambridgeUniversityPress, London.
2	Kumar, H.D.1999.Introductory Phycology. Affiliated East West Press, Delhi
3	Singh, Pandey and Jain. 2020. A text book of Botany, Publication, Meerut. 5thEdition, Rastogi
4	Vashishta, P.C.2014.S.Chand & Company Ltd, New Delhi.
5	Ian Morris.1977.Anintroductiontothealgae. 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.TheAlgae.AlphaNumera.
4	Fritsch, F.E.1945. Structure and reproduction of Algae. Cambridge University press..
5	Round, FE. 1984. The Ecology of Algae. Cambridge University Press.

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-BiodiversityTaxonomy-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

Course Outcomes	On completion of this course, students will be able to
CO1	Recall and identify algae using key characters.
CO2	Demonstrate practical skills in preparation off rash mount and identification of algal forms from algal mixture
CO3	Describe the internal structure of algae prescribed in the syllabus
CO4	Decipher the algal diversity in fresh/marine water and their economic significance
CO5	Identify algae in natural habitats

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Diversity-I - Practical

Title of the Course	Plant Diversity- I Practical						
Course Type	Core - Major Practical - 1						
Year	I	Semester		Credits	3	Course Code	24UMBOL1
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		-	--		3	3	

Learning Objectives	
LO1	To develop skills to identify algae based on habitat, thallus structure and the internal organization
LO2	To identify micro algae in a mixture.
LO3	To developed skills to prepare the micro slides of algae.
LO4	To study the economic importance of species of algae.
LO5	To understand importance of algae to animals and humans

Practical

1. Micro-preparation 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) Cattle Feed (iii) Bio fertilizers (iv) Single Cell Protein (SCP) (v) Agar-Agar (vi) Alginic acid.
5. Field visit to study fresh water/marine water algal habitats.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination Question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Kumar, H.D. 1999.Introductory Phycology. Affiliated East-West Press, Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020.TextBookofPracticalBotany-1(10th Ed). Rastogi Publications, Meerut. 3. Round, FE.1984.TheEcology 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-. 5. Singh, Pandey and Jain.2020.A text book of Botany, 5th Edition, Rastogi Publication, and Meerut...
Reference Books	1. Nancy SerediakandM.Huynh.2011.Algae identification lab Guide. Accompanying 2. Manu alto 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 4thEdition, Cambridge University Press, New York. 5. Dehradun. Edward lee, R.2018. Phycology,5th Ed., Cambridge University Press, London
Web sources	1. https://www.amazon.in/Practical Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id= 8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts- of-Botany- Algae-(PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Course outcomes: CO	On completion of this course, the students will be able to
CO1	Recall and identify algae using key characters.
CO2	Demonstrate practical skill sin preparation of fresh mount and identification of algal forms from algal mixture.
CO3	Describe the internal structure of algae prescribed in the syllabus
CO4	Decipher the algal diversity in fresh/marine water and their economic significance
CO5	Identify algae in natural habitats

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

Allied botany-I

Title of the Course		Allied botany -I					
Course Type		Elective – I					
Year	I	Semester	I	Credits	3	Course Code	24UEBO11
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		4	1		--	4	

Learning Objectives	
LO1	To study morphological and anatomical features of algae
LO2	To familiarize with the general characters and economic uses of fungi, bacteria and virus
LO3	To familiarize with the general characters and life histories of bryophytes, pteridophytes and gymnosperms
LO4	To explore the general morphology and life histories of pteridophytes.
LO5	To gain an understanding of the general characteristics and life cycles of gymnosperms
Unit	**Contents**
I	**Algae:** General characters of algae-Structure, reproduction and lifecycle of the following genera- *Gracilaria*, economic importance of algae.
II	**Fungi and Lichens** General characters of fungi, structure, reproduction and lifecycle of Penicillium and economic importance of fungi. **Lichens** General characters and economic importance of Lichens Structure and reproduction of *Usnea,*
III	**Bacteria**- Vegetative and sexual reproduction in Bacteria **Virus**-General characters, structure of TMV.
IV	**Bryophytes and Pteridophytes** **Bryophytes -** General characters of Bryophytes, Structure and life cycle of *Marchantia* **Pteridophytes**-General characters of Pteridophytes, Structure and lifecycle of *Lycopodium*
V	**Gymnosperms**- General characters and economic importance of Gymnosperms, Structure and lifecycle of *Cycas*

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Dehradun. Edward lee, R .2018. Phycology, 5th Ed., Cambridge University Press, London.
2	Kumar,H.D.1999.IntroductoryPhycology.AffiliatedEastWestPress,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	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S..

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	MihirKumar,D.2010.AlgalBiotechnology.DayaPublishingHouse,NewDelhi
3	Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numeral.
4	Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press...
5	Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, 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-BiodiversityTaxonomy-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

Course outcomes	On completion of this course, students will be able to
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.
CO2	Develop an understanding of fungi and appreciate their adaptive strategies.
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes
CO4	Understand and differentiate the structural organization and life histories of Bryophytes and Pteridophytes
CO5	Comprehend the core concepts of gymnosperm biology, including their general features, economic significance, and the structure and life cycle of Cycas.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Allied Botany Practical -I

Title of the Course		Allied Botany Practical - I					
Course Type		Elective - I					
Year	I	Semester	I	Credits	3	Course Code	24UEBOL1
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		-	--		2	2	

Learning Objectives	
LO1	To develop skill-based techniques for preparing and analyzing micro-preparations of Algae, Lichens, Bryophytes, Pteridophytes, and Gymnosperms.
LO2	To observe and interpret the microstructure of Algae and Fungi through prepared slides and specimens.
LO3	To identify and differentiate viruses and lichens using microscopic slides and photographic representations.
LO4	To recognize and compare the structural features of Bryophytes, Pteridophytes, and Gymnosperms through microscopic analysis.
LO5	To acquire field-based knowledge and practical experience by studying plants in their natural habitats and preparing a detailed field report.

Practical

1. Make suitable micro preparation prescribed in the syllabus of Alage, Lichen, Bryophytes, Pteriodophytes and Gymnosperms.
2. Observation of micro slides/ specimen prescribed in syllabus of Algae and Fungi
3. Identifying the micro slides / photographs relevant to the syllabus of virus and lichen.
4. Identifying the micro slides / photographs relevant to the syllabus of Bryophytes, Pteridophytes and Gymnosperms.
5. Field trip (Minimum 2 days) to places under the guidance of teachers to study plants in their natural habitat and submit a report.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Sharma, O.P. 2017.Bryophyta, MacMillan India Ltd, New Delhi
2	Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3	Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
4	Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5	Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

References Books:	
1	Strick berger, M.W. 2005. Genetics (III Ed). Prentice Hall, New Delhi, India.
2	Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying manual to algae identification field guide, Ottawa Agriculture and Agrifood Canada publisher.
3	Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
4	Aler Gingauz.2001.MedicinalChemistry.OxfordUniversityPress&Wiley Publications.
5	Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
Web Resources:	
1	https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883
2	https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover
3	https://www.amazon.in/Computational-Phytochemistry-Satyajit-Dey-Sarker-
4	ebook/dp/B07CV96NZJ4.https://medlineplus.gov/genetocs/understanding/basics/cell/
5	https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
6	http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf
7	https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-

Course outcomes	On completion of this course, students will be able to
CO1	Gain knowledge on the internal organization of various plant groups.
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.
CO3	Analyze the microscopic structure and organization of Algae, Lichens, Bryophytes, Pteridophytes, and Gymnosperms.
CO4	Understand the comprehensive understanding of the structural and reproductive features of Bryophytes, Pteridophytes, and Gymnosperms.
CO5	Gain experiential learning through field exploration of plant diversity in natural habitats and preparation of a detailed field report.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

Organic farming

Title of the Course		Organic farming					
Course Type		Skill Enhancement Course - I					
Year	I	Semester	I	Credits	2	Course Code	24USBO11
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	---		--	2	

Learning Objectives	
LO1	To enable students to gain knowledge on the properties and importance of soil
LO2	To impart practical in sights sustainable agriculture, green manuring-recycling and composting.
LO3	To understand the significance of organic and green manures
LO4	To know about the importance of bio fertilizers
LO5	To study methods of recycling of bio degradable wastes.

Unit	Contents
I	Soil–physical, chemical properties. Ill effects of soil, chemicals–fertilizers, pesticide and herbicides
II	Organic farming–definition, basic concept of organic farming, Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts and Mulches importance of organic manure, importance of green manure, oil cake. Vermin compost-methods, production and utilization.
IV	Bio fertilizers –definition, importance and advantages, Mass mass cultivation, inoculant formulations and application method of Rhizobium, Azolla production and application.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes–bio compost making methods.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TRB/ NET/UGC–CSIR/GATE/TNPSC/others to be solved(To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	NIIR Board. 2012. The complete Technology Book on Bio fertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services.
2	Sa the, T.V. 2004.Vermiculture and Organic Farming. Daya publishers.
3	SubbaRaoN.S.2017.BiofertilizersinAgricultureandForestry.Fourth Edition . Med tech.
4	Vayas, S.C, Vayas, S. and Modi, H.A. 1998.Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
5	Dongarjal, R.PandZade,S.B.2019.Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi

References Books:	
1	Vayas, S.C, Vayas, Sand Modi, H.A. 1998.Bio-fertilizers and organic Farming Akta Prakashan, Nadiad.
2	Sathe,T.V. 2004. Vermi culture and Organic Farming. Day a publishers
3	Subha Rao, N.S. 2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi
4	Reddy,S.R.2019.FundamentalsofAgronomyKalyaniPublications,UttarPradesh
5	Tolanur, S. 2018. Fundamentals of Soil Science 2nd Edition, 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=7263656357513Assessment-and-Biotechnology/Pereira Neto/p/book/9781466581678Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh

Course outcomes	On completion of this course, students will be able to
CO1	Recognize the different forms of soils and ill effects of chemical fertilizers
CO2	Explain and interpret the components, patterns, and processes of Organic maturing and composting
CO3	Apply techniques for synthesizing green manure and develop strategies to increase crop yield.
CO4	Analyze and decipher the significance of bio fertilizers
CO5	Develop new strategies for recycling of solid organic wastes

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Environmental Biotechnology

Title of the Course		Environmental biotechnology					
Course Type		Skilled Enhancement Course - I					
Year	I	Semester	I	Credits	2	Course Code	24USBO12
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	---		--	2	

Learning Objectives	
LO 1	To introduce the student to the various developed and applications of Environmental biotechnology.
LO 2	To provide knowledge about the scope of bio remediation and bioleaching Using GMOs.
LO 3	To study about pollution of water bodies
LO 4	To know about bio remediation.
LO 5	To study about bio mineralization.
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 Bio sorption. Removal of oils pills 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 Xenobiotic. Degradation of Xenobiotic–pathways of phenol, pentachlorophenol and polychlorinated biphenyl degradation.
IV	Bioremediation: Introduction to bio remediation, exist and insist bioremediation.
V	Bio metallurgy and related topics: Bio mineralization–bioleaching-Bio films and bio corrosion.

Extended Professional Component (is a part of internal component only, not To be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TR B/NET/UGC–CSIR/GATE/TNPSC/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 Bio technology. Pearson Education Limited
2	Dubey R.C. 2004. A text book of Bio technology aspects of microbiology, British Sun Publication.
3	Joseph C. Deniel. 1996. Environmental aspects of microbiology, British Sun Publication.
4	Keeshav Thehan. 1997. Bio technology, New age international)P) Limited, New Delhi.
5	Chandra, A. M and Ghosh, S.K. 2010. Remote sensing and Geographical Information System, Nares a Publishing House Pvt. Ltd. New Delhi.

References Books:

1	SsSharma, P.D. 2005. Environmental Microbiology, Narosa Publishing House Pvt. Ltd., New Delhi.
2	RainaMaierM.IranPepperL.,CharlesP.Gerba,2000, Environmental Microbiology, Academic press, U.K.
3	AlexanderN.GlazerandHiroshiNikaido.1994.MicrobialBiotechnology.
4	Special issue on Bioremediation and bio degradation. 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. 2nded. Cambridge University Press. ISBN. 978-1107114234.

Web Resources:	
1	https://www.elsevier.com/books/environmental-biotechnology/vallero/978-0-12-
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

Course outcomes	On completion of this course, students will be able to
CO1	Recognize the various causes of pollution and control measures.
CO2	Explain about the beneficially role of GMO son environment.
CO3	Reflect upon various sustainable environmental protection strategies...
CO4	Analyze the different methods of air, water, and soil quality monitoring process.
CO5	Evaluate the implications of international legislations and policies for environmental protection.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Nursery and Landscaping

Title of the Course		Nursery and Landscaping					
Course Type		Skilled Enhancement Course - I					
Year	I	Semester	I	Credits	2	Course Code	24USBO13
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	---		--	2	

Learning Objectives	
LO1	To recognize the importance of growing plants in nursery and their role in landscaping.
LO2	To study and practice the methods of propagation
LO3	To gain knowledge on the types of garden
LO4	To know about the types of structures in nursery.
LO5	To learn about composting methods.

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– Greenhouse, garden Implements – spade, pruning scissor water can, digging fork. Topiary, Bonsai culture.
V	Management of organic wastes and green manures: Farm manures, Composts and Mulches importance of organic manure, importance of green manure, oil cake. Vermicompost-methods, production and utilization.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/TR B/NET/UGC–CSIR/GATE/TNPSC/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 Land scaping, M/s IBD Publishers, New Delhi
2	Butts, Eand 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.

References 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.FundamentalsofHorticulture.KalyaniPublishers
5	SharmaV.K.1999.EncyclopediaofPracticalHorticulture,VolI–IV,DeepAndDeep 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-Amarnathbiotechnology/vallero/978-0-12-
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

Course outcomes	On completion of this course, students will be able to
CO1	Recognize the basic principles and nursery and landscaping
CO2	Explain and practice plant propagation techniques.
CO3	Apply techniques for design various types of gardens according to the culture and art of bonsai.
CO4	Analyse the importance of plant growing structures
CO5	Explain the methods of composting

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Basics of Botany

Title of the Course		Basics of botany					
Course Type		Foundation Course					
Year	I	Semester	I	Credits	2	Course Code	24UFBO11
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		2	---		--	2	

Learning Objectives	
LO1	To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
LO2	To Enable the learners to understand various cell structures and functions of Prokaryotes and eukaryotes and the salient features and functions of cellular organelles.
LO3	Togainknowledgeonthemorphologyofvariousplantpartsandtheirmodifications
LO4	To Understand of laws of inheritance, genetic basis of loci and alleles.
LO5	To become familiar with important plant physiological processes like absorption and transpiration

Unit	Contents
I	**Plant diversity** Salient features of various Plant Groups: Algae, Fungi, Bryophytes, Pteridophytes Gymnosperms, and Angiosperms.
II	**Cell biology** Cell as the basic unit of life- Ultra Structure of Prokaryotic and Eukaryotic Cell (Plant Cell) -Cell Wall-Cell Membrane, Chloroplasts, Mitochondria and Nucleus.
III	**Plant morphology** Structure and Modification of Root, Stem and Leaf- Inflorescences– recemose and cymose types. Types of fruits (Outline only)
IV	**Genetics** Mendel‘s Laws of Inheritance, Monohybrid, Test cross, Back cross and Dihybrid cross.
V	**Plant physiology** Water relation - Diffusion, Osmosis, Plasmolysis, Imbibition Ascent of sap, Translocation of solutes.

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/UGCCSIR/GATE/TNPSC/otherstobesolved(Tobediscussedduringthe Tutorial hour)
Skills acquired from this course	Knowledge,ProblemSolving,Analyticalability,ProfessionalCompetency,Professional Communication and Transferrable Skill

Recommended Texts:

1	Singh, V., Pande, P. CandJain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2	Bhatnagar, S.P and AlokMoitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3	Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4	Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5	Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S. Chand and Co. New Delhi.
6	Rao, K., Krishnamurthy, K.VandRao, G.S.1979. Ancillary Botany, S.Viswana than Pvt. Ltd., Madras.

References Books:

1	Parihar, N.S.2012.An introduction to Embryophyta–Pteridophytes-Surjeet Publications, Delhi.
2	Alexopoulos, C.J.2013.Introduction to Mycology. Willey Eastern Pvt.Ltd
3	Vashishta, P.C.2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4	Coulter, M.Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5	Vashishta, P.C.2014. Botany for Degree Students Algae.2014. Chand & Company Ltd, Delhi.
6	Parihar, N.S.2013. An introduction to Embryophyta – Bryophytes - Surjeet Publications, Delhi.

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

Course outcomes CO	On completion of this course, students will be able to
CO1	Develop acritical understanding on the distinguishing traits, geographic distribution lichens, and bryophytes
CO2	Compare the structure and function of prokaryotic and eukaryotic cell
CO3	Develop critical understanding on morphology of various plant parts
CO4	Understand the basic concepts of genetics
CO5	Understand the core concepts and fundamentals of plant physiology

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Semester - II

Plant Diversity II

Title of the Course		Plant Diversity II					
Course Type		Core - III					
Year	II	Semester	II	Credits	5	Course Code	24UMBO21
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		--	5	
Learning Objectives							
LO 1	To describe the general characteristics of fungi as being heterotrophic, Unicellular/multicellular.						
LO 2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles						
LO 3	To learn the structure and reproduction in Bacteria and viruses						
LO 4	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bio indicator species						
LO 5	To identify the main groups of plant pathogens, their symptoms various types of plant diseases.						

