

**ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN
PALANI**



**(AUTONOMOUS)
RE-ACCREDITED WITH B⁺⁺ GRADE BY NAAC
(Affiliated to Mother Teresa Women's University, Kodaikanal)**

DEPARTMENT OF BOTANY

SYLLABUS

FOR

B.Sc., BOTANY

&

EXTRA-CREDIT COURSES

**UNDER CHOICE BASED CREDIT SYSTEM
2023 - 2026**

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN,
PALANI

DEPARTMENT OF BOTANY

BOARD OF STUDIES MEETING

HELD ON 12. 07. 2023

UNIVERSITY NOMINEE:

Dr. C. Thamaraiselvi
Assistant Professor
Department of Biotechnology
Mother Teresa Women's University, Kodaikanal.

MEMBERS:

Dr. M. Anandi
Associate Professor & Head
PG & Research Department of Botany
Arulmigu Palaniandavar College of Arts and culture
Palani

Mr. P. Badrakali (Entrepreneur)
Chitra Mushroom Farm
Near Sastha Mill
Pappampatti
Palani

Dr. C. Jayachitra (Alumni)
Associate Professor
PG & Research Department of Botany

Arulmigu Palaniandavar College of Arts and Culture
Palani.

Ms. M. Sivaranjani
(Student Representative)

II M.Sc Botany
Arulmigu Palaniandavar Arts College for Women
Palani

Head of the Department

Dr. R. Prema

Assistant Professor and Head
Arulmigu Palaniandavar Arts College for Women
Palani

Members of the Faculty

Mrs. V. Vanitha

Assistant Professor of Botany

Mrs. P. Mohanapriya

Assistant Professor of Botany

Dr. Anjana Surendran

Assistant Professor of Botany

Dr. R. Ilamathi

Assistant Professor of Botany

ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN, PALANI

PREAMBLE

The Department of Botany came into existence in the year 1971. The Department stands for its academic excellence and well equipped laboratories. The highlight of the Department is the active participation of the faculty members in skill development programmes like Mushroom cultivation, Azolla cultivation, Herbal plant cultivation etc. Many seminars, workshops and outreach programmes are conducted to encourage creative skills of the students. The faculty members have published many International and National papers in reputed Journals. Our Department renders dedicative service to empower women and also raising the status of women by developing them as a entrepreneur through skill based training by introducing relevant papers in the Curriculum to fulfill their local needs through the Board of Studies.

COLLEGE VISION

- Enlightenment and Empowerment of Rural Women.

COLLEGE MISSION

- Providing high quality teaching learning environment with practical exposure
- Imbibing research culture and collaborate programs with local communities
- Imparting strong and supportive education to promote employability
- Encouraging questioning spirit and self – reliance

**ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN,
PALANI**

DEPARTMENT OF BOTANY

VISION

- To upgrade the department into PG and Research Centre.
- To start PG diploma courses.
- To motivate the students in the research field
- To mould the students into a good citizen.

MISSION

- To focus the areas where Entrepreneurial scope for Botanists
- To create awareness about the environment, Bioethics and Biodiversity Conservation.
- To update the students with latest technologies in the field of science.

**ARULMIGU PALANIANDAVAR ARTS COLLEGE FOR WOMEN,
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DEPARTMENT OF BOTANY

Programme Educational Objectives (PEOs)

PEO 1 Graduates of the program will develop a strong and competent knowledge in basic biological science required for critical learning and research.

PEO 2 Graduates students will develop diversified basic professional skills through various laboratory technical training, communicational and presentation skills.

PEO 3 They will possess an ability to identify, formulate, and solve biological problems to contribute to service efforts to communicate in both the professional and private realm.

PEO 4 Graduates will integrate related topics from separate parts of the course such as levels of organization, cell biology, ecology, evolution, biochemistry, genetics, embryology, basic biotechnology, physiology, molecular biology for successful career.