Unit	Contents
I	**FUNGI** Characteristic features of Fungi, Classification of fungi (Alexopoulos and Mims, 1979), thallus organization, mode of nutrition, structure, reproduction and life-history of Zygomycotina - Mucor, Ascomycotina - Peziza, Basidiomycotina - Puccinia and Deuteromycotina - Cercospora.
II	**ECONOMIC IMPORTANCE OF FUNGI:** Fungi as food; Fungi in agriculture application – bio-fertilizers; Mycotoxins-biopesticides; Production of industrially important products from fungi -- ethanol, organic acids - citric acid, Applications of fungi in pharmaceuticals -Penicillin. Importance of VAM fungi. Harmful effects of Fungi (any five)
III	**BACTERIA, VIRUS:** Classification- outline (Bergey, 1994), Ultra structure and reproduction - vegetative and sexual in bacteria. Viruses: general characters, structure and reproduction of bacteriophage.
IV	**PLANT PATHOLOGY:** General symptoms of plant diseases; Disease cycle. Prevention and control of the following plant diseases: Bacterial diseases - Citrus canker and Bacterial wilt of Banana Viral diseases-Tobacco Mosaicand Vein clearing of Ladies finger. Fungal diseases - Blast disease in rice and Tikka disease of Groundnut.

V	**LICHEN:** Classification (Hale, 1969). Habitat, nature of association, Study of growth forms of lichens (crustose, foliose and fruticose). Structure, distribution and reproduction of *Usnea*. Economic importance of Lichens.-Food, Medicine, Dye, Ecological importance,.
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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
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.
References 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

Course outcomes CO	On completion of this course, students will be able to
CO1	Recognize the general characteristics of fungi
CO2	Develop an understanding on the economic uses of fungi
CO3	Comprehend the structure and reproduction in bacteria and virus
CO4	Analyze the structure and reproduction in Lichens and their role in agricultural and pharmaceutical applications.
CO5	Identify the common plant diseases and device control

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Diversity II– Practical - 2

Title of the Course	**Plant Diversity II- Practicals**						
Course Type	**Core – IV – Lab - 2**						
Year	**II**	**Semester**	**II**	**Credits**	**2**	**Course Code**	**24UMBOL2**

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

Learning Objectives	
LO 1	To enable students to identify microscopic and macroscopic fungi.
LO 2	To know about the economic uses of fungi
LO 3	To know the ultra-structure of bacteria and virus through photomicrographs
LO 4	To identify the lichens based on the morphology, and micro slides.
LO 5	To identify the symptoms of plant diseases caused by microbes

Practical

1. Micro preparation of vegetative and reproductive structures of fungi prescribed in the syllabus.
2. Study of economically important products obtained from fungi: Fungal bio fertilizers, bio pesticides, edible mushroom/Yeast, organic acids (citric acid), and antibiotics (Penicillin) Mycorhiza: Eecto-mycorhiza and endo-mycorrhiza (Photographs) Grams staining procedure for identification of bacteria.
3. Micro photograph for ultra-structure of Bacteria and Bacteriophage Vegetative and reproductive structure of Usnea- Micro-preparation
4. Visit to nearby Microbial Industry.

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

Reference Books	1. Dehradun. Edwardlee, R.2018. Alexopoulos, JandMims,W. 1985 .Introductory Mycology, Wiley Eastern Limited New Delhi. 2. Bendre, M.Ashok and AshokKumar, A.2 020.Text Book of Practical Botany 1 (10th ed). Rastogi Publications, Meerut. 3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur. 4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.Phycology,5th Ed.,Cambridge University Press, London
Web sources	1. https://www.amazon.in/Practical-Manual-FungiFungicides/dp/B0025AEFP4https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_e sc=y 2. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfhs9b https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEACAAJ&redir_esc=y

Course outcomes: CO	On completion of this course, the students will be able to
CO1	Develop practical skills for Identifying fungi using key characters
CO2	Access the useful role of fungi in agriculture and pharmaceutical industry
CO3	Identify the type of bacteria through grams staining procedure.
CO4	Analyze the characteristics of various types of lichens pathogens
CO5	Recognize the symptoms of plant diseases caused by pathogens

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

Mushroom Cultivation

Title of the Course		**Mushroom Cultivation**					
Course Type		**Skill Enhancement Course - II**					
Year	**I**	**Semester**	**II**	**Credits**	**2**	**Course Code**	**24USBO21**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		2	**--**		**--**	**2**	
Learning Objectives							
LO1	To learn about morphology and importance of mushrooms						
LO2	To understand the structure and life cycle of mushrooms						
LO3	To know about methods involved in growth and harvesting of mushrooms						
LO4	To recognize the techniques of mushroom cultivation.						
LO5	To study about the diseases of mushrooms and post-harvest technology						

Unit	Contents
I	Introduction: Morphology, Types of Mushroom, identification of Edible and poisonous mushroom, Nutritive values.
II	Structure and Life cycle of *Pleurotusspp* and *Agaricus spp.*
III	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
IV	Mushroom cultivation methods: Bag method, Bed method. Prospects and scope of Mushroom cultivation in small scale Industry.
V	Diseases -, Insect pests, nematodes, mites, viruses, fungal competitors. Post harvesting technology.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Handbook of Mushroom Cultivation. 1999. TNAU publication.
2	Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3	Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
4	Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun.
5	Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing.Daya Publishing House.
References Books:	
1	Handbook of Mushroom Cultivation. 1999. TNAU publication.
2	Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3	Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
4	Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17.
5	Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi
Web Resources:	
1	https://www.amazon.in/Mushroom-Cultivation-India-BC/dp/817035479Xbiotechnology/vallero/978-0-12-
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

Course outcomes CO	On completion of this course, students will be able to
CO1	Recall various types and nutritive values of mushroom.
CO2	Explain about the morphology and life cycle of mushrooms.
CO3	Know the strategies for marketing of mushrooms
CO4	Apply techniques for cultivation of various types of mushroom
CO5	Understand the diseases and pests of mushroomsK5

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Botanical Garden and Landscaping

Title of the Course		Botanical Garden And Landscaping					
Course Type		Skill Enhancement - II					
Year	I	Semester	II	Credits	2	Course Code	24USBO24
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	--		--	2	

Learning Objectives	
LO1	To know about the fundamental concepts of gardening and its importance
LO2	To provide an overview of various components of a garden
LO3	To illustrate the significance of garden adornments like rockery
LO4	To provide an insight into indoor gardening
LO5	To create entrepreneurial skills for landscaping.

Unit	Contents
I	Types of gardening – Formal and Informal garden, Ornamental garden, Importance of garden making. Principles of designing a garden.
II	Garden components – Green house, Lawn, Planting trees, shrubs, climbers and creepers. Flower beds and borders
III	Ornamental hedges, Edges ,Pergola, Rockery and water garden
IV	Topiary, indoor gardening, Bonsai -preparation of soil and its composition, manuring, watering and maintenance,
V	Basic principles of landscape design – components of landscape design – plant materials and structural materials. Vertical gardens. Landscaping of residential and public areas.
Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UP SC/TRB/NET/UGC–CSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd
2	Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd.
3	Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency .
4	Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
5	Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
References 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

Course outcomes CO	On completion of this course, students will be able to
CO1	Recognize fundamental concepts of gardening
CO2	Explain about significance of garden components
CO3	Apply techniques for creation of garden adornments
CO4	Identify methods for preparation and maintenance of Topiary and Bonsai.
CO5	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Global Climate Change

Title of the Course		Global Climate Change					
Course Type		Skill Enhancement Course - II					
Year	I	Semester	II	Credits	2	Course Code	24USBO23
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	--		--	2	

Learning Objectives	
LO1	To gain insights on the impact of greenhouse effect on global climate change and mitigation measures.
LO2	To understand the implications of carbon and ecological footprint.
LO3	To apply the knowledge to greenhouse effects.
LO4	To know the rain and its effects on plants.
LO5	To know about Global Environmental change issues.

Unit	Contents
I	Global Environmental change issues. UNFCC, IPCC, Koyo to protocol, CDM, Carbon footprint and ecological footprint.
II	Stratospheric ozone layer: Evolution of ozone layer; Causes of depletion and consequences; Effects of enhanced UV-B on plants, microbes, animals, human health and materials; Global efforts for mitigation ozone layer depletion.
III	Climate change: Greenh ouse effects; causes; Greenhouse gases and their Sources; Consequences of climate, oceans, agriculture, natural vegetation and humans; International efforts on climate change issues.
IV	Atmospheric deposition: Past and present scenario; Causes and consequences of excessive atmospheric deposition of nutrients and trace Elements; Eutrophication.
V	Acid rain and its effects on plants, animals, microbes and ecosystems.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UP SC/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
References Books:	
1	Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.
2	Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.
3	Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
4	Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5	Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.
Web Resources:	
1	https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/
2	http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html
3	https://www.smashwords.com/books/category/4727/newest/0/free/any
4	https://www.free-ebooks.net/environmental-studies-academic/Global-Warming
5	https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

Course outcomes CO	On completion of this course, students will be able to
CO1	Relate to the anthropogenic pressure on the environment and carbon footprint.
CO2	Explain about the physical basis of natural green gas house effect on man and materials.
CO3	Evaluate human influenced driver of our climate system and its applications..
CO4	Analyze the causes and effects of depletion of the stratospheric ozone layer.
CO4	Develop new strategies to mitigate issues of global environmental change.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Herbal Medicine

Title of the Course		Herbal Medicine					
Course Type		Skill Enhancement Course - III					
Year	I	Semester	II	Credits	2	Course Code	24USBO22
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	--		--	2	
Learning Objectives							
LO1	To understand the nuances of medicinal plants and their Phyto constituents of commercial value						
LO2	To design and develop medicinal garden.						
LO3	To apply the knowledge to cultivate medical plants.						
LO4	To know the pharmacological importance of medicinal plants.						
LO5	To enlist phytochemicals and secondary metabolites of market and commercial value.						

Unit	Contents
I	Importance and Relevance of Herbal drugs in Indian System of Medicine, Pharmacognaosy – Aim and scope.
II	Medicinal gardening – Gardens in the Hills and plains; House gardens; plants for gardening- cultivation of *Aloe vera, Gloriosa superba, Catharanthus roseus, Ocimum sanctum*
III	Extraction methods – Water distillation, and steam distillation. .Extraction of Eucalyptus oil, Sandal oil, Rose oil, Clove oil.
IV	zizanioides, Vinca rosea; Rhizomes – Ginger and Acorus; wood –Sandal and bark drugs – Cinnamon
V	Botanical description active principles and uses of leaves – Aloe, Coleus; seed – Pepper, Neem and entire plants – *Phyllanthus niruri, Andrographis paniculata*

Examination question paper)tended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UP SC/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
References Books:	
1	Matthew. R.A. 2009. Jon Barnett, Bryan McDonald. Global Environmental Change and Human Security. MIT Press., USA.
2	Hester, R.E and Harrison, R.M. 2002. Global Environmental Change. Royal Society of Chemistry.
3	Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234.
4	Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5	Kormondy, E.J. 2017. Concepts of Ecology. Prentice Hall, U.S.A. 4th edition.

Web Resources:	
1	https://www.ebooks.com/en-us/subjects/the-environment-climate-change-ebooks/2074/
2	http://www.ebooks-for-all.com/bookmarks/detail/Climate-Change/onecat/Electronic-books+Environment-and-nature/0/all_items.html
3	https://www.smashwords.com/books/category/4727/newest/0/free/any
4	https://www.free-ebooks.net/environmental-studies-academic/Global-Warming
5	https://www.nap.edu/catalog/14673/climate-change-evidence-impacts-and-choices-pdf-booklet

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

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Allied Botany - II

Title of the Course		Allied Botany-II					
Course Type		Core Allied - II					
Year	I	Semester	II	Credits	3	Course Code	24UEBO21
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		--	4	

Learning Objectives	
LO1	To be familiar with the basic concepts of morphology of plant parts
LO2	To Learn the vegetative and floral characters of angiosperm families
LO3	To Understand the internal structure of vegetative plant parts
LO4	To become familiar with the concepts of embryology of flowering plants
LO5	To learn about the physiological processes that underline plant metabolism.

UNIT	CONTENTS
I	**MORPHOLOGY OF FLOWERING PLANTS:** Structure of root, stem and leaf. Leaf types- simple and compound. Phyllotaxy. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.
II	**TAXONOMY:** Study of the vegetative and floral characters and economic importance of the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Poaceae
III	**ANATOMY** Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot root, stem and leaf.
IV	**EMBRYOLOGY** Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization.
V	**PLANT PHYSIOLOGY** Absorption of water- Mechanism .Photosynthesis -Light reaction, dark reaction (Calvin cycle). Respiration - Glycolysis - Krebs cycle - electron transport system.

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/UGCCSIR/GATE/TNPSC/others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies.
2	Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi.
3	Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi.
4	Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
5	Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
References Books:	
1	Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2	Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3	Pandey, B.P. 2012. Plant Anatomy. S Chand Publishing.
4	Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
5	Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
6	Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
7	Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand & Co., New Delhi
Web Resources:	
1	https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0 Mb9gC&redir_esc=y
2	https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id= Roi0lwSXFnUC&redir_esc=y
3	https://archive.org/EXPERIMENTS/plantanatomy031773mbp
4	https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar- ebook/dp/B00UN5KPQG
5	https://www.crcpress.com/Plant-Physiology/Stewart- Globig/p/book/9781926692692

Course outcomes CO	On completion of this course, students will be able to
CO1	Understand the fundamental concepts of morphology
CO2	Analyze and recognize the different families of flowering plants
CO3	Understand the internal organization and tissue components of vegetative parts
CO4	Know the structure of anther, Classify the types of Ovule and the method of fertilization in angiosperms
CO5	Understand the mechanism of photosynthesis and respiration in plants

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Allied Botany - Practicals

<table>
<tr><td>Title of the Course</td><td colspan="7">Allied Botany - Practicals</td></tr>
<tr><td>Course Type</td><td colspan="7">Allied Practicals – Lab - II</td></tr>
<tr><td>Year</td><td>I</td><td>Semester</td><td>II</td><td>Credits</td><td>2</td><td>Course Code</td><td>24UEBOL2</td></tr>
<tr><td colspan="2" rowspan="2">Instructional Hours per week</td><td>Lecture</td><td colspan="2">Tutorial</td><td>Lab Practice</td><td colspan="2">Total</td></tr>
<tr><td>-</td><td colspan="2">--</td><td>2</td><td colspan="2">2</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>LO1</td><td colspan="7">To enhance information on the arrangement of leaves on stem and identification of inflorescence types</td></tr>
<tr><td>LO2</td><td colspan="7">To learn the skill of floral dissection</td></tr>
<tr><td>LO3</td><td colspan="7">To be familiar with the physiological experiments related to photosynthesis and respiration</td></tr>
<tr><td>LO4</td><td colspan="7">To develop the skill for micro preparation of vegetative plant parts</td></tr>
<tr><td>LO5</td><td colspan="7">To learn about the structure of anther and ovule</td></tr>
<tr><td colspan="8">Practical</td></tr>
<tr><td colspan="8">1. Phyllotaxy types – Alternate, Opposite and Whorled
2. Inflorescence types- Racemose and Cymose
3. Dissect out and draw the floral parts of the plants belonging to the families prescribed in the syllabus.
Demonstration experiments
1. Ganong‘s Light screen
2. Fermentation – Kuhn‘s experiment
3. To make suitable micro preparations of vegetative plant parts prescribed in the syllabus.
4. Permanent micro slides / photographs for Observation of anther and ovule.</td></tr>
</table>

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

Mapping with Programme Outcomes and Programme Specific Outcomes

Course outcomes: CO	On completion of this course, the students will be able to
CO1	Identify the type of phyllotaxy and inflorescence types.
CO2	Develop critical understanding on the floral features of angiosperm families through floral dissection
CO3	Demonstrate simple experiments related to photosynthesis and respiration
CO4	Understand the internal organization of vegetative parts of the plant
CO5	Comprehend the structure of anther and ovule.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Semester - III

Plant Diversity III

Title of the Course		**Plant Diversity III**					
Course Type		**Core III**					
Year	**II**	**Semester**	**III**	**Credits**	**5**	**Course Code**	**24UMBO31**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		3	**2**		**--**		**5**
Learning Objectives							
LO 1	To enable the students to have an overview of General characters classification and economic importance of Bryophytes						
LO 2	To understand the morphological diversity, structure and reproduction of Bryophytes.						
LO 3	To know the General characters and classification of Pteridophytes						
LO 4	To understand the morphological diversity, structure and reproduction of Pteridophytes.						
LO 5	To gain knowledge on the economic uses of Pteridophytes						

Unit	Contents
I	General characters of Bryophytes, classification (Rothmaler 1951. Upto the order level) .Economic importance of Bryophytes – Ecological importance (Pollution Indicators and monitoring), Medicinal uses, horticulture, industrial uses and absorbent bandages.
II	Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (Marchantia); Anthoceratopsida (Anthoceros) and Bryopsida (Polytrichum).
III	Pteridophytes General Characters of Pteridophytes - Classification (Sporne, 1951).Apogamy and apospory, homospory and heterospory.
IV	Morphology, anatomy and reproduction of the forms belonging to the following classes: Psilotopsida (Psilotum), Lycopsida (Selaginella),
V	Morphology, anatomy and reproduction of the forms belonging to the class Pteropsida (Marsilea). Economic importance of Pteridophytes- Medicinal uses, horticulture, industrial and ecological uses.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Sharma, O.P.2017. Bryophyta, Mac Millan India Ltd. Delhi.
2	Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
3	Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
4	Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
5	Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
References Books:	
1	Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
2	Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteriodophyta, Central book depot, Allahabad.
3	Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
4	Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
5	Watson, E.V.1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
Web Resources:	
1	http://www.bryoecol.mtu.edu/
2	https://www.amazon.in/IntroductionBryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFWQK
3	http://www.bsienvis.nic.in/Database/Pteridophytes-in-India_23432.aspx
4	http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
5	http://www.botany.ubc.ca/bryophyte/mossintro.html aeTIUC&redir_esc=y

Course outcomes CO	On completion of this course, students will be able to
CO1	Recognize morphological variations and uses of Bryophytes
CO2	Explain the anatomy and reproduction of Bryophytes belonging to different classes
CO3	Identify the distinguishing features of Pteridophytes
CO4	Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Pteridophytes
CO5	Access the useful role Pteridophytes

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Diversity III - Lab

Title of the Course	**Plant Diversity III - Lab**						
Course Type	**Core-Major Practical's-III**						
Year	**II**	**Semester**	**III**	**Credits**	**2**	**Course Code**	**24UMBOL3**
Instructional Hours per week		**Lecture**		**Tutorial**		**Lab Practice**	**Total**
		-		**--**		**3**	**3**

Learning Objectives

LO 1	To enable students to learn the skill of hand sectioning.
LO 2	To study diversity of morphological diversity, structure and reproduction of Bryophytes..
LO 3	To understand the morphological diversity, anatomical structure and reproduction Pteridophytes
LO 4	To Develop skills in micro preparation of reproductive structures of Bryophytes and Pteridophytes
LO 5	To identify Bryophytes and Pteridophytes in natural habitats.

Practical

Bryophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Bryophytes genera included in the theory syllabus.

Pteridophytes

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera included in the theory syllabus.

2. Botanical excursion- Field Study

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts	1. Sharma, O.P.2017. Bryophyta, MacMillan India Ltd, New Delhi. 2. Sharma, O.P.2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi. 3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication. 4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India. 5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.
Reference Books	1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication. 2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing. 3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi. 4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai. 5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.
Web sources	https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4 https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Course outcomes: CO	On completion of this course, the students will be able to
CO1	Recognize the major groups of Non-vascular and Vascular Cryptogams.
CO2	Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.
CO3	Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes.
CO4	Develop comprehensive skills in sectioning and micro Preparation.
CO5	Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

Cell and Molecular Biology

Title of the Course		**Cell and Molecular Biology**					
Course Type		**Skill Enhancement Course - IV**					
Year	**II**	**Semester**	**III**	**Credits**	**2**	**Course Code**	**24USBO31**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		2			**--**		**2**
Learning Objectives							
LO 1	To understand the structure and function of eukaryotic and prokaryotic cells.						
LO 2	To know molecular mechanisms of gene expression, regulation, and protein synthesis.						
LO 3	To Understand the molecular details of cell division, signalling, and metabolism.						
LO 4	To Analyze experimental data related to molecular and cellular processes.						
LO 5	To know techniques such as PCR, gel electrophoresis						

Unit	Contents
I	Ultra structure of Prokaryotic cell and Eukaryotic cell. Plasma membrane - structure (fluid mosaic model) and function. Cell cycle, Cell division, Mitosis and their significance.
II	Structure and function of Endoplasmic reticulum, Ribosomes, Mitochondria, Chloroplast.
III	**Molecular Basis of Inheritance**- Structure of DNA and RNA. DNA replication and repair mechanisms. Transcription and translation.
IV	**Cellular Metabolism**: Outline of cellular respiration: Glycolysis, Citric Acid Cycle, Oxidative Phosphorylation. Photosynthesis: Light and dark reactions.
V	**Molecular Techniques in Biology :** Introduction to recombinant DNA technology. Applications of molecular techniques in medicine and biotechnology . Ethical issues in genetic engineering.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). Molecular Biology of the Cell (6th Edition). Garland Science
2	Lodish, H., Berk, A., Zipursky, S. L., et al. (2016). Molecular Cell Biology (8th Edition). W. H. Freeman and Company
3	Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th Edition). John Wiley & Sons
4	Berg, J. M., Tymoczko, J. L., & Gatto, G. J. (2015). Biochemistry (8th Edition). W.H. Freeman and Company
5	Glick, B. R., & Pasternak, J. J. (2010). Molecular Biotechnology: Principles and Applications of Recombinant DNA (4th Edition). ASM Press

Reference Books

1	Karp, G. (2010). Cell and Molecular Biology: Concepts and Experiments (6th Edition). John Wiley & Sons.
2	Campbell, N. A., Reece, J. B., & Urry, L. A. (2008). Biology (8th Edition). Pearson Education.
3	Watson, J. D., Baker, T. A., Bell, S. P., et al. (2007). Molecular Biology of the Gene (6th Edition). Pearson.
4	Stryer, L., Berg, J. M., & Tymoczko, J. L. (2002). Biochemistry (5th Edition). W.H. Freeman.
5	Cell Signaling: Principles and Mechanisms, 2nd Edition (2014), by Wendell Lim, Bruce Mayer, and Tony Pawson.

Web Resourse

1	https://www.ncbi.nlm.nih.gov
2	https://cellbio.uia.edu
3	https://www.garlandscience.com
4	https://www.khanacademy.org/science/biology
5	https://www.coursera.org/courses?query=cell%20biology

Course outcomes CO	On completion of this course, students will be able to
CO1	Understand fundamental cell biology concepts
CO2	Analyze cell structure and function
CO3	Comprehend molecular mechanisms of inheritance
CO4	Explore cellular metabolism
CO5	Apply molecular techniques in biology

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Herbal Technology

Title of the Course		**Herbal Technology**					
Course Type		**Skill Enhancement Course - IV**					
Year	**II**	**Semester**	**III**	**Credits**	**2**	**Course Code**	**24USBO32**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		2	**-**		**--**		**2**

Learning Objectives	
LO 1	To provide an overview of Herbal medicines.
LO 2	To gain an insight into the commercially important secondary products
LO 3	To understand the basic concept of Pharmacognosy
LO 4	To recognize the phytochemical screening methods.
LO 5	To know the methods of processing and storage of herbal drugs

Unit	Contents
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation, harvesting, processing and storage of herbs and herbal products.
II	Major herbs used as herbal medicines-, Ocimum. Nutraceuticals- *Embilica officinale*, cosmeticals- *Aloe vera*, and biopesticides-Neem, their Botanical names, plant parts used, major chemical constituents and their uses.
III	Pharmacognosy - Binomial, botany of the plant part used and active principles of the following herbs: Curcuma, Fenugreek*, Catharanthus roseus, Withania somnifera, Centella asiatica, Tinospora.*
IV	Analytical pharmacognosy: Phytochemical screening tests for secondary metabolites - alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds.
V	Processing - storage of herbs and herbal products, quality control for use in herbal formulations.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	AYUSH (www.indianmedicine.nic.in). About the systems—An overview of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy. New Delhi: Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (AYUSH), Ministry and Family Welfare, Government of India
2	Evans, W.C. 2009: Trease and Evans PHARMACOGNOSY. 16th Edition, SAUNDERS / Elsevier.l Science. 10.2174/97898114337881200101.
3	Sivarajan, V.V. and India, B. 1994. Ayurvedic Drugs and Their Plant Sources.. Oxford & IBH Publishing Company, 1994 - Herbs - 570 pages.
4	Miller, L. and Miller, B. 2017. Ayurveda & Aromatherapy: The Earth Essential Guide to Ancient Wisdom and Modern Healing. Motilal Banarsidass,; Fourth edition .
5	Kokate, C.K. 2003. Practical Pharmacognosy. Vallabh Prakashan, Pune.

References Books:

1	Agarwal, P., Shashi, Alok., Fatima, A. and Verma, A. 2013. Current scenario of Herbal Technology worldwide: An overview. Int J Pharm Sci Res; 4(11): 4105-17.
2	Arbe r, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur..
3	Varzakas, T., Zakynthinos, G, and Francis Verpoort, F. 2016. Plant Food Residues as a Source of Nutraceuticals and Functional Foods. Foods 5 : 88.
4	Aburjai, T. and Natsheh, F.M. 2003. Plants Used in Cosmetics. Phytotherapy Research 17 :987-1000.4.
5	Patri, F. and Silano, V. 2002. Plants in cosmetics: Plants and plant preparations used as ingredients for cosmetic products - Volume 1. ISBN 978-92-871-8474-0, pp 218.

Web Resources:	
1	https://www.kopykitab.com/Herbal-Science
2	2.https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7
3	3.https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural- healing/herbal-medicine/_/
4	4.http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404
5	5.https://www.dattanibookagency.com/books-herbs-science.html

Course outcomes CO	On completion of this course, students will be able to
CO1	Define and describe the principle of cultivation of herbal products.
CO2	List out the categories of commercially important herbal medicines
CO3	List out the categories of commercially important herbal medicines
CO4	Apply phytochemical tests for identification of secondary metabolites
CO5	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Silviculture and Agroforestry

Title of the Course		**Silviculture and Agroforestry**					
Course Type		**Skill Enhancement Course - IV**					
Year	**II**	**Semester**	**III**	**Credits**	**2**	**Course Code**	**24USBO33**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		2			**--**		**2**

Learning Objectives	
LO 1	To provide knowledge regarding the application of silvi cultural principles for the production and protection benefits from the forests.
LO 2	To make students familiar with trees and shrubs (fruit, fodder and small timber) suitable for agroforestry.
LO 3	To acquaint the students with the advanced silvi cultural practices in forestry with particular reference to commercial and short rotation forestry.
LO 4	To develop understanding about tree seed development, harvesting, processing, storage, dormancy, germination of tropical, sub-tropical and temperate species, their testing and certification.
LO 5	To develop skill and expertise on industrial wood production and processing technology.

Unit	Contents
I	Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment Plantation forestry - reforestation and afforestation - maintenance of plantations - enrichment planting.
II	Silvi culture - 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.
III	Tending operations - weeding, cleaning, thinning, pruning, after care techniques; cultural operations - soil working. Silvicultural systems - clear felling, shelter wood, selection and coppice systems - improvement felling.
IV	**Agro-forestry and Social Forestry** Definition, concept and need of agro- and Social Forestry Classification of agro-forestry and Social Forestry systems. Ecological aspects of agroforestry - benefits and limitations of agroforestry. Agroforestry practices for different agro-climatic zones of Tamil Nadu. Agroforestry practices for wasteland reclamation
V	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

Text books	
1.	Daniel TW, Helms JA and Baker FS. 1979. Principles of Silviculture. McGraw-Hill Book Company.
2.	Julius E. 1992. Plantation Forestry in the Tropics. Oxford University Press
3.	Khanna LS. 1996. Principle and Practice of Silviculture. International Book Distributors
4.	Khanna LS. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher
5.	Lamprecht. 1986. Silviculture in the Tropics.Verlag Paul Parey, Hamburg und Berlin
Reference Books	
1.	Nyland RD, Laura S, Kenefic, Kimberly K, Bohn and Susan LS.2016 Silviculture: Concepts and Applications (III
2.	Pascal. 1988. Wet Evergreen Forests of the Western Ghats.
3.	Shepherd KR. 1986. Plantation Silviculture. Springer.
4.	Smith DM, Larson BC, Ketty MJ and Ashton PMS. 1997. The Practices of Silviculture- Applied Forest Ecology.John Wiley & Sons
5.	Khanna LS. 2015. Theory and Practice of Indian Silviculture Systems. Bio-Green Publisher
Web Resources	
1.	https://en.wikipedia.org/wiki/Agroforestry
2.	https://www.uou.ac.in/lecturenotes/science/BSC- 17/FR01Unit%2001.pdf
3.	https://www.ctc-n.org/technology-library/agro-forestry-silviculture-mixed-farming/general-agro-forestry-silviculture-

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Semester - IV

Plant Diversity - IV

Title of the Course		Plant Diversity - IV					
Course Type		Core - VII					
Year	II	Semester	IV	Credits	4	Course Code	24UMBO41

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

Learning Objectives	
LO1	To enable the students to understand the general characters, classification and economic importance of gymnosperms
LO2	To enable the students to understand the morphology, internal structure and reproduction in Gymnosperms.
LO3	To acquaint students with evidences of the past history of plant groups and significance of the fossilization.
LO4	To understand the various fossil genera representing different fossil groups.
LO5	To know about basic concepts on evolution and origin of life To know about basic concepts on evolution and origin of life

Unit	Contents
I	**Gymnosperms** General characteristics, classification of Gymnosperms (Sporne,1954) (up to Order). Economic importance of Gymnosperms with special reference to oil, resin, timber, Ornamental and medicinal values.
II	Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Coniferales (*Pinus*). Cycadales (*Cycas*).
III	**Paleobotany** Paleobotany: Geological time scale and Radiocarbon dating, Fossils and different types of fossils – Compression, Impression, Petrifaction, casts, molds, Coal balls. Contributions of Birbal Sahni.
IV	Detailed study of internal and External morphology and Reproduction of fossil forms: *Rhynia, Lepidodendron* and *Lyginopteris*
V	**Evolution** Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory**.**

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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	Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
5	Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
References 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=fndpg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%2o%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.hml?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/

Course outcomes CO	On completion of this course, students will be able to
CO1	Recognize morphological variations and uses of Gymnosperms
CO2	Explain the anatomy and reproduction of Gymnosperms belonging to different classes
CO3	Identify the distinguishing features of Gymnosperms
CO4	Compare the internal and external morphology and reproductive structures of fossil plants.
CO5	Assess the evolutionary theories proposed by Lamarck, Darwin, and De Vries.

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Diversity IV – Practical - 4

<table>
<tr><td>Title of the Course</td><td colspan="7">Plant Diversity IV – Practical - 4</td></tr>
<tr><td>Course Type</td><td colspan="7">Core – VIII – Practicals - 4</td></tr>
<tr><td>Year</td><td>II</td><td>Semester</td><td>IV</td><td>Credits</td><td>2</td><td>Course Code</td><td>24UMBOL4</td></tr>
<tr><td rowspan="2">Instructional Hours per week</td><td colspan="2">Lecture</td><td>Tutorial</td><td>Lab Practice</td><td colspan="3">Total</td></tr>
<tr><td colspan="2">-</td><td>--</td><td>3</td><td colspan="3">3</td></tr>
<tr><td colspan="8">Learning Objectives</td></tr>
<tr><td>LO1</td><td colspan="7">To enable students observe and record the morphological features of selected species of Gymnosperms</td></tr>
<tr><td>LO2</td><td colspan="7">To enable students observe and record the anatomical features of selected species of Gymnosperms</td></tr>
<tr><td>LO3</td><td colspan="7">To develop the skill of identification of fossil forms</td></tr>
<tr><td>LO4</td><td colspan="7">To enable students to gain knowledge on the contributions of evolutionary scientists</td></tr>
<tr><td>LO5</td><td colspan="7">To identify gymnosperms in natural habitats.</td></tr>
<tr><td colspan="8">PRACTICALS
Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pinus and Cycas
Study the following fossil forms: Rhynia, Lepidodendron and, Lyginopteris through permanent slides/photographs
Photograph of evolution scientists mentioned in the syllabus.
Field visit to study the habitat.</td></tr>
</table>

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/ TRB / NET / UGC – CSIR / GATE / TNPSC /others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan. 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.
Reference Books	1. Smith, G.M. 1955. Cryptogamic Botany Vol. II. Tata McGraw Hill. New Delhi. 2. James. W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom. 3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi. 4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York. 5. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London
Web sources	1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv 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

Course outcomes: CO	On completion of this course, the students will be able to
CO1	Analyze and observe and record the morphological features of selected species of Gymnosperms.
CO2	Identify and Illustrate the morphological and anatomical features of gymnosperms .
CO3	Describe the structure of fossil forms prescribed in the syllabus.
CO4	Develop skills in sectioning and micro preparation.
CO5	Interpret the significance evolutionary mechanisms

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

Post-Harvest Technology

Title of the Course		Post-Harvest Technology					
Course Type		Skill Enhancement Course - V					
Year	I	Semester	IV	Credits	2	Course Code	24USBO41
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2			--	2	
Learning Objectives							
LO1	Understand the physiological and biochemical changes in plants after harvest.						
LO2	Learn about post-harvest handling, storage, and transportation of perishable crops.						
LO3	Study various post-harvest treatments and preservation techniques.						
LO4	Analyze the impact of biotic and abiotic factors on post-harvest quality.						
LO5	Learn about food processing technologies and value addition in agricultural products.						