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DEPARTMENT OF BOTANY

B.Sc., Botany

Programme Specific Outcomes:

- **PSO1:** Acquire good knowledge and understanding, to solve specific theoretical & practical problems in different area of Botany.
 - **PSO2:** Understand, formulate, develop mathematical arguments, logically and use quantitative models to address issues arising in social sciences, business and other context /fields.
 - **PSO3:** To prepare the students who will demonstrate respectful engagement with other's ideas, behaviors, beliefs and apply diverse frames of references to decisions and actions. To create effective entrepreneurs by enhancing their critical thinking, problem solving, decision making and leadership skill that will facilitate startups and high potential organizations.
 - **PSO4:** Developing a research framework and presenting their independent ideas effectively.
 - **PSO5:** Equipping their employability skills to excel in professions like teaching and exposing them to various activities to empower them through communication skills.
 - **PSO6:** Enabling a holistic perspective towards the socio-political inequalities and environmental issues.
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PROGRAM OUTCOME

Upon completion of B.Sc., Botany Degree Programme the graduates will be able to

PO 1	Develop a broad fundamental knowledge of the plant diversity especially habit ,habitat ,morphology, adaptations and classification of plant kingdom.
PO 2	Analyze the relationship between plants, animals, microbes and deal with the local national global environment issues by realizing the right of the individuals and also need to conserve our biosphere.
PO 3	Understand how organisms function at the level of gene, genome, cell tissue, thallus, plant body drawing upon this knowledge, they are able to give specific examples of the physiological adaptations developed, reproduction and behavior of different forms of life.
PO 4	Gain knowledge about the application of biological sciences in mushroom cultivation, azolla cultivation, nursery management, herbal garden management, pest management, there by impart skill as well a source of income and self employment .
PO 5	Generate innovative ideas for performing experiments in the areas of biochemistry, physiology, genetics, microbiology, Developmental biology, anatomy, taxonomy, economic botany, and ecology.
PO 6	Explain the recent developments in genetic engineering, biotechnology, microbiology, for research activities in the department or in collaboration with other research institutions.
PO 7	Organize and deliver relevant applications of knowledge through effective written verbal, graphical/virtual communications and interact with people from diverse back ground.

Credit Distribution for UG Programmes

Sem I	Credit	H	Sem II	Credit	H	Sem III	Credit	H	Sem IV	Credit	H	Sem V	Credit	H	Sem VI	Credit	H
Part 1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	Part..1. Language – Tamil	3	6	5.1 Core Course – CC IX Plant Morphology, Taxonomy and Economic Botany	4	5	6.1 Core Course – CC XIII Plant Ecology and Phytogeography	3	5
Part. 2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	Part..2 English	3	6	5.2 Core Course – CC X Plant Anatomy, Embryology, Plant Morphology, Taxonomy And Economic Botany - Practical-V	4	5	6.2 Core Course – CC XIV Plant Biotechnology and Molecular Biology	3	5
1.3 Core Course – CC I Plant Diversity I – Alga	5	5	2..3 Core Course – CC III Core Course Plant Diversity II –	5	5	3.3 Core Course – CC V Plant Diversity III – Bryophytes	4	4	4.3 Core Course – CC VII Plant Diversity IV - Gymnosperms,	5	5	5.3 Core Course CC – XI Plant Anatomy and Embry	4	5	6.3 Core Course – CC XV Plant Physiology and Plant Biochemistry	3	5