Unit	Contents
I	**Introduction to Post-Harvest Technology -** Importance and scope of post-harvest technology. Physiology of fruits and vegetables after harvest. Ripening process and its regulation.
II	**Harvesting and Handling of Horticultural Crops** - Pre-harvest factors affecting post-harvest quality. Methods of harvesting and handling. Storage techniques and their impact on shelf life.
III	**Post-Harvest Processing and Preservation** - Methods of preservation: refrigeration, freezing, dehydration, and irradiation. Role of packaging in maintaining quality.
IV	**Biotic and Abiotic Factors Affecting Post-Harvest Quality** - Microbial spoilage, role of pathogens in post-harvest diseases(Bacteria, Fungus, Virus and Insects), methods of disease management
V	**Food Processing and Value Addition** - Principles of food processing, value-added products from fruits and vegetables (Pickle, Jam, Soup, Sauce and Jelly), Importance of food safety and regulations in food processing industries.

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/JAM /TNPSC and others to be solve (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Kader, A. A. (2002). Postharvest Technology of Horticultural Crops. University of California Press.
2	Wills, R. B. H., McGlasson, W. B., Graham, D., & Joyce, D. (2007). Postharvest: An Introduction to the Physiology and Handling of Fruit and Vegetables (5th Edition). CABI.
3	Verma, L. R., & Joshi, V. K. (2000). Postharvest Technology of Fruits and Vegetables. Indus Publishing.
4	Thompson, J. F. (2006). Postharvest Handling: A Systems Approach. Elsevier
5	Pantastico, E. B. (1975). Postharvest Physiology, Handling, and Utilization of Tropical and Subtropical Fruits and Vegetables. AVI Publishing.
References Books:	
1	FAO Post-Harvest Management
2	National Horticulture Board, India
3	ICAR-Indian Institute of Horticultural Research
4	Postharvest Information Network (UC Davis)
5	Khan Academy – Food Science
Web Resources:	
1	https://www.ncbi.nlm.nih.gov
2	https://cellbio.uia.edu
3	https://www.garlandscience.com
4	https://www.khanacademy.org/science/biology
5	https://www.coursera.org/courses?query=cell%20biology

Course outcomes CO	On completion of this course, students will be able to
CO1	Understand fundamental post-harvest concepts
CO2	Analyze factors affecting post-harvest quality and losses
CO3	Apply various post-harvest preservation and storage techniques
CO4	Evaluate the impact of biotic and abiotic factors on harvested crops
CO5	Implement food processing and value addition methods

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Fermentation Technology

Title of the Course		Fermentation Technology					
Course Type		Skill Enhancement Course - V					
Year	II	Semester	IV	Credits	2	Course Code	24USBO42
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		2	-		--	2	

Learning Objectives	
LO1	To appreciate the significance of microbes synthesizing fermented products.
LO2	To gain insights in the principles of fermentation
LO3	To design and operation of industrial practices in mass production of fermented products.
LO4	To know about the various methods in fermentation technology
LO5	To learn about the bio product recovery

Unit	Contents
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms- Yeast, Lactobacillus.
II	Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture
III	Production of fermented products, Maintenance and preservation of microorganisms involved in - cheese and bread.
IV	Fermentative production of Vinegar, Beer, Gluconic acid and Streptomycin
V	Microbial production of enzymes: Amylase and Protease. Bio product recovery.

Extended Professional Component (is a part of internal component only, Not To be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

- Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition, Blackwell Science, London, UK.
- Prescott S.C., Dunn C.G., Reed G. 1982. Prescott & Dunn's Industrial Microbiology, 4th Edition, AVI Pub. Co., USA.
- Reed G. 2004. Prescott & Dunn's industrial microbiology, 4th Edition, AVI Pub. Co.,
- USA.
- JR Casida L.E. 2015. Industrial Microbiology, 3rd Edition, New Age International (P)
- Limited Publishers, New Delhi, India.
- Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
- Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi

References Books:

- Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.
- Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.
- T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.
- Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.
- John E. Smith. Biotechnology. 2009. Cambridge University Press.UK

Web Resources:

- https://ebooks.foodtechlearning.xyz/2020/12/principal-of-fermentation-technology-by.html
- https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01LMDYFNQ
- https://www.amazon.in/Principles-Fermentation-Technology-Peter-Stanbury-ebook/dp/B01E3IC73W
- https://www.pdfdrive.com/principles-of-fermentation-technology-e189052809.html
- https://www.ebooks.com/en-us/book/2698294/principles-of- fermentation-technology/peter-f-stanbury/

Course outcomes CO	On completion of this course, students will be able to
CO1	Enumerate the significance of microbes in fermentation technology.
CO2	Explain the principles of fermentation
CO3	Explain the process of maintenance and preservation of microorganisms
CO4	Analyze the various aspects of fermentation in the production Of preservatives and antibiotics
CO5	Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover

Mapping with Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Vermicomposting

Title of the Course		Vermicomposting					
Course Type		Skill Enhancement Courses - V					
Year	II	Semester	IV	Credits	3	Course Code	24USBO43
Instructional Hours per week		Lecture	Tutorial		Lab Practice		Total
		3	2		--		5

Learning Objectives	
LO1	To provide theoretical and practical aspects of vermin compost.
LO2	To know the various types of eco-friendly environment in front of Homes by products of vermin culture.
LO3	To know the simple practice for the improvement of innovative Vermin culture technique.
LO4	To enable the students to be self-reliant knowledge and self-employment.
LO5	To design, execute the establishment and manage an organic farm for a crop.

Unit	Contents
I	Vermiculture Need for vermin culture- Earth worm types. Life cycle of Earth worm - problems in Vermiculture & remedial solutions.
II	Vermi technology Raw materials for vermicomposting –vermin bed preparation- factors affecting vermicomposting - Harvesting of vermin compost.
III	Vermi wash Small scale earthworm farming for home gardens - earthworm compost for home gardens. 2. Conventional commercial composting - earthworm composting larger scale (pit, brick and, heap systems, and Kadapa slab method). 3. Vermin wash unit. Applications of vermiwash.
IV	Vermicompost Application Recycling of wastes through vermin composting - natural enemies of earthworm- Recycling of food wastes in vermin technology. Use of Earth worm in food & medicine
V	Vermicomposting potentials and economics. Indoor vermicomposting- outdoor vermicomposting. Role of Earthworm in sustainable agriculture.

Recommended Text books	
1.	National Institute of Industrial Research, (2010): The Complete Technology Book on Vermiculture and Vermicompost, Published by National Institute of Industrial Research, Delhi-7, India..
2.	Sinha, R. K. et.al (2010) Vermitechnology-The Emerging 21st Century Bioengineering technology for sustainable development and protection of human health and environment Review, Dynamic Soil and Dynamic Plant, Global Science Books.
3.	Sharma S. et .al, (2009) Earthworm and Vemitechnology –Review, Dynamic Soil and Dynamic Plant, Global Science Books
4.	Chauhan, A. (2012) Vermitechnology, Vermiculture, Vermicompost and Earthworms: Vermiculture, Vermicomposting, Vermitechnology and Mirobes,Lambert Academic Publishing, Germany.
5.	Lamprecht. 1986. Silviculture in the Tropics.Verlag Paul Parey, Hamburg und Berlin
Reference Books	
1.	Lekshmy, M. S., Santhi R. (2012) Vermitechnology, Sara Publications, New Delhi, India, 4
2.	Lee, K.E. (1985) "Earthworms: Their ecology and Relationship with Soils and Land Use" Academic Press, Sydney
3.	Wallwork, J.A. (1983) "Earthworm Biology" Edward Arnold (Publishers) Ltd. London..
4.	Kevin, A and K.E.Lee (1989) "Earthworm for Gardeners and Fisherman" (CSIRO, Australia, Division of Soils). IV.
Web Resources	
1.	https://composting.ces.ncsu.edu/vermicomposting-2/#:~:text=Vermicomposting%20is%20a%20process%20that,and%20source%20of%20plant%20nutrients.
2.	https://en.wikipedia.org/wiki/Vermicompost
3.	https://rodaleinstitute.org/science/articles/vermicomposting-for-beginners/
4.	https://www.ecomena.org/vermicomposting/
5.	https://static.vikaspedia.in/media/files_en/agriculture/farm-based-

Course Outcomes

Course Outcomes	On Completion of this Course, Students will able to
CO1	Can analyze quality of ayurvedic drugs
CO2	To make the country self-reliant and self-sufficient.
CO3	Can appreciate the role of biology in societal issues,
CO4	To effectively manage ayurvedic stores.
CO5	Are conscious and aware of natural resources and environment

Mapping With Programme Outcomes and Programme Specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Semester - V

Taxonomy of Angiosperms and Economic Botany

Title of the Course		**Taxonomy of Angiosperms and Economic Botany**					
Course Type		**CORE - IX**					
Year	**III**	**Semester**	**V**	**Credits**	**4**	**Course Code**	**24UMBO51**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	**1**			**5**	

Learning Objectives	
LO1	To provide knowledge on the morphology (vegetative structures and floral structures) of flowering plants.
LO2	To enable the Students to know about the systems of classification of plants.
LO3	To know and identify the key floral characteristics of the selected families.
LO4	To know and identify the key floral characteristics of the selected families.
LO5	To know the economic importance of plants.

UNIT	**CONTENTS**
I	Morphology: root system – tap root, modifications; Shoot system: underground modifications; Leaf: Types - simple and compound-phyllotaxy, modifications-phylloclade, phyllode, tendrils, stipules; Inflorescences: racemose, cymose and special types; Fruits – classification (outline only).
II	Systems of Angiosperm classification – Artificial, Natural and Phylogenetic. An outline of Bentham and Hooker system of classification. Botanical nomenclature–rules, typification and author citation. Herbarium technique–collection, pressing, drying, mounting and preservation of plant specimens.
III	Study of the following families based on the Natural system and their economic importance: Annonaceae, Rutaceae, Caesalpiniaceae, Cucurbitaceae, Apocynaceae and Asclepiadaceae.

IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Euphorbiaceae, Liliaceae, and Poaceae.
V	Economic importance of families prescribed in the syllabus with reference to Fruits, vegetables, cereals and medicine. Indian Knowledge system- Siddha and Ayurveda.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Pandey, B.P. (2021). *Plant Morphology*. S. Chand & Company, New Delhi.
2	Eames, A.J. & MacDaniels, L.H. (2019). *An Introduction to Plant Anatomy*. McGraw Hill Education.
3	Singh, G. (2021). *Plant Systematics: Theory and Practice* (4th Ed.). CRC Press / Taylor & Francis.
4	Bridson, D. & Forman, L. (2010). *The Herbarium Handbook* (3rd Ed.). Royal Botanic Gardens, Kew.
5	Kochar, S.L. (2021). *Economic Botany in the Tropics* (4th Ed.). Macmillan India.

References Books:

1	Eames, A.J. & MacDaniels, L.H. (2019). *An Introduction to Plant Anatomy* (2nd Indian reprint). McGraw Hill Education, New Delhi.
2	Bhatnagar, S.P. & Moitra, A. (2020). *Gymnosperms, Pteridophytes and Angiosperms*. New Age International Publishers, New Delhi.
3	Singh, G. (2021).*Plant Systematics: Theory and Practice* (4th Edition). CRC Press / Taylor & Francis, Boca Raton.
4	Dutta, A.C. (2020).*Botany for Degree Students – Taxonomy*. Oxford University Press, New Delhi.
5	Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA
6	Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-HilI Book Co., New York.

Web Resources:	
1	https://easybiologyclass.com/angiosperm-systematics-and-taxonomy-free-online-study-materials-and-lecture-notes
2	https://egyankosh.ac.in/handle/123456789/57292
3	https://epdf.pub/introduction-to-the-principles-of-plant-taxonomy.html
4	https://www.biodiversitylibrary.org/
5.	https://plantnet.rbgsyd.nsw.gov.au/Telopea/

Course outcomes CO	On completion of this course, students will be able to
CO1	Define the concepts in plant morphology and rules of ICN in botanical nomenclature
CO2	Classify systems of plant classification and recognize the importance of herbarium.
CO3	Define vegetative and floral features of selected families
CO4	Analyze the characters of the families according to the Bentham and Hooker's system of classification.
CO5	Describe the core concepts of economic Botany And relate its applications to human life

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Anatomy and Embryology of Angiosperms

Title of the Course		Plant Anatomy and Embryology of Angiosperms					
Course Type		CORE - X					
Year	III	Semester	V	Credits	4	Course Code	24UMBO52
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		-	5	

Learning Objectives	
LO1	To distinguish between simple and complex tissues.
LO2	To know fundamental concepts of structure and function of tissues.
LO3	To understand the internal tissue organization of various plant organs.
LO4	To familiarize with normal and anomalous secondary growth in plants.
LO5	To comprehend the structural organization of reproductive organs with relevance to the process of pollination and fertilization.

UNIT	CONTENTS
I	Meristems - Characteristics of meristematic tissues - Classification of meristem, Types, functions and Theories of meristems (Apical Cell Theory, Histogen Theory, and Tunica-Corpus Theory). Structure and functions of simple tissues (parenchyma, collenchyma, and sclerenchyma) and complex permanent tissues (xylem and phloem).
II	Structure of dicot and monocot stem, root, and leaves.Nodal anatomy: Types of nodes - unilocular, trilocular and multilocular; leaf traces and leaf gaps; epidermal tissue system: stomatal types, trichomes and glands.
III	Normal secondary thickening in dicot stem and root; anomalous secondary growth in the stem of *Boerhaavia* and *Dracaena*.
IV	Structure of anther and ovule**,** types of ovules. Structure of Microsporangium, Microsporogenesis, Development of male gametophyte, Structure of Megasporangium, Development of Female gametophyte; Megasporogenesis: Structure and Development of female gametophytes - monosporic (*Polygonum*), bisporic (*Allium*) and tetrasporic (*Fritillaria*) and megagametogenesis.
V	Process of Double fertilization and triple fusion. Post fertilization changes in flower. Structure of Endosperm and its types - free nuclear, cellular, helobial, Ruminate endosperm. Structure and development of dicot embryo (*Capsella bursa-pastoris*) and Structure and development of Monocot embryo (*Luzula*).

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	
1	Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
2	Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
3	Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
4	Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
5	Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
References Books:	
1	Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2	Esau, K. 1985. Anatomy of Seed Plants –John Willey.
3	Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
4	Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
5	Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
6	Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
Web Resources:	
1	https://mahaveerpublications.com/product/morphology-anatomy-and-embryology-of-angiosperms-as-per-fyugp-nep
2	http://rastogipublications.com/index.php?route=product/product&product_id=106
3	https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y.
4	https://www.ebookselibrary.com/book-detail/higher-education/botany/BOTANY-%E2%80%93III-ANATOMY-AND-EMBRYOLOGY-SEM-III-(UTTARAKHAND-EDITION)-2110
4	https://link.springer.com/book/10.1007/978-94-017-1203-3
5	https://link.springer.com/book/10.1007/978-3-642-69302-1
6.	https://nusearch.nottingham.ac.uk/discovery/fulldisplay?docid=alma992255652280556 1&context=L&vid=44NOTTS_UNUK:44NOTUK&lang=en&search_scope=MyInst_and_CI&adaptor=Local%20Search%20Engine&tab=Everything&query=sub,exact,Plant%20anatomy&offset=0

Course outcomes CO	On completion of this course, students will be able to
CO1	Relate to the fundamental concepts of meristems, their types, characteristics, and theories, and the structure and functions of simple and complex permanent tissues
CO2	Describe the internal tissue organization of various plant organs
CO3	Elucidate the stages of normal and abnormal secondary growth.
CO4	Analyse the patterns of normal and anomalous secondary growth
CO5	Compare the structural organization of reproductive organs in relation to the process of pollination and fertilization

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Taxonomy of Angiosperms and Economic Botany - Practical-V

Title of the Course	**Taxonomy of Angiosperms and Economic Botany - Practical-V**						
Course Type	**CORE - XI - Lab - 5**						
Year	**III**	**Semester**	**V**	**Credits**	**2**	**Course Code**	**24UMBOL5**
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		-	**-**		**3**		**3**

Learning Objectives	
LO 1	To study morphology of plant parts
LO 2	To enable the students to describe the plant technically using the floral characteristics.
LO3	To preserve the plants and prepare herbarium sheets.
LO4	To understand the economic importance of flowering plants
LO5	To be able to identify the local flora.

PRACTICALS

1. Morphology of root, stem and leaf modification, types of inflorescence as mentioned in the theory.
2. Dissection, identification, observation of the floral parts of the plants belonging to the families included in the syllabus.
3. Preparation and submission of ten Herbarium sheets and field notebook
4. Study the products of plants mentioned in the syllabus of economic botany with special reference to the morphology, botanical name and family.
5. Field trips to places for observation, study and collection of plants prescribed in the syllabus for 2 to 3 days under the guidance of faculties

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
	2. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
	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 for Systematics21st Century. Portlant Press Ltd., London.
Reference Books:	1. Mann J. Davidson, R.S and J.B. Hobbs, D.V. Banthorpe, J.B. Harborne. 1994. *Natural Products*. Longman Scientific and Technical Essex.
	2. Gopalan, C., B.V. Ramasastri and S.C. Balasubramanian. 1985. Nutritive Value of Indian Foods. National Institute of Nutrition, Hyderabad.
	3. Grant, W.E. 1984. Plant Biosystematics. Academic Press, London.
	4. Harrison, H.J. 1971. New Concepts in Flowering Plant Taxonomy. Rieman Educational Book Ltd., London.
	5. Jones, A.D. and Wilbins, A.D. 1971. Variations and Adaptations in Plant Species. Hiemand & Co. Educational Books Ltd. London.
Web resources:	1. https://libguides.bodleian.ox.ac.uk/plant_taxonomy 2. https://www.kew.org/science/collections-and-resources/collections/economic-botany-collection 3. https://www.classcentral.com/course/swayam-economic-botany-495982 4. https://www.bgbm.org/idb/botecon.html 5. https://egyankosh.ac.in/handle/123456789/25139

Course outcomes CO	On completion of this course, students will be able to:
CO1	Recognize the distinguishing plant morphological characters.
CO2	Identify locally available plants to their respective families.
CO3	Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.
CO4	Understand the economic uses of flowering plants.
CO5	Validate the local flora by analyzing and dissecting the vegetative and floral characters.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Anatomy and Embryology of Angiosperms Practical-VI

Title of the Course	**Plant Anatomy and Embryology of Angiosperms Practical-VI**						
Course Type	**CORE - XII – Lab - 6**						
Year	**III**	**Semester**	**V**	**Credits**	**2**	**Course Code**	**24UMBOL6**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		-	**1**		**3**		**4**

Learning Objectives:

LO1	To identify the structure of plant tissues
LO2	To learn about structure and function of plant tissues.
LO3	To differentiate the monocot and dicot plants
LO4	To understand about normal and anomalous secondary growth
LO5	To recognize the structure of anther, ovule and learn the skill of embryo dissection

Anatomy

1. To observe and identify the following slides showing
a) Meristems - shoot apex and root apex
b) Simple tissues
c) Xylem elements
2. Sectioning primary structure of stem, root and leaves of dicot and monocot plant
3. Normal secondary thickening in dicot stem and root.
4. Anomalous secondary growth in *Boerhaavia* and *Dracaena*.

Embryology

1. Sectioning mature anther - *Datura*
2. Types of ovules- Anatropous, Orthotropous, Circinotropous, Amphitropous, Campylotropous (Permanent slides).
3. Types of Endosperm - Nuclear endosperm, cellular endosperm and helobial endosperm
Dissection and display of any one stage of embryo in *Tridax.*

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this Course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.
	2. Panshin, A.J and C. de Zeeuw.1980.Textbook of wood technology. Structure, identification and uses of the commercial woods of the United States and Canada. Fourth Edition. New York: McGraw-Hill Book Company.
	3. Sharma, H.P. 2009. Plant Embryology: Classical and Experimental, Bombay Popular Prakashan, ISBN-8173199698, 9788173199691.
	4. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi
Reference Books:	1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
	2. Sundara Rajan, S, 2003. Practical Manual of Plant Anatomy and Embryology 1st ed, Anmol Publications, ISBN-812610668.
	3. Richard Crang, Sheila Lyons-Sobaski and Robert Wise, 2018. Plant Anatomy. Springer
	4. Ray E. Evert. 2006. Esau's Plant anatomy: Meristems, cells, and tissues of the plant body: Their structure, function and development
	5. Akinloye Gurnah, 2018. Introduction to Plant Anatomy. AGRi HORTI PRESS.
Web resources:	1. https://www.amazon.in/Practical Anatomy-Adriance-1901-1973- Foster/dp/1341784509
	2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&redir_esc=y
	3. https://www.scribd.com/document/887663880/Plant-Morphology-and-Anatomy-Practical-Material
	4. https://www.freebookcentre.net/biology-books-download/Plant-Anatomy-Laboratory-Micrographs-of-plant-cells-and-tissues,-with-explanatory-text.html
	5. https://www.perlego.com/book/3866258/plant-anatomy-an-applied-approach-pdf
	6. https://onlinelibrary.wiley.com/doi/book/10.1002/0470047380

Course outcomes CO	On completion of this course, students will be able to:
CO1	Identify the structure of cell organelles and stages of cell division.
CO2	Identify types of plant tissues
CO3	Compare the functions of various ergastic substances present in plant tissues.
CO4	Perform free hand sectioning of plant materials and decipher the internal tissue organization.
CO5	Interpret the stages of embryo development through dissection

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Project with Viva-Voce

Title of the Course		Project with Viva Voce					
Course Type		Project - 1					
Year	III	Semester	V	Credits	3	Course Code	24UMBOP1
Instructional Hours per week		Lecture	Tutorial		Lab	Total	
		-	-		4	4	

Learning Objectives; This course aims to provide knowledge on

LO1	To recognize the concept of research and its various forms in the context of botany.
LO2	To improve abilities relating to scientific experiments.
LO3	To become proficient in data collection and the documentation of scientific findings.
LO4	To prepare students for entry-level positions or professional training programmes in any field of Botany.
LO5	Data analysis using appropriate tools.

UNIT	CONTENTS
I	1. Each student will be allotted a Project Guide from the faculty of the department concerned by lot method. 2. The topic of the dissertation shall be assigned to the candidate before the beginning of third semester. 3. After the completion of the project work, the student has to submit four copies of dissertation with report carrying his/her project report for evaluation by examiners. After evaluation, one copy is to be retained in the College Library. 4. Project work will be evaluated by both the external and the internal (Project Guide) examiners for the maximum of 100marks in total on the scale of the maximum of 50 marks for the internal and the external each. Viva-voce will be conducted by the panel comprising, External examiner and Internal Examiner for the maximum of 100 marks in total on the scale of the maximum of 50 marks for the internal and the external each
II	1. Dissertation/Thesis based on the work done by the student. 2. Soft copy of the project on CD/DVD. PROJECT EVALUATION GUIDELINES: The Internal: 50 marks I Review – Selection of the field of study, topic and literature collection - 20 marks II Review – Research design and data collection - 15 marks III Review – Analysis and conclusion, preparation of rough draft - 15 marks External: 50 marks Thesis/ Dissertation - 20 marks Presentation - 15 marks Viva-voce - 15 marks project is evaluated on the basis of following heads:
III	Suggested areas of work: Algae, fungi, microbiology, biocontrol agents, plant tissue culture, plant physiology, phytochemistry, biochemistry, anatomy, plant taxonomy, Ethnobotany, ecology, sustainable agriculture, herbal formulations, cytogenetics, molecular biology, biotechnology, bioinformatics, nanotechnology and applied botany..
IV	**Methodology:** **Each dissertation should contain the following details:** 1. Introduction on the topic 2. Review of Literature 3. Materials and Methods 4. Results and Discussion – evidences in the form of figures, tables and photographs. 5. Summary 6. Bibliography.

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1. Wilson, KandJ. Walke (Eds). 2010. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
2. Bendre, A. M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
3. Manju Bala, Sunita Gupta, Gupta, N.K.2012.Practicals in Plant Physiology and Biochemistry. Scientific Publisher.
4. Kothari, C.R. 2004. *Research Methodology: Methods and Techniques* (2nd Edition). New Age International Publishers, New Delhi.
5. RodneyBoyer.2000. s try, 3rd Edition. Published by Addison Wesley Longman.

Reference Books:

1. Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
2. Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.
3. Ruzin, S.E. 1999. Plant micro technique and microscopy. Oxford University Press, New York, U.S.A.
4. Wilson and Goulding. 1987. Principles of biochemical techniques, Oxford University Press.
5. Mukherji, S. and Ghosh, A.K. 2005. Plant Physiology. First Central Edition, New Central Book Agency (P) Ltd., Kolkata.
6. Taiz, L and Zeiger, E. 2010. Plant Physiology. 5th Edition. Sinauer Associates, USA.
7. Heldt, H.W and Piechulla, B. 2010. Plant Biochemistry, 4th Edition. Academic Press, NY.
8. Sharma, R.K. 2015. Research Methods in Botany (1st Edition). ABC Publishers, Mumbai.
9. Gurumani, N. 2009. Research Methodology for Biological Sciences. MJP Publishers, Chennai.

Entrepreneurial botany

Title of the Course		Entrepreneurial Botany					
Course Type		Elective - V					
Year	III	Semester	V	Credits	3	Course Code	24UEBO51
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		-	4	

Learning Objectives ; This course aims to provide knowledge on

LO1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.
LO2	To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.
LO3	To comprehend the molecular processes.
LO4	To expose the students a fundamental of the various value added products.
LO5	To introduce the entrepreneurial opportunities.

UNIT	CONTENTS
I	Need-definition and concept-Types and characterization-entrepreneurial values-motivation and barriers- entrepreneurship as innovation, risk assessment and solutions.
II	Industry - overview of Spirulina, Pleurotus, Natural dyes, Banana fibers, Wine, Hydroponics, Drumstick and coconut - Straight Vegetable Oil (SVO) and Pure Plant Oil (PPO) -methods and marketing - fresh and dry flowers for aesthetics.
III	Canning of fruits - process and equipment, fruit and vegetable based products (squash) -ready to serve (RTS) (syrup, pulp, paste, ketchup, soup, vegetable sauces, jam and jellies),Palmyrah Palm products, Perfumes from Rose/Jasmine- Bamboo and cane based products virgin coconut oil ,jasmine oil production.
IV	TIIC, DIC, NABARD -case study-sarvodaya–SIDCO–Micro Small and Medium Enterprises–support structure for promoting entrepreneurship–various government schemes.
V	Understanding a market and assessment, selection of an enterprise, business planning, mobilization of resources, Break Even Analysis, project proposal (guidelines, collection of information and preparation of project report), trademarks and copyright, Intellectual Property Rights ,export and import license

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts:	1. Taneja,S. and Gupta,S.L.2015.Entrepreneurship development, New ventu recreation, Galgeha publication company, New Delhi.ISSN:2321-8916. 2. Desai, V., 2015. Entrepreneurship development, Firstedition. Himalayap ublication house, Mumbai. ISBN: 9789350973837. 3. Khanna,S.S.2016.Entrepreneurialdevelopment.S.Chan dcompanylimited,Ne wDelhi.ISBN:9788121918015 4. Bendre, M.Ashok and AshokKumar, A.2020. Text Book of Practical Botany 1 (10thed). Rastogi Publications, Meerut. 5. Singh, Rand U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur. Sharma, R. 2013. Agro Techniques of Medicinal Plants. Daya Publishing House, Delhi.
Reference Books	1. Manohar, D. 1989. Entrepreneurship of small scale industries, vol. III. Deep and deep publication, New Delhi. ISSN: 09735925. 2. Lal, G. Siddhapa, G.S. and Tand on, G.L., 1988. Preservation of fruits and vegetables. Indian Council of Agricultural Research (ICAR). ISSN:0101-2061 3. Ranganna, S, 2001. Handbook of analysis and quality control of fruits and Vegetable products, Second edition, Tata McGraw hill, New Delhi.ISBN:780074518519 4. Gupta. P.K. 1998. Elements of Bio technology. Rastogi publications, Meerut Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi

Web Resources:	1. https://www.learninsta.com/entrepreneurial-botany/ 2. https://www.shaalaa.com/textbook-solutions/ 3. https://www.embibe.com/subjects/Biology/Economic-Botany/ 4. https://cap.mgu.ac.in/SYLLABUS/.../PlantBasedStartups-Specialization30_07_25.pdf 5. https://store.pothi.com/.../botanical-entrepreneurship/
Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Recognize the significance of government agencies for entrepreneurship.
CO2	Explain about entrepreneurial values, risk assessment and solutions.
CO3	Make use of entrepreneurial opportunities.
CO4	Analyse and decipher the significance of bio venture and Value mechanism.
CO5	Devise innovative method for making value-added products.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Bio-Analytical Techniques

Title of the Course		Bio-Analytical Techniques					
Course Type		Elective - V					
Year	III	Semester	V	Credits	3	Course Code	24UEBO52
Instructional Hours Per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		--	4	

Learning Objectives ; This course aims at providing knowledge on

LO1	To understand the principle, operation of microscopes.
LO2	To know the principle and application of chromatographic techniques.
LO3	To equip students with understanding on pH me try and gel electrophoresis.
LO4	To provide an overview of spectrophotometry and centrifugation techniques.
LO5	To give an exposure to application of statistics in biological research.

UNIT	CONTENTS
I	Principles and structure of microscopy; Light microscopy; Fluorescent Transmission and Scanning electron microscopy. Microscopic measurements-micrometry- Stage and ocular micrometer.
II	Principle and applications: Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS).
III	Basic principle, construction and operation and applications of pH meter. gel electrophoresis (PAGE), Agarose Gel Electrophoresis.
IV	Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer. Principles, methods of types of centrifuge and applications.
V	**BIOSTATISTICS:** Collection and interpretation of data, sampling; Representation of Data: Tabular, Graphical– Histogram, frequency curve, Bar diagram. Measures of central tendency – Mean, Median and Mode; Standard deviation, Standard error, Chi-square test and goodness of fit –t test.

Extended professional component (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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts:	1. Sharma, V.K. 1991. Techniques in microscopy and cell biology, Tata McGraw Hill, New Delhi.
	2. Sawhney, S.K and Randhir Singh. 2000. Introductory practical biochemistry, Narosa Publishes
	3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications.
	4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New
	5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications.
	6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.
References Books:	1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications.
	2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
	3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
	4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
	5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw Hill Publication, New York.
	6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London.
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-Pandey-ebook/dp/B01JP
	4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-Khandpur-ebook/dp/B021&tag=kindlecontentin50-21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpY8D9JNpJZsOcXQC BwE
	5. https://www.kobo.com/us/en/ebooks/biostatistics
	6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG

Course outcomes CO	On completion of this course, students will be able to:
CO1	Relate to the various techniques in microscopy and Micro measurements
CO2	Explain the principles and application of chromatography for separation of biomolecules
CO3	Develop methodologies for extraction and analysis of Bio chemical compounds.
CO4	Compare and contrast the significance of different types of separation techniques.
CO5	Apply suitable strategies in data collections and disseminating research findings.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Aquatic Botany

Title of the Course		Aquatic Botany					
Course Type		Elective - V					
Year	III	Semester	V	Credits	3	Course Code	24UEBO53
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		-	4	

Learning Objectives ; This course aims at providing knowledge on

LO1	To give an overview of the distribution of lower plant forms and its ecological significance.
LO2	To enable students to understand the ecological functions and economic uses of aquatic plants.
LO3	To equip students to collect, analyze and identify planktons.
LO4	To give an exposure to various forms seaweeds.
LO5	To know about the values and uses of aquatic plants.

UNIT	
I	General Characteristics and economics importance of common seaweeds of Indian subcontinent *Ulva, Caulerpa, Sargassum, Gelidium Gracilaria,* including lichen photobionts of Indian subcontinent.
II	Mangrove forests of India - Sundarbans, Pichavaram, Kerala, Rathnagiri. Morphological and Physiological adaptation of Common species of mangroves and mangrove associated plants: *Avicennia, Rhizophora, Acanthus* and *Aegiceras*. Ecological significance of mangroves. Morphological and Physiological adaptation of halophytes: *Salicornia* and *Sesuvium*.
III	General Characteristics and economics importance of Common marine microalgae of India - *Anabaena, Chlorella*, *Scenedesmus.* Including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common limnetic and terrestrial cyanobacteria of India.
IV	General Characteristics of Common aquatic angiosperms of India- Lotus, Water Lilly, Water hyacinth. Ecology, life cycle and economic importance of common aquatic angiosperms.
V	Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill.
Recommended Texts:	1. Daubenmire, R.F.1973. Plant and Environment. John Willey.
	2. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge.
	3. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013. Prescott's
	4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press.
	5. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 *ISSN*: 0971-8044.
	6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi.
References Books:	1. Rana, S.V.S. 2009. Biotechniques: Theory and Practice. Rastogi Publications.
	2. Zar, J.H. 2012. Biostatistical Analysis. 4th edition. Pearson Publication. U.S.A.
	3. Sundar Rao, P.S.S and Richard, J. 2011. Introduction to Biostatistics and research methods, PHI learning Private Ltd., New Delhi.
	4. Johansen, D.A. 1940. Plant Micro technique, TATA McGraw Hill Book Co., Ins., New Delhi.
	5. Peter Gray. 1964. Handbook of Basic Micro technique. McGraw hill publication, New York.
	6. Cooper, T.G. 1991. The Tools of Bio - chemistry, John Wiley & sons, London.

Web Resources:	1. https://wizape.com/English/Conservation-of-Aquatic-Ecosystems
	2. https://wizape.com/English/Introduction-to-Aquatic-Ecosystem-Managemen
	3. https://edis.ifas.ufl.edu/topics/aquatic-and-wetland-plants
	4. https://wclc2019.iaslc.org/public/publication/Download_PDFS/Water_Plants_A_Study_Of_Aquatic_Angiosperms_Cambridge_Library_Collection_Botany_And_Horticulture.pdf
	5. https://plantlet.org/books/

Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Relate to the various techniques in microscopy and Micro measurements
CO2	Explain the principles and application of chromatography for separation of biomolecules
CO3	Develop methodologies for extraction and analysis of Bio chemical compounds.
CO4	Compare and contrast the significance of different types of separation techniques.
CO5	Apply suitable strategies in data collections and disseminating research findings.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Computer application in Botany

Title of the Course		Plant Biotechnology					
Course Type		Elective - VI					
Year	III	Semester	V	Credits	2	Course Code	24UEBO54
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		--	4	

Learning Objectives	
LO1	To familiarize the student with the fundamentals concepts of bioinformatics.
LO2	To equip students with computational skills for drug design..
LO3	To learn about the bioinformatics database, data format and data retrieval from line sources.
LO4	To develop interdisciplinary skills in using computers in botany to learn about the biological database.
LO5	Student is aware with the most recent technologies for sequencing and bioinformatics analysis and is able to apply them to the structural and functional genomics of plants.