e			Fungi, Bacteria, Viruses, Plant pathology and Lichens			and Pteridophytes			Paleobotany and Evolution			ology			Core Course XVI Plant Biotechnology, Molecular Biology, Plant Physiology and Plant Biochemistry Practical VI	3	3
1.4 Core Course – CC II Plant Diversity I Algae - Practical-I	4	4	2.4 Core Course IV – CC IV Fungi, Bacteria, Viruses, pathology and Lichens – Practical II	4	4	3.4 Core Course – CC VI Plant Diversity III Bryophytes and Pteridophytes – Practical-III	4	4	4.4 Core Course – CC VIII Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-I-IV	4	3	5.4. Core Course – CC – XII Project with viva-voce	4	5	6.4 Elective - VII EC 7 1. Horticulture 2. Natural Resource Management	3	5
Elective Course EC 1 Allied: Zoology – I	2	3	Elective Course EC 2 Allied: Zoology – II	2	3	Elective Course EC 3 Allied: Chemistry – I	2	3	Elective Course EC 4 Allied: Chemistry – II	2	3	5.5 Elective V EC5 1. Bio-Analytical Techniques 2. Aquatic Botany	3	4	6.5 Elective VIII EC 8 1. Forensic Botany 2. Bionanotechnology	3	5
Allied Zoology Practical	2	2	Allied Zoology Practical	2	2	Allied Chemistry Practical	2	2	Allied Chemistry Practical	2	2	5.6 Elective VI EC6 – 1. Entrepreneurial Botany 2. Forestry	3	4	6.6 Extension Activity	1	-

NM E-I Nursery and Landscaping	2	2	NME-II Mushroom cultivation	2	2												
1.7 Skill Enhancement - (Foundation Course) Basics of Botany	2	2	2.7 Skill Enhancement Course – SEC-3 Botanical garden and landscaping	2	2	3.7 Skill Enhancement Course SEC-4 *Entrepreneurial opportunities in botany SEC 5 Herbal Technology	2 2	2 2	4.7 Skill Enhancement Course SEC 6 Fermentation technology SEC 7 Environmental impact analysis	2 2	2 2	5.7 Value Education	2 2	2 2	6.7 Professional Competency Skill Training for Competitive examinations Botany for Competitive examinations (2 hours)	2 2	2 2
						3.8 E.V.S.	-	1	4.8 E.V.S	2	1	5.8 Summer Internship/Industrial Training	2				
	23	30		23	30		22	30		25	30		26	30		21	30
Total – 140 Credits																	

CBCS - COURSE PATTERN AND SYLLABUS

UG - BOTANY

I SEMESTER

Class	I SEMESTER	Title of the course	Credit	Hours	Marks		
I B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course I Plant Diversity I –Algae	5	5	25	75	100
		Core Course II Plant Diversity I Algae - Practical-I	4	4	25	75	100
	Part III	Elective Course EC 1 Allied: Zoology – I	2	3	25	75	100
		Allied Zoology Practical	2	2			
	Part - IV	NME-I Nursery and Landscaping	2	2	25	75	100
		Foundation Course Basics of Botany	2	2	25	75	100
Total			23	30			

II SEMESTER

Class	II SEMESTER	Title of the course	Credit	Hours	Marks		
I B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course III Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	5	5	25	75	100
		Core Course IV Fungi, Bacteria, Viruses, pathology and Lichens – Practical II	4	4	25	75	100
	Part III	Elective Course EC2 Allied: Zoology Paper – II	2	3	25	75	100
		Allied: Zoology Practical	2	2	25	75	100

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	Part - IV	NME-II Mushroom cultivation	2	2	25	75	100
	Skill Enhancement Courses SEC 3	Botanical garden and landscaping	2	2	25	75	100
Total			23	30			

III SEMESTER

Class	III SEMESTER	Title of the course	Credit	Hours	Marks		
II B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course V Plant Diversity III – Bryophytes and Pteridophytes	4	4	25	75	100
		Core Course VI Plant Diversity III Bryophytes and Pteridophytes – Practical-III	4	4	25	75	100
	Part III	Elective Course EC3 Allied: Chemistry Paper – III	2	3	25	75	100
		Allied Chemistry Practical	2	2	25	75	100
	Skill Enhancement Course SEC 4	*Entrepreneurial Skill Entrepreneurial opportunities in botany	2	2	25	75	100
	Skill Enhancement Courses SEC 5	Herbal Technology	2	2	25	75	100
	Part IV	Environmental studies	-	1	-	-	-
Total			22	30			

IV SEMESTER

Class	IV SEMESTER	Title of the course	Credit	Hours	Marks		
	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100

II B.Sc.	Part III	Core Course VII Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	5	5	25	75	100
		Core Course VIII Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV	4	3	25	75	100
	Elective Course EC4	Allied: Chemistry Paper – IV	2	3	25	75	100
		Allied Chemistry Practical	2	2	25	75	100
	Skill Enhancement Course SEC 6	Fermentation technology	2	2	25	75	100
	Skill Enhancement Courses SEC 7	Environmental impact analysis	2	2	25	75	100
	Part IV	Environmental studies	2	1	25	75	100
Total			25	30			
*Road map for SE5: Workshop on Entrepreneurship with hands-on training special lectures by experts/industrialists on entrepreneurial schemes and funding available from Central/State Government							
Second Year Vacation – Internship - 40 hours 2 credit							

V SEMESTER

Class	V SEMESTER	Title of the course	Credit	Hours	Marks		
III B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part III	Core Course IX Plant Morphology, Taxonomy and Economic Botany	4	5	25	75	100
		Core Course X Plant Anatomy, Embryology, Plant Morphology, Taxonomy And Economic Botany - Practical-V	4	5	25	75	100
		Core Course XI Plant Anatomy and Embryology	4	5	25	75	100
		Core Course XII Project with Viva-voce	4	5	25	75	100
		Elective course 5	3	4	25	75	100
		EC5 1. Bio-Analytical Techniques 2. Aquatic Botany					

	Elective Course 6	EC6 – 1. Entrepreneurial Botany 2. Forestry	3	4	25	75	100
	Part IV	Value Education	2	2	25	75	100
	Part V	Internship	2	-	100	-	-
	Total		26	30			

VI SEMESTER

Class	VI SEMESTER	Title of the course	Credit	Hours	Marks		
	Part			Theory/ Practical	Internal	External	Total
III B.Sc.	Part III	Core Course XIII Plant Ecology and Phytogeography	3	5	25	75	100
		Core Course XIV Plant Biotechnology and Molecular Biology	3	5	25	75	100
		Core Course XV Plant Physiology and Plant Biochemistry	3	5	25	75	100
		Core Course XVI Plant Biotechnology, Molecular Biology, Plant Physiology and Plant Biochemistry Practical VI	3	3	25	75	100
	Elective course 7	EC 7 1. Horticulture 2. Natural Resource Management	3	5	25	75	100
	Elective Course 8	EC 8 1. Forensic Botany 2. Bionanotechnology	3	5	25	75	100
	Skill Enhancement Courses Professional Competency Enhancement	Training for Competitive examinations Botany for Competitive examinations (2 hours)	2	2	25	75	100
	Part IV	Extension activity	1	-	100	-	100
Total			21	30			
TOTAL CREDITS			140	---			

Part No	Course Code	Course Title	Lecture/ Practical (Hours /Week)	Duration of Exam (Hours)	Max Marks			Credit Points
					Internal	External	Total	
SEMESTER I, III & V								
VI		Extra Credit Paper I Dietary and Nutritional Value of Fruits and Vegetables	-	3	-	-	100	2
		Extra Credit Paper II Commercial Plant Products	-	3	-	-	100	2
		Extra Credit Paper III Biodiversity Conservation and Management	-	3	-	-	100	2

Part No	Course Code	Course Title	Lecture/ Practical (Hours /Week)	Duration of Exam (Hours)	Max Marks			Credit Points
					Internal	External	Total	
SEMESTER II, IV & VI								
IV		Value Added Course I Organic Farming	-	3	-	-	100	
		Value Added Course II Landscape Gardening	-	3	-	-	100	
		Value Added Course III Terrace Gardening	-	3	-	-	100	