UNIT	CONTENTS
I	Introduction to computers and Bioinformatics. Introduction to Computers – classification, computer generation, low, medium and high level languages, software and hardware, operating systems personal, mini, main frame and super computers, characteristics and application, computer memory and its types, data representation and storage. Microsoft excel, data entry, graphs, aggregate functions, formulas and functions, number systems, conversion devices, secondary storage media
II	Biological Research on the web: Using search engines, finding scientific articles. Fundamentals of networking, internet, intranet, search engines- yahoo, Google, etc. telnet, ftp.
III	Computer fundamentals - programming languages in bioinformatics, role of supercomputers in biology. Historical background. Scope of bioinformatics - Genomics, Transcriptomics, Proteomics, Metabolomics, Molecular Phylogeny, computer aided Drug Design (structure based and ligand based approaches), Systems Biology and Functional Biology. Applications and Limitations of bioinformatics.

IV	Introduction to databases. Biological databases- NCBI, EMBL and DDBJ. Data Generation and Data Retrieval Generation of data (Gene sequencing, Protein sequencing, Mass spectrometry, Microarray), Sequence submission tools (BankIt, Sequin, Webin); Sequence file format (flat file, FASTA, GCG, EMBL, Clustal, Phylip, Swiss-Prot); Sequence annotation; Data retrieval systems (SRS, Entrez) DNA sequencing methods. Protein sequencing Phylogenetic analysis Similarity, identity and homology, Alignment – local and global alignment, pairwise and multiple sequence alignments, alignment algorithms. Methods of Alignment (Dot matrix, Dynamic Programming, BLAST and FASTA); Phylogenetic analysis: Construction of phylogenetic tree, dendrograms, methods of construction of phylogenetic trees..
V	Applications: Application of Taxonomic Software for preparation of Dichotomous Key. Phylogenetic analysis. Make line drawing of Plants for description. Usage of plant identification apps on android phones. Computer application in biostatistics - MS Excel and SPSS. Computer Aided Designing (CAD) for outdoor and indoor Land scaping. Exposure to CAD (Computer Aided Designing).

Extended Professional Component (is a part of internal component only, Not to be included In the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	P.K. Gupta. Biotechnology and Henomics. 2016-2017. Rastogi Publications, 7th Reprint (1st Edition.
2	Ghosh, Z., Mallick, B. 2008. Bioinformatics – Principles and Applications, 1st edition. New Delhi, Delhi: Oxford University Press..
3	Baxevanis, A.D. and Ouellette, B.F., John.2005. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd edition. New Jersey, U.S.: Wiley & Sons, Inc.
4	Roy, D. 2009. Bioinformatics, 1st edition. New Delhi, Delhi: Narosa Publishing House..
5	Andreas, D., Baxevanis, B.F., Francis, Ouellette. 2004. Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd edition. New Jersey, U.S.: John Wiley and Sons.

References Books:

1	Gibas, C and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2	David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3	Harshitha, D. 2006. Techniques of Teaching Computer Science, International Book Distributor, Dehradun.
4	Chwan-Hwa (John) Wu, J. David Irwin. 2016. Computer networks and cyber security. CRC Press**.**

5	Rui Jiang, Xuegong Zhang and Michael Q. Zhang. 2013. Basics of Bioinformatics. Springer-Verlag Berlin Heidelberg.

Web Resources:	
1	https://www.youtube.com/watch?v=xuwV3ywCxW8
2	https://www.youtube.com/watch?v=utlKKvqxbWw
3	https://www.youtube.com/watch?v=iJTj8Y65Qlo
4	https://www.youtube.com/watch?v=D5aEKiez_nw
5	https://www.youtube.com/watch?v=fo2dI4leUfY

Course outcomes CO	On completion of this course, students will be able to
CO1	Recognize advanced resources for accessing scholarly literature from the internet.
CO2	Explain the concept of databases and use of different public domain for DNA and proteins sequence retrieval.
CO3	Apply various software resources with advanced functions to carry out analysis of data procured through research.
CO4	Decipher the effective utilization of bibliography management software while typing and downloading citations.
CO5	Determine how the knowledge gained can be used for designing experiments and data interpretation.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Bio resources

Title of the Course		Plant Bio resources					
Course Type		Elective Course – VI					
Year	III	Semester	V	Credits	3	Course Code	24UEBO55
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		--	4	

Learning Objectives; This course aims to provide knowledge on

LO1	To know the existing usages of various plant Bio resources
LO2	Gain knowledge on various production processes & applications of the plant Bio resources
LO3	Encourage research and entrepreneurial ideas about plant Bio resources & their utilisation in different fields.
LO4	To understand industrial uses in microbes.
LO5	To provide knowledge on the role of medicine and the food industry in plant Bio resources.

UNIT	CONTENTS
I	**AGRICULTURE USES OF ALGAE:** Algae- The role of algae in soil fertility, green manure, nitrogen fixation, medicinal uses, and biofuels. Algae as pollution indicators.
II	**INDUSTRIAL USES OF ALGAE:** Role of algae as food and fodder. Commercial products- Agar- Agar, Carrageenan, Alginic acid, diatomite and their uses in various industries.
III	**INDUSTRIAL USES OF MICROBES Fungi and bacteria**: Role in medicine, food, industrial uses –alcohol, enzyme, cheese, antibiotics.
IV	**ORGANIC FARMING & BIO-REMEDIATIONS:** Organic farming- definition and basic concepts, farm manures. Recycling of biodegradable municipal and industrial wastes.
V	**USES OF CRYPTOGAMS AND GYMNOSPERMS**: Role in Medicine and Food, industrial uses in Cryptogams and Gymnosperms

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 Skills

Recommended Texts:	
1	Vashishta, B.R., Sinha, A.K. and Singh, V.P. 2008. Botany for Degree Students: Algae. S. Chand & Company Ltd., New Delhi.
2	Vashishta, B.R. 1990. Botany for Degree Students: Fungi. S. Chand & Company Ltd., New Delhi.
3	Vashista, P.C. 1997. Botany for Degree Students Pteridophyta. S. Chand and Company Ltd., New Delhi.
4	Vashishta, P.C. 1996. Botany for Degree Students-Gymnosperms (2nd Edn.,). S. Chand and Company Ltd., New Delhi.
5	Pandey, B.P. 2001. College Botany Vol. I: Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd., New Delhi.
References Books:	
1	Kumar, H.D. 1999. Introductory Phycology (2nd edition). Affiliated EastWest Press Pvt. Ltd. Delhi.
2	Sharma OP. 1989. Text Book of fungi. Tata McGraw Hill, New York.
3	Hale, 1996. The biology of Lichens, New Age International Publishers, New Delhi.
4	Smith, G.M. 1955. Cryptogamic Botany Vol. II Bryophytes and Pteridophytes (2nd edn.). Tata McGraw Hill Publishing Co., New Delhi...
5	Pandey. 1998. A Text Book of Botany Vol. II. S. Chand & Co. Ltd. 1980.
6	Palaniappan, S.P and K. Annadurai. 2018. Organic farming theory and practice, Scientific Publishers Jodhpur, India.
Web Resources:	
1	https://www.mooc-list.com/course/introduction-algae-coursera
2	https://swayam.gov.in/nd2_cec20_bt11/preview
3	https://www.brainkart.com/article/Economic-importance-Plants---Food,-Rice, Oil,-Fibre,-Timber-yielding-plant_1095/
4	https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine cones-an-introduction-to-gymnosperms.pdf
5	https://onlinelibrary.wiley.com/doi/book/10.1002/9781118460566

Course outcome	On completion of this course, students will be able to:
CO1	Understand algae as bio resources in soil fertility, medicine and research; the role of algae in pollution studies.
CO2	Learn about algal commercial products.
CO3	Appreciate industrial uses of Microbes.
CO4	Explore the use of Lichens, Bryophytes, Pteridophytes and Gymnosperms
CO5	Expose to the production of Industrial products.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Seed Biology

Title of the Course		Seed Biology					
Course Type		Elective - VI					
Year	III	Semester	V	Credits	3	Course Code	24UEBO56
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	1		-	4	

Learning Objectives ; This course aims at providing knowledge on

LO1	To study the morphology, structural details of economically important seeds.
LO2	To Know about Physico-chemical aspects of seed germination.
LO3	To enable the students to perform seed germination test.
LO4	Understand seed viability, tetrazolium test and seed vigour test.
LO5	Learn dormancy, its various kinds and factors to break dormancy.

UNIT	CONTENTS
I	**INTRODUCTION TO SEED BIOLOGY:** Morphology and structural details of seeds: Cereals : Paddy Pulses : Dolichos ,Oil seeds : Castor; Fibers : Cotton Vegetables : Cucurbita
II	**SEED GERMINATION:** Germination - General account. Factors affecting germination. Changes that take place during germination (physical and chemical) Treatments given to quicken germination (Physical and chemical)
III	**SEED GERMINATION TEST AND EVALUATION:** Seed germination test under laboratory conditions. Using paper (BP & TP) sand and soil. The environmental test conditions. Evaluation of germination test.
IV	**SEED VIABILITY:** Seed viability; Topographical Tetrazolium Test. Seed vigour: Definition, concept, Direct and Indirect vigour tests.
V	**SEED DORMANCY:** Dormancy – Primary and secondary dormancies. Causes and methods used to break dormancy.

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. T. T. Kozlowski. 2012. Seed Biology: Importance, Development, and Germination (Physiological ecology). Kindle Edition volume-1, Academic press, New York.
	2. Eli Bridge 2024. Seed Biology –Kruger Brentt Publisher UK. Ltd.
	3. Nash Belle 2022. Seed Biology- Basic and translational Research; States Academic Press.
	4. Baba Saheb B Desai 2004. Seeds Hand Book: Biology, production, processing,and storage. CRC Press 2nd Edition, United Kingdom.
	5. Agarwal, R.L. Seed Technology. 2020. CBS Publishers and Distributors Pvt Ltd.
References Books:	1. Nirmal Mandal and Dr. Sanjoy Kumar bordolui 2025. Seed biology, Biotechnology, Productionsand Management, New Delhi publishers. India.
	2. K. Vanangamudi, K. natarajan 2024. Seed Physiology, Astral International Pvt. Ltd. India.
	3. Carol C. Baskin and Jerry M. Baskin 2014. Seeds Ecology, Biogeography, and Evoluation of Dormance and Germination, Acatemic press, 2nd Edition, India.
	4. Lisa Swinton 2025. Seeds: Physiology, Germination and Dormance, States Academic Press., India.
	5. Dennis B. Egli 2017. Seed Biology and Yield of Grain Crops, CABI Publishing, 2nd edition Inida.
Web Resources:	1. https://swayam.gov.in/nc_details/NPTEL2 https://swayam.gov.in/NPTEL 3
	2. https://swayam.gov.in/explorer 4
	3. https://www.classcentral.com/course/swayam-principles-of-seed-technology- 17741
	4. https://www.classcentral.com/course/swayam-plant-groups-19787
	5. https://www.kanchiuniv.ac.in/assets/SWAYAM-BOOKLET.pdf 7
	6. https://www.hindiyojana.in/swayam-free-online-course-registration/ 8
	7. https://www.aicte-india.org/sites/default/files/SWAYAM_1.pd

Course outcomes CO	On completion of this course, students will be able to:
CO1	Understand seed biology and morphology of different seeds.
CO2	Learn about seed germination process and changes associated with it.
CO3	Know about tests required for seed germination
CO4	Gain knowledge on various seed germination tests and seed vigour.
CO5	Overview what is dormancy, its kind, significance and how to break it.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Internship

Title of the Course		Internship					
Course Type		Training					
Year	III	Semester	V	Credits	2	Course Code	24UINT51
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		-	-		-	-	

Learning Objectives ; This course aims at providing knowledge on

LO1	The main goal of the internship programme is to give students exposure to industry and help them comprehend current management techniques by having them work for at least fifteen days in an industry/institution over the summer.
LO2	To comprehend how theoretical ideas are applied in many sectors and industries.
LO3	To create a foundation for industry-integrated education, as well as to give students better practical knowledge and hands-on experience, improve their leadership qualities, and sharpen their problem- solving and management skills.
LO4	The internship must focus on practice. The college will require the students to visit the offices of the research lab/industry/institution it has a memorandum of understanding (MOU) with in order to receive on-the-job training in the many different areas of those businesses' operations.
LO5	Internships provide students with practical experience in a variety of fields, including manufacturing, productivity, development, and quality analysis. These experiences prepare students for competitive hiring processes in reputable MNC industries.

IT	CONTENTS
I	**Guidelines for Internship Programme:** 1. To give students the opportunity to spend at least fifteen days on their own during the II Semester vocation in order to acquire exposure to research labs, industry, and respected institutions and comprehend contemporary research procedures. 2. Individual instruction is provided for the internship. The internship programme must be completed in order to receive a credential. 3. Students are required to identify a research labs/industry/recognized institution for their Internship Programme Coordinator in consultation with and approval of their faculty guide. The choice of the research labs/industry/recognized institution should be intimated to the Internship coordinator before commencement of the Internship. Simultaneously, students should also have identified a guide within the research labs/industry/recognized institution (industry guide) under whose supervision and guidance they would carry out their Internship Program. 4. Students are expected to learn about the history of the research labs, industry, and recognized institution during their time. They must also learn about its founders or shareholders, the nature of business, organizational structure, reporting relationships, and how the various management functions (such as finance, HR, marketing, sales, and operations) operate. This list is merely

	Illustrative and not comprehensive. Students should collect and gather as much as possible of written materials, published data, and related matter. 5. Before leaving the research labs/industry/recognized institution, obtain the Internship Programme completion certificate on the letterhead of a research lab/industry/, or an accredited institution. 6. Maintain Internship Programme record with details on activities and personal learning during their project period. 7. The department head and the coordinator of the internship programme form a committee to ensure that the internship is followed. 8. At least two copies of the report must be prepared by the intern at the conclusion of the internship program—one for submission to the college and one copy for the student. If the organization, the guide, or both request additional copies, more copies may be made. The sources from which the information was gathered should be made crystal apparent in the report. Every page needs to have a number, which should be centred at the bottom of the page. All tables, figures, and appendices must be appropriately labeled and consecutively numbered or lettered. The report must be printed, bound (ideally with soft binding), and contain at least 25 pages. 9. The internship training report should be submitted to the department within a month from the date of commencement of third semester. 10. However, such submission shall not be accepted after the end of third semester Examinations.

II	**Evaluation of the Internship:** i. The internship program will be assessed by the assigned Internship Programme Coordinator from the host institute. ii. Evaluation will be done by the Internship Programme Coordinator of the host institute and through seminar presentation/viva-voce. iii. The presentation should be specific, clear and well analyzed, and indicate the specific sources of information. iv. According to the statement of the draft the evaluation of the interns will be done as per the sincerity and research output of the students. In addition the evaluation will also be assessed according to the activity of the log book, format of presentation, quality of the report made by the interns, uniqueness, skill sets and evaluation report of the internship coordinator.
III	**College Guide Manual – Summer Internship Program** 1. The Internship Programme Coordinator should give proper procedures to the intern before and after the Internship. 2. The Internship Programme Coordinator should interact with the research labs/industry/recognized institution at least once before completion of the internship. 3. The weekly report submitted by the student should be reviewed and reported to the Internship Programme coordinator.
IV	**Internal:** 100 marks Academic Industrial Activity- Programme Completion certificate - 50 marks Internship report- 50 marks Presentation - 20 marks Viva-voce - 30 marks
V	**CONTENTS OF THE REPORT** Title page for supervisory committee Table of Acknowledgement Academic Industrial Activity- Programme Certificate **Executive Summary** Introduction of the Report Overview of the Organization What I have Learned Analyses Summary Recommendation and Conclusion References Appendices

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts:	Dawson, C. 2002. Practical research methods. UBS Publishers, New Delhi.
	Stapleton, P., Yondeowei, A., Mukanyange, J., Houten, H. 1995. Scientific writing for agricultural research scientists – a training reference manual. West Africa Rice Development Association, Hong Kong.