Internal Question Pattern Part III

Section	Pattern	Marks	Total
A	1-6 MCQ (Answer all)	6x1	6
B	7-8 (Either or Choices)	2x4	8
C	9-12 (Any Two out of Four)	1x8	16
		TOTAL	30
Assignment			5
Seminar			5
Total Internal Marks			25

External Question Pattern Part III

Section	Pattern	Marks	Total
A	1-10 MCQ (Answer All)	10x1	10
B	11-15 (Either or Choices)	5x7	35
C	16-20 (Any Three out of Five)	3x10	30
		TOTAL	75

Internal Question Pattern Part IV

Section	Pattern	Marks	Total
A	1-3 (Any Two Out of Three)	2x2	4
B	4-5 (Any One Out of Two)	1x4	4
C	6-7 (Any One Out of Two)	1x7	7
		TOTAL	15
Assignment			5
Seminar			5
Total Internal marks			25

External Question Pattern Part IV

Section	Pattern	Marks	Total
A	1-8 (Any Five Out of Eight)	5x3	15
B	9-16 (Any Five Out of Eight)	5x6	30
C	17-21 (Any Three Out of Five)	3x10	30
		TOTAL	75

SEMESTER I

Class	I SEMESTER	Title of the course	Credit	Hours	Marks		
I B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course I Plant Diversity I –Algae	5	5	25	75	100
		Core Course II Plant Diversity I Algae - Practical-I	4	4	25	75	100
	Part III	Elective Course EC 1 Allied: Zoology – I	2	3	25	75	100
		Allied Zoology Practical	2	2			
	Part - IV	NME-I Nursery and Landscaping	2	2	25	75	100
		Foundation Course Basics of Botany	2	2	25	75	100
	Total		23	30			

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Plant Diversity- I Algae
Course Type: Core Paper - I	Course Code:
Contact Hours: 5 Hours/Week	Credits: 5
CIA: 25	CE: 75

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

V	Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite. Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO ₂ sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.
Recommended Texts	<ol style="list-style-type: none"> 1. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London. 2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi 3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut. 4. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.
References Books	<ol style="list-style-type: none"> 1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1. 2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi. 3. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera. 4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press. 5. Round, FE. 1984. The Ecology of Algae. Cambridge University Press. 6. Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York. 7. Bold, H.C and Wynne, M.J. 1978. Introduction to the Algae: Structure and Function. Prantice Hall of India New Delhi.
Web Resources	<ol style="list-style-type: none"> 1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382 2. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382 3. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327 4. https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678 5. https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh 6. https://www.wileyindia.com/a-textbook-of-algae.html 7. https://www.kobo.com/in/en/ebook/algae-biotechnology 8. https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO6	PSO7	PSO8	PSO9	PSO10
CO1	3	3	1	3	2	1	2	2	2	1
CO 2	3	3	2	2	3	3	2	1	3	3
CO 3	2	2	1	1	2	2	1	3	2	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	3	2	3	3	3	2	3

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Plant Diversity- I Algae Practical
Course Type: Core Paper - II	Course Code:
Contact Hours: 4 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To develop skills to identify algae based on habitat, thallus structure and the internal organization.	
C2	To identify microalgae in a mixture.	
C3	To develop skills to prepare the microslides of algae.	
C4	To study the economic importance of few species.	
C5	To understand importance of algae to animals and humans	
Course outcomes	On completion of this course, students will;	
CO1	Recall and identify algae using key identification characters.	K1
CO2	Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.	K2
CO3	Describe the internal structure of algae prescribed in the syllabus	K3
CO4	Decipher the algal diversity in fresh/marine water and their economic significance.	K4
CO5	Evaluate the various techniques used to culture algae for commercial purposes	K5
EXPERIMENTS		
1. Micro-preparation of the types prescribed in the syllabus. 2. Identifying the micro slides relevant to the syllabus. 3. Identifying types of algal mixture. 4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth. 5. Field visit to study fresh water/marine water algal habitats. 6. Visit to nearby industry actively engaged in algal technology.		
Recommended Texts	1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical	