Course outcomes CO	On completion of this course, students will be able to:
CO1	For students in those pertinent core areas, the internship is preparing them to become professionals after graduation.
CO2	Compile data and familiarize yourself with techniques for pl and carrying out tests
CO3	Collect data and educate yourself on how to analyze the res your scientific studies.
CO4	This in-the-moment industrial exposure helps them become Knowledgeable and skilled in the latest technology.
CO5	Improving communication skills and coming up with creative ideas are crucial components of training that help someone become an entrepreneur

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Semester - VI
Plant Physiology and Biochemistry

Title of the Course		**Plant Physiology and Biochemistry**					
Course Type		**Core - XIII**					
Year	**III**	**Semester**	**VI**	**Credits**	**5**	**Course Code**	**24UMBO61**
Instructional Hours per week		**Lecture**	**Tutorial**		**Lab Practice**	**Total**	
		4	**2**		**--**	**6**	

Learning Objectives	
LO1	To know about plant water relationships
LO2	To understand the mechanism of transpiration and translocation
LO3	To conceptualize the processes of photosynthesis and respiration
LO4	To know importance, functions and applications of growth hormones
LO5	To familiarize with the structure and function of various biomolecules

UNIT	**CONTENTS**
I	Water relations—imbibition, diffusion, osmosis and plasmolysis; mechanism of water absorption – active and passive, Ascent of sap – path, Mechanism – Transpiration pull and cohesion theory.
II	Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories. Translocation of solutes – path, mechanism - Munch mass flow hypothesis
III	Photosynthesis - Light reaction: Electron transport system - Cyclic and non-cyclic photophosphorylation. Dark reaction - C3 cycle, C4 cycle. Respiration- Types, Glycolysis, Krebs Cycle, Oxidative phosphorylation, CAM pathway.
IV	Growth – Growth curve, plant growth regulators hormones physiological effets of - auxins, gibberellins and cytokinins. Photoperiodism and Vernalization
V	Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties, classification, nomenclature of enzymes, mode of enzyme action.

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. Bhatla, S.C. & Lal, M.A. (2024). Plant Physiology, Development and Metabolism (2nd edition). Springer Nature Singapore.
	2. Taiz, L. & Zeiger, E. (2024). Plant Physiology and Development (6th edition). Sinauer Associates / Oxford University Press, New York.
	3. Pandey, S.N. & Sinha, B.K. (2023). Plant Physiology (4th edition). Vikas / S. Chand Publishing, New Delhi
	4. Hopkins, W.G. & Hüner, N.P.A. (2023). Introduction to Plant Physiology. Wiley, New York.
	5. Salisbury, F.B. & Ross, C.W. (2019). Plant Physiology (5th edition). Cengage / Wadsworth, Belmont, CA.
	6. Raven, P.H., Evert, R.F. & Eichhorn, S.E. (2019). Biology of Plants (8th edition). W.H. Freeman, New York.
	7. Lehninger, A.L., Nelson, D.L. & Cox, M.M. (2024). Principles of Biochemistry (8th edition). Macmillan / Worth, New York.
	8. Stryer, L., Berg, J.M. & Tymoczko, J.L. (2023). Biochemistry (9th edition). W.H. Freeman, New York.
	9. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont.
	10. B P Pandey (Ed.) (2023). Botany for B.Sc. Students: Plant Physiology, Metabolism & Biochemistr
References Books:	1. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
	2. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry
	3. Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA.
	4. Taiz, L. & Zeiger, E. (2024). Plant Physiology and Development (6th Ed.). Sinauer Associates / Oxford
	5. Salisbury, F.B. & Ross, C.W. (2019). Plant Physiology (5th Ed.). Cengage / Wadsworth, Belmont, CA.
	6. Bhatla, S.C. & Lal, M.A. (2024). Plant Physiology, Development and Metabolism. Springer Nature Singapore.
	7. Zubay, G.L. (1995). Biochemistry. McGraw Hill, New York.
	8. Nelson, D.L. & Cox, M.M. (2021). Lehninger Principles of Biochemistry Student Companion. Worth Publishers.

	9. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA.
	10. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA.
	11. Singhal, G.S., Renger, G., Sopory, S.K., Irrgang, K.D and Govindjee. 1999. Concepts in Photobiology: Photosynthesis and Photo morphogenesis. Narosa Publishing House, New Delhi.
	12. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA.
	13. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.
	14. N. K. Srivatava (2017). Plant Physiology, Rastogi Publications, Meerut.
Web Resources:	1. https://www.agrobotany.in/p/syllabus-of-physiology.html
	2. https://webnotee.com/water-relation-class-12-biology-notes/
	3. https://www.embibe.com/subjects/Biology/Plant-Physiology
	4. https://webnotee.com/water-relation-class-12-biology-notes/
	5. https://edurev.in/t/150354/Introduction-to-Plant-Physiology
	6. https://sathee.iitk.ac.in/revision-hub/mindmaps/biology-mindmaps/biology-comprehensive-mindmap/

Course outcomes CO	On completion of this course, students will be able to:
CO1	Relate to the significance of water in plant growth and development.
CO2	Summarize the physiological events during transpiration and translocation
CO3	Analyze the importance of photosynthesis and respiration
CO4	Recapitulate the important growth factors and role of growth hormones
CO5	Comprehend the structure, function and importance of various biomolecules.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Genetics and Plant Ecology

Title of the Course		Genetics and Plant Ecology					
Course Type		CORE - XIV					
Year	III	Semester	VI	Credits	4	Course Code	24UMBO62
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		4	2		--	6	

Learning Objectives	
LO1	To relate Mendelian genetics and laws of inheritance
LO2	To know phenomenon of gene interaction
LO3	To familiarize with the structure of chromosome and aberration types
LO4	To know about concepts of ecology
LO5	To understand the organization of ecosystem and flow of energy

UNIT	CONTENTS
I	GENETICS - Mendelian genetics – monohybrid, dihybrid crosses. Laws of Mendel. Reciprocal cross – Back cross and Test cross. Incomplete dominance - *Mirabilis jalapa*. Lethal gene action in Maize
II	Interaction of factors – Complementary genes, Supplementary genes, Epistasis (dominant and recessive), duplicate genes. Extra nuclear inheritance and its significance - Male sterility in corn, Maternal inheritance – Plastid Inheritance in *Mirabilis jalapa*.
III	Chromosome theory of linkage, crossing over, recombinations. Mutation-types and significance. chromosomal aberration – addition, deletion, inversion, duplication and translocation
IV	Structure of Ecosystem, Biotic and Abiotic components trophic levels; food chains and food web; energy flow in an ecosystem. Types of ecosystems: structure of pond ecosystem and grassland ecosystem. Ecological pyramids.
V	Vegetation – Units of Vegetation – Formation, Association, Consociation, Methods of study of vegetation (Quadrat and transect). Plant succession – Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical adaptations in hydrophytes and X e r o phytes.

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. Snustad, D.P. & Simmons, M.J. (2018). Principles of Genetics. John Wiley & Sons, New York
	2. Brooker, R.J. (2017). Genetics: Analysis and Principles (6th Ed.). McGraw-Hill Education, New York.
	3. Verma, P.S. & Agarwal, V.K. (2021). Genetics. S. Chand Publishing, New Delhi.
	4. Odum, E.P. & Barrett, G.W. (2020). Fundamentals of Ecology (6th Ed.). Cengage Learning, Boston..
	5. Krebs, C.J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance (7th Ed.). Pearson, New York.
	6. Raven, P.H., Evert, R.F. & Eichhorn, S.E. (2019). Biology of Plants (8th Ed.). W.H. Freeman, New York.
	7. Sharma, P.D. (2022). Ecology & Environment (14th Ed.). Rastogi Publications, Meerut.
	8. Shukla, R.S. & Chandel, P.S. (2021). Plant Ecology (10th Ed.). S. Chand Publishing, New Delhi.
References Books:	1. Griffiths, A.J.F., Wessler, S.R., Carroll, S.B., Doebley, J. & Suzuki, D.T. (2020). Introduction to Genetic Analysis (12th Ed.). W.H. Freeman, New York.
	2. Molles, M.C. (2019). Ecology: Concepts and Applications (8th Ed.). McGraw-Hill Education, New York.
	3. Krebs, C.J. (2016). Ecology: The Experimental Analysis of Distribution and Abundance (7th Ed.). Pearson, New York
	4. Begon, M., Townsend, C.R. & Harper, J.L. (2020). Ecology: From Individuals to Ecosystems (5th Ed.). Wiley, UK.
	5. Raven, P.H., Evert, R.F. & Eichhorn, S.E. (2019). Biology of Plants (8th Ed.). W.H. Freeman, New York.
	6. Kormondy, E.J. (2014). Concepts of Ecology (7th Ed.). Prentice Hall, New Delhi.

Web Resources:	1. https://www.khanacademy.org/science/biology/heredity
	2. https://openstax.org/details/books/biology-2e
	3. https://easybiologyclass.com/genetics/
	4. https://ncert.nic.in/textbook.php
	5. https://www.britannica.com/science/ecology
	6. https://www.agrobotany.in
	7. https://swayam.gov.in

Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Relate concepts of mendelian genetics.
CO2	Explain the phenomenon and factors associated with gene interaction
CO3	Elucidate structure, function and aberration of chromosomes.
CO4	Interpret the types of ecosystems and energy flow at various trophic levels.
CO5	Analyze the importance of vegetation and adaptation of plants in environment.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Physiology and Biochemistry Practical

Title of the Course	Plant Physiology and Biochemistry Practical						
Course Type	Core - XV – Lab - 7						
Year	III	Semester	VI	Credits	2	Course Code	24UMBOL7
Instructional Hours Per week		Lecture	Tutorial		Lab Practice		Total
		-	-		4		4

Learning Objectives :

LO1	To study plant water relations and membrane permeability
LO2	To demonstrate rate of photosynthesis and respiration
LO3	To carryout experiments related with separation of compounds
LO4	To carry out estimation of important biomolecules
LO5	To learn about structure of nucleic acids and enzyme action through models and charts

PRACTICALS

PHYSIOLOGY EXPERIMENTS

1. Determination of osmotic potential by plasmolytic method.
2. Effect of temperature on membrane permeability.
3. Water potential by Falling drop method.
4. Effect of temperature on permeability of Plasma membrane.

Demonstration

1. Tissue tension
2. Suction due to transpiration
3. Ganong's potometer
4. Fermentation – Kuhn's Tube experiment

Spotters: Growth curve, Growth hormones

BIOCHEMISTRY

1. Estimation of Sugar – Anthrone method
2. Estimation of Starch - I_2 – KI Method
3. Estimation of Protein – Biuret method

Models for enzyme action – Lock and key, Induced fit

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. Plummer, D.1988. An introduction to Practical Biochemistry, Tata McGraw– Hill Publishing Company Ltd., New Delhi
	2. Palanivelu, P.2004. Laboratory Manual for analytical biochemistry and separation techniques, School of Biotechnology, Madurai Kamaraj University, Madur
	3. Jayaraman. J. 1981. Laboratory Manual in Biochemistry. Whiley Eastern Limited, New Delhi
	4. Bendre, A.M. and Ashok Kumar, 2009. A textbook of practical Botany. Vol. I &II Rastogi Publication. Meerut. 9th Edition.
Reference Books	1. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
	2. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge
	3. Bendre, A. M and Ashok Kumar. 2009. A textbook of practical Botany. Vol. I & II Rastogi Publication. Meerut. 9th Edition.
	4. Manju Bala, Sunita Gupta, Gupta, N.K.2012. Practicals in Plant Physiology and Bio chemistry. Scientific Publisher
Web resources	1. https://www.ncertbooks.guru/class-11-biology-notes-water-relations/
	2. https://www.biologydiscussion.com/cell-plasmolysis/
	3. https://www.learncbse.in/water-potential/

Course outcomes CO	On completion of this course, students will be able to:
CO1	Relate the importance of plant water relationships.
CO2	Demonstrate Experiments on rate of photosynthesis and respiration.
CO3	Elucidate the basic principles involved in separation of biological compounds
CO4	Quantify important biomolecules in plant samples.
CO5	Appreciate the structure and mechanism of enzyme action by using models and charts

Genetics and Plant Ecology – Practical

Title of the Course	**Genetics And Plant Ecology – Practical**						
Course Type	**CORE - XVI – Lab - 8**						
Year	**III**	**Semester**	**VI**	**Credits**	**2**	**Course Code**	**24UMBOL8**
Instructional Hours Per week		**Lecture**	**Tutorial**		**Lab Practice**		**Total**
		-	**2**		**2**		**4**

Learning Objectives :	
LO1	To solve problems in Mendelian ratios
LO2	To demonstrate mechanism of crossing over, mutations and male Sterility
LO3	To familiarize with the methods of studying vegetation
LO4	To study morphological adaptation of plants in different habitats
LO5	To identify internal adaptive characters of plants in different habitats

PRACTICALS

GENETICS

Genetic problems – test cross, back cross, incomplete dominance and interaction of genes.

Photographs / Charts

1. Male sterility in Corn -
2. Maternal Inheritance
3. Crossing over- single and double crossing over
4. Mutation- Addition, Deletion Duplication

Ecology

1. Analysis of herbaceous vegetation by using Quadrat and line transect method
2. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes.

Hydrophytes : *Nymphaea, Hydrilla*

Xerophytes : *Nerium, Casuarina*

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 / UGCCSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut.
	2. Odum, E.P. & Barrett, G.W. (2020). Fundamentals of Ecology (6th Ed.). Cengage Learning, Boston.
	3. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
	4. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.
	5. Jackson, S.A., Kianian, S.F., Hossain, K.G and Walling, J.G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York.
Reference Books	1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.
	2. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
	3. Pandey, B.P. (2023). Botany Practical Manual: Ecology & Genetics. S. Chand Publishing, New Delhi.
	4. Molles, M.C. (2019). Ecology: Concepts & Applications (8th Ed.). McGraw-Hill Education, New York.
	5. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II.Rastogi Publication. Meerut. 9th Edition.
	6. Sharma, P.D. (2022). Ecology & Environment (14th Ed.). Rastogi Publications, Meerut.
Web resources	1. https://ncert.nic.in/textbook.php?jess2=0-12
	2. https://www.biologydiscussion.com/genetics/problems-and-solutions/60172
	3. https://www.easybiologyclass.com/genetics-notes/
	4. https://www.biologydiscussion.com/genetics/cytoplasmic-inheritance/
	5. https://www.learncbse.in/quadrat-method-line-transect/

Course outcomes CO	On completion of this course, students will be able to:
CO1	Relate to the Important concepts in mendelian genetics
CO2	Demonstrate Skills in studying the mechanism of crossing over and mutations
CO3	Elucidate the basic principles practices involved in studying plant vegetation.
CO4	Identify the morphological features of plants in different habitats
CO5	Analyse the internal adaptations of plant organs with reference to the habitat.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Horticulture and Plant Breeding

Title of the Course		Horticulture and Plant Breeding					
Course Type		Elective Course – VII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO61
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		

Learning Objectives	
LO1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.
LO2	To develop skills plant propagation methods.
LO3	To know about the components of a garden.
LO4	To provide an over view of plant breeding.
LO5	To impart knowledge on importance of plant breeding.
UNIT	**CONTENTS**
I	Scope, importance and divisions of horticulture. Gardening: Definition and objectives; different types of gardening – Formal, informal and kitchen garden.
II	Propagation methods: Cutting – root, stem and leaf; Layering – ground and air layering, grafting– tongue and approach grafting; Budding – T budding and Patch budding; Vegetative propagules - bulb, sucker, corm. Seed Propagation: Preparation of Nursery beds, Transplantation – steps and Methods.
III	Garden components: Lawn, Hedges, Edges, Rockery, Topiary, water garden, Bonsai and Hanging basket.
IV	Nature, Scope and Objectives of Plant Breeding; Plant introduction- selection methods (pure line and mass), Hybridization techniques, Heterosis breeding, Interspecific and intergeneric hybridization.
V	Mutation Breeding: Procedure and practices, Mutagens, Polyploidy breeding and its applications. Breeding for disease resistance.

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/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. Mallikarjuna Reddy, Aparna Rao 2010. Plant Breeding In Horticulture. Pacific Books International, India.
	2. Dr. N. Kumar 2020. Introduction to Horticulture, Oxford and ibh Pub 7th Edition, USA.
	3. Kalyani(Jitendra Singh) 2020. Basic Horticulture. Generic, India.
	4. B.D. Singh 2018. Plant Breeding: Principles and methods, Kalyani Publisher; 11th Edition, India.
	5. B.S. Jamwal, Mohd. Suhail, Manish Bakshi 2019. Breeding of Field and Horticulture Crops.Write and print publications, India.
	6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
	7. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi.
	8. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta.
	9. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore.
	10. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi

References Books:	1. V. Kumaresan 2022. Horticulture and Plant Breeding. Saras Publications, India.
	2. Dr. N. Kumar 2017. Introduction to Horticulture, MedTech Sciencepress, 8th Edition, India.
	3. Clive Koelling 2018. Horticulture and Plant breeding, Callisto Reference Publisher, USA.
	4. Phundan Singh (Kalyani) 2022. Fundamentals of Plant Breeding: Visionias Publisher; India.
	5. Buster Beer 2023. Fundamentals of Horticulture and Plant Breeding, White Press Academic publications, India.
	6. Hartman, H.T and Kester, D.E. 1989. Plant propagation. Printice Hall Ltd., New Delhi.
	7. Abraham, A and Vatsala, P. 1981. Introduction to Orchids. Trop. Bot. Garden,
	8. Bose, T.K and Yadav, L.P. 1989. Commercial flowers. Naya Prakash, Calcutta.
	9. Mc Daniel, G.L. 1982. Ornamental horticulture. Reston Publ., London.
	10. Helleyer, A. 1976. The Collingridge Encyclopedia of gardening Chartwell Book, Inc., New Jercy.
Web Resources:	1. https://www.kopykitab.com/Precision-Horticulture-by-Archarya-SK
	2. https://www.ebooks.com/en-us/subjects/science-horticulture-ebooks/423/
	3. http://www.agrimoon.com/horticulture-icar-ecourse-pdf-books/
	5. https://cbseportal.com/ebook/vocational-books-horticulture
	6. http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Enumerate the concepts in horticulture and nursery management.
CO2	Demonstrate a working knowledge on propagation methods
CO3	Appraise the importance of various components of a garden.
CO4	Analyze different methods of Plant breeding technique
CO5	Validate the role of plant breeding in producing disease resistant crops

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Natural Resource Management

Title of the Course		Natural Resource Management					
Course Type		Elective Course – VII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO62
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	--	5		

Learning Objectives	
LO1	To develop an appreciation for the natural resources and their ecological and economic impact.
LO2	To gain an understanding of various strategies of natural resource management.
LO3	To understand the concept of different natural resources and their utilization.
LO4	To create the models of natural resource conservation and maintenance.
LO5	To study the significance of natural resources pertaining to economy and environment.

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

IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, Causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their Management.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
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.

References 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_Man agement.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/1951836crLIC&redir_esc=y
	6. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y
	7. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS- WATER-ebook/dp/B00OPTWHOE
	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

Course outcomes CO	On completion of this course, students will be able to:
CO1	Relate to significance of natural resources pertaining to economy and environment.
CO2	Understand the concept of different natural resources and their utilization.
CO3	Evaluate the management strategies of different natural resources.
CO4	Critically analyze the sustainable utilization land, water, forest and energy resources.
CO5	Design new models of natural resource conservation and maintenance.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Forensic Botany

Title of the Course		Forensic Botany					
Course Type		Elective – VII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO63
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		--	5	

Learning Objectives	
LO1	To provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
LO2	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.
LO3	To learn classification of plants from forensic point of view.
LO4	To understand forensic importance of different parts of plants.
LO5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.

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 scene consideration.

V	Analysis of samples, DNA analysis, plant DNA typing, Classic forensic botany cases: Case histories by using Plant anatomy and systematic, Palynology, Plant ecology, Limnology, Plant Molecular Biology and DNA, Drug enforcement and DNA.

Extended professional component (is a part of internal component only, not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive UPSC/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

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.pp 129–149.
References 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-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

Course outcomes CO	On completion of this course, students will be able to:
CO1	Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.
CO2	Summarize the forensic importance of different parts of plants
CO3	Apply techniques for the collection and preserve of botanical evidences of crime.
CO4	Analyze and decipher the significance of classic and DNA based forensic botany cases.
CO5	Interpret and deduce new methods for the detection of plant poisons used in crime.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Plant Biotechnology

Title of the Course		Plant Biotechnology					
Course Type		Elective - VIII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO64
Instructional Hours per week		Lecture	Tutorial		Lab Practice	Total	
		3	2		--	5	

Learning Objectives	
LO1	To understand the definition, history, scope and branches of biotechnology.
LO2	To understand the tools, vectors, recombinant DNA technology, and gene transfer methods used in genetic engineering.
LO3	To understand and apply the principles and techniques of plant tissue culture
LO4	To understand the role of plant growth-promoting microorganisms fin nitrogen fixation, nodulation and biological control.
LO5	To understand the application of biotechnology in agriculture, medicine, environment and bioenergy

UNIT	CONTENTS
I	Fundamental of Biotechnology – definition, historical development and scope. Branches of biotechnology: plant, microbial, medical and environmental. Conventional and modern biotechnology – comparison. Overview of biotechnology industries and their significance.
II	Genetic engineering: Tools of genetic engineering: restriction endonuclease, DNA ligase, reverse transcriptase. Vectors; plasmid vectors, lambda bacteriophage vectors, cosmids. Recombinant DNA technology, basic steps involved in gene cloning. Gene transfer techniques: Indirect gene transfer- *Agrobacterium tumefaciens* -mediated–gene transfer (Ti plasmid). Direct gene transfer – Biolistic (Gene gun) method.
III	Plant tissue culture - introduction, scope and importance, concept of totipotency, process of differentiation, de-differentiation and re-differentiation, aseptic techniques and laboratory requirements for plant tissue culture. Culture media - composition and types; preparation of Murashige and Skoog (MS) medium, sterilization techniques, explant selection, preparation and inoculation. Callus induction and micro-propagation. Synthetic seed – concept, advantages and disadvantages.

IV	Plant growth-promoting microorganism (PGPM). Biological nitrogen fixation – nitrogenase enzyme system. Role of hydrogenase. Process of nodulation, Biocontrol of plant pathogens, Growth promotion by free-living bacteria.
V	Application of biotechnology – Agriculture: Biofertilizers (Phosphate solubilizing bacteria) and Biopesticides (Bt cotton). Medicine: Antibiotics – Penicillin (production and importance), Recombinant vaccine (Hepatitis B vaccine), Recombinant products - insulin. Environment: Bioremediation Super bug (concept) and Bio-fuel production–bio-ethanol using *Saccharomyces cerevisiae*.

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/JAM /TNPSC and others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:

1	Singh, B. D. (2022). *Biotechnology: Expanding Horizons* (1st Edition). Kalyani Publishers.
2	Glick, B. R., & Pasternak, J. J. (2019). *Molecular Biotechnology: Principles and Applications of Recombinant DNA* (5th Edition). ASM Press / Wiley.
3	Bhojwani, S. S., & Razdan, M. K. (2019). *Plant Tissue Culture: Theory and Practice* (4th Edition). Elsevier / Academic Press.
4	Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2024). *Molecular Biology of the Cell* (7th Edition). Garland Science.
5	Nair, A. J. 2010. Introduction to Genetic Engineering & Biotechnology. Jones & Bartlett Publishers, Boston, USA.
6	Gamborg, O.L., and Philips, G.C. 2004. Plant cell, Tissue and Organ Culture - Fundamental Methods; Narosa Publishing House, New Delhi.
7	Nair. A.J. 2004. Basics of Biotechnology; Laxmi Publications, New Delhi.

References Books:	
1	Current Protocols in Molecular Biology (2025 Update). Wiley-Interscience
2	Bhojwani, S. S. & Dantu, P. K. (2004). *Plant Tissue Culture: An Introductory Text*. Springer.
3	Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K. & Walter, P. (2024). *Molecular Biology of the Cell* (7th Edition). Garland Science.
4	Kumar, H.D. Modern concept of Biotechnology; Vikas Publishing House, Pvt. Ltd., New Delhi.
5	Siddiqui, M. N. (2021). *Textbook of Biotechnology* (2nd Edition). Atlantic Publishers
6	P. K. Gupta (2017). Plant Biotechnology, Rastogi Publication, Meerut.
7	R. C. Dubey (2017). Advanced Biotechnology, S, Chand Publication, New Delhi.
Web Resources:	
1	**AgBiotechNet** – searchable scientific literature on *agricultural biotechnology*.
2	**NCBI PubMed / Bookshelf** – searchable literature relevant to any biotech topics
3	**NCBI – National Center for Biotechnology Information** – central hub for genetics, molecular biology and biomedical databases (PubMed, Bookshelf, GenBank, BLAST, etc.).
4	**ISAAA – International Service for the Acquisition of Agri-biotech Applications** – biotech educational content & GMO information (often cited as resource in plant biotech courses).
5	**UniProt - The Universal Protein Resource-PubMed-NIH -** comprehensive, freely accessible database used by researchers to retrieve, analyze, and store, high-quality, annotated protein sequence and functional data

Course outcomes CO	On completion of this course, students will be able to
CO1	Recall basic concepts, branches, tools, and application of biotechnology.
CO2	Explain principles of genetic engineering, plant tissue culture and microbial processes
CO3	Apply biotechnological techniques in gene transfer, cloning, tissue culture, and bio-applications.
CO4	Explain the mechanism of plant growth promotion, biological nitrogen fixation, nodulation, and biocontrol by microorganisms.
CO5	Evaluate the importance and impact of biotechnological applications in agriculture, medicine, and environment.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Forestry

Title of the Course		Forestry					
Course Type		Elective – VIII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO65

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

Learning Objectives	
LO1	To study the distribution pattern, composition and diversity of forest ecosystems.
LO2	To understand forest management principles and conservation methods.
LO3	To enable them to contribute in the forest conservation meaningfully.
LO4	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.
LO5	To provide a platform to appreciate biodiversity and the importance.

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. Nutrient cycling in forests (Carbon, Nitrogen, oxygen, phosphorus and sulphur).
II	**SILVICULTURE**: Forests - definition. Forest types of India and Tamil Nadu - revised classification – pure and mixed stands - even and uneven aged stands. Role of forests - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Nursery techniques - containerized seedling production - techniques and methods.
III	**Forest Resources and Utilization:** Non-Timber Forest Products (NTFPs): gums, resins, oleoresins, fibres, oil seeds nuts, rubber, canes, bamboos, medicinal plants, charcoal, lac and shellac. Timber identification - general principles. Pulp, paper and rayon.
IV	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.
V	**Conservation of forests**: Importance of forests in Carbon sequestration, the social, cultural and economic value of forests and ecosystem services, Indian Forest Policy (1990), National Forest Policy (1988), People's involvement in protecting forests, Joint Forest Management, Involvement of women in forest conservation

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough 2. Approach to forest service. Jain Bros.
	3. Roger Sands. 2013. Forestry in a global context, CAB international.
	4. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun.
	5. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi.
	6. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi.
	7. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat.
	8. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun.
	9. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
	10. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi.
	11. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
	12. Roger Sands. 2013. Forestry in a global context, CAB international.
References Books:	1. Donald L. Grebner.Jacek P. Siry and Pete Bettinger. 2012. Introduction to forestry and Natural resources Academic press
	2. West, P.W. 2015. Tree and forest measurement, Springer international publishing Switzerland.
	3. Kollmann, F.F.P and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.
	4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. OxfordIBH Publishing Co., New Delhi.
	5. Belcher, B.M. 1998. A production-to-consumption systems approach: Lessons from thebamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia.

	6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. WertzKanounnikoff. 2007. Incentives and constraints shape forest outcomes. In: At loggerheads? Agricultural expansion, poverty reduction and environment in tropical forests. The World Bank, Washington, DC.
	7. Rao, K.R. and Juneja, K.B.S. 1992. Field identification of 50 important timbers of India. ICFRE Publi. Dehradun 123 p
Web Resources:	1. http://wwwwds.worldbank.org/external/default/WDSContentServ er/WDSP/IB/2006/10/19/000112742_20061019150049/Rendered/PDF/367890Loggerheads0Report.pdf.
	2. https://www.cbd.int>development>doc.
	3. https://www.britannica.com/science/forestry
	4. https://en.wikipedia.org/wiki/Forestry.
	5. https://www.biologydiscussion.com/forest/essay- forest-importance.major-products-and-its- conservation/25119
	6. https://academic.oop.com
	7. https://www.sciencedirect.com/topics/agriculture-and-biological- 8. Science-forest-product.

Course outcomes CO	**On completion of this course, students will be able to:**
CO1	Relate to the basic concepts related to forest distribution, Degradation, protection, management and resource utilization.
CO2	Understand complex interactions of humans and forest Ecosy stems in a global context.
CO3	Demonstrate skills for ecological measurements and Interpretation of forest ecology management.
CO4	Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood Preservation.
CO5	Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Pomology

Title of the Course		Pomology					
Course Type		Elective - VIII					
Year	III	Semester	VI	Credits	3	Course Code	24UEBO66
Instructional Hours per week		Lecture	Tutorial	Lab Practice	Total		
		3	2	-	5		

Learning Objectives ; This course aims at providing knowledge on

LO1	Understand pomology, tropical fruit cultivation, its status, fruit growing regions of India and in Tamil Nadu.
LO2	Find out the overall strategies and techniques to grow different commercial fruits.
LO3	Impart knowledge on cultivation methods of some prominent fruit varieties.
LO4	Learn about the cultivation methods of subtropical and tropical fruits.
LO5	Study about temperate fruits and their propagation methods.

UNIT	CONTENTS
I	**INTRODUCTION TO TROPICAL FRUITS:** Tropical fruits cultivation - Past and present status of tropical General appraisal of fruit growing regions / Zones in India and Tamil Nadu.
II	**TROPICAL FRUIT CULTIVATION:** Climate and soil requirements - propagation techniques - planting. Nutrition- nutrient deficiency and management – flowering, fruit set, bearing problems - special horticultural technique. Harvesting techniques – post harvest handling & post-harvest treatments - ripening of fruits - storage and processing of Mango, Banana.
III	**EDAPHIC FACTOR FOR FRUIT CULTIVATION:** Soil type and structure, texture, pH, salinity, moisture and temperature. Manures and manuring of Papaya, Guava, Sapota, Lemon, Sweet orange, Jack fruit and Pine apple.
IV	**MANAGEMENT OF FRUIT CROPS:** Subtropical and humid zones of India and Tamil Nadu – importance and scope of fruit crops in these zones – management of nutrient – water needs – weed management – pruning method – physiology of flowering, use of plant growth regulators – harvesting procedures – post harvest aspects of the following crops: Mandarin, Avocado, Litchi, Carambola.
V	**PRODUCTION AND POST HARVEST MANAGEMENT OF FRUIT CROPS:** Classification of temperate fruits – detailed study of area, production, varieties– harvesting – post harvest handling and storage in the following crops: Apple, Pear, Plum, Strawberry, Cherries.

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/JAM/TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill

Recommended Texts:	1. Bose, T. K.S K. Mitra, and D. S. Rathore. 1998. Temperate Fruits – Nayaprakash, Calcutta.
	2. Bose, T.K. 1996. Fruits of India – Tropical and sub – tropical. Nayaprakash, Calcutta.
	3. Bose T.K. S. K. Mitra and M. K. Sadhu. 1988. Mineral Nutrition of Fruit Crops.Naya Prokash, Calcutta.
	4. Bose, T. K., S. K. Mitra and D. Sanyal, 2001. Fruits: Tropical and subtropical volume I. Naya Udyog, Calcutta.
	5. Gardener, Bradford and Hooker. 1952. Fundamentals of fruit production. McGraw Hill Book Co. Inc. London.
	6. Singh, S., Krishnamoorthy. S., and Katyal, S. L. 1967. Fruit culture in India. ICAR, New Delhi.
References Books:	1. Bose, T.K & S. K. Mitra, Nayaprakash. 1990. Fruits: Tropical and subtropical. 206 Bidhan Saram, Calcutta – 700 116, India.
	2. Mithra, S. K. T. K. Bose and D.S. Rathore. 1990. Temperate fruits. Horticulture and Allied Publisher.
	3. Chattopadhyay, T.K. 1994. A text book of Pomology (Vol 1-3) Kalyani Publishers, New Delhi.
	4. Pal, J.S. 1997. Fruit Growing, Kalyani Publishers, New Delhi.
	5. Singh, S.P. 1995. Commercial Fruits, Kalyan Publishers, Ludhiyana.
Web Resources:	1. http://ugcmoocs.inflibnet.ac.in/ugcmoocs/moocs_courses.php 8
	2. https://www.indiacustomercare.com/swayam-online-education-toll-free- number-18001219025 9
	3. https://www.britannica.com/science/pomology 10
	4. https://www.thefreedictionary.com/pomolog
	5. https://swayam.gov.in/NPTEL

Course outcomes CO	On completion of this course, students will be able to:
CO1	Gain information about cultivation of Indian fruits.
CO2	Understand pomology, tropical fruit cultivation of India.
CO3	Identify methods for producing subtropical humid zone fruits.
CO4	Get a thorough knowledge about classification and production methods of temperate fruits.
CO5	Learn about the production of export varieties of fruits.

Mapping with programme outcomes and programme specific Outcomes

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	3	3	2	3	3	2	3	3
CO2	2	3	3	3	2	3	3	2
CO3	3	3	3	2	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	2	3	3	2	3	3	2

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

CO/ PSO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Blue Print – End Semester Examinations Semester – I to VI

Class: U.G. **Time: 3 Hours** **Max. Marks: 75**

Section A **(10 x 1 = 10)**

Answer all questions.
Choose the correct answer. (With four options)

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	1 & 2	3 & 4	5 & 6	7 & 8	9 & 10

Section B **(5 x 5 = 25)**

Answer all questions choosing either (a) or (b).
Answer should not exceed 250 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	11 (a) & 11 (b)	12 (a) & 12 (b)	13 (a) & 13 (b)	14 (a) & 14 (b)	15 (a) & 15 (b)

Section C **(5 x 8 = 40)**

Answer all questions choosing either (a) or (b).
Answer should not exceed 500 words

	Unit I	Unit II	Unit III	Unit IV	Unit V
Question Nos.	16 (a) & 16 (b)	17 (a) & 17 (b)	18 (a) & 18 (b)	19 (a) & 19 (b)	20 (a) & 20 (b)