	Botany-1 (10 th ed). Rastogi Publications, Meerut. 3. Round, FE. 1984. The Ecology of Algae. Cambridge University Press. 4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani. ISBN: 978-9922-20-391-1. 5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
Reference Books:	1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying 2. manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher. 3. Chapman, V.J and Chapaman, D.J. 1960. The Algae, ELBS & MacMillan, London. 4. Lee, R.D. 2008. Phycology 4th Edition, Cambridge University Press, New York. 5. Dehradun. Edwardlee, R. 2018. Phycology, 5 th Ed., Cambridge University Press, London.
Web resources:	1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492 2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id=8d5DAAAACAAJ&redir_esc= 3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html 4. https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/ 5. https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	1	3	2	1	2	3	2	1
CO 2	3	3	2	2	3	3	2	3	3	3
CO 3	2	2	3	3	1	2	1	3	1	2
CO 4	3	3	3	3	3	2	3	3	3	2
CO 5	3	3	2	2	2	3	3	3	2	3
S-Strong (3)			M-Medium (2)			L-Low(1)				

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Elective Allied Botany-I
Course Type: Core-Allied-I	Course Code:
Contact Hours: 3 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To study morphological and anatomical adaptations of plants of various habitats.	
C2	To demonstrate techniques of plant tissue culture.	
C3	To familiarize with the structure of DNA, RNA.	
C4	To carryout experiments related with plant physiology.	
C5	To perform biochemistry experiments.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
CO3	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	Compare the structure and function of cells and explain the development of cells.	K4
CO5	Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5
Unit	CONTENTS	
I	Algae: General characters of algae - Structure, reproduction and life cycle of the following genera - <i>Anabaena</i> and <i>Sargassum</i> and economic importance of algae.	
II	Fungi, Bacteria and Virus: General characters of fungi, structure, reproduction and life cycle of the following genera - <i>Penicillium</i> and <i>Agaricus</i> and economic importance of fungi. Bacteria - general characters, structure and reproduction of <i>Escherichia coli</i> and economic importance of bacteria. Virus - general characters, structure of TMV, structure of bacteriophage.	
III	Bryophytes, Pteridophytes and Gymnosperms: General characters of Bryophytes, Structure and life cycle of <i>Funaria</i> . General characters of Pteridophytes, Structure and life cycle of <i>Lycopodium</i> .	

	General characters of Gymnosperms, Structure and life cycle of <i>Cycas</i> .
IV	Cell Biology: Prokaryotic and Eukaryotic cell- structure /organization. Cell organelles - ultra structure and function of chloroplast, mitochondria and nucleus. Cell division - mitosis and meiosis.
V	Genetics and Plant Biotechnology: Mendelism - Law of dominance, Law of segregation, Incomplete dominance. Law of independent assortment. Monohybrid and dihybrid cross - Test cross - Back cross. Plant tissue culture - <i>In vitro</i> culture methods. Plant tissue culture and its application in biotechnology.
Recommended Texts	<ol style="list-style-type: none"> 1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.
Reference Books	<ol style="list-style-type: none"> 1. Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi. 2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd. 3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi. 4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi. 5. Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi. 6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi. 7. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I &II, S.Chand and Co. New Delhi.
Web Resources	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/the-algae-world 2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/ 5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 6. https://www.us.elsevierhealth.com/medicine/cell-biology 7. https://www.us.elsevierhealth.com/medicine/genetics https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

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

S-Strong (3)**M-Medium (2)****L-Low(1)****Mapping with Programme Specific Outcomes:**

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Nursery and Landscaping
Course Type: Core Paper - III	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.	
C2	To be able to design gardens and become entrepreneur in Horticulture.	
C3	To study the methods of propagation.	
C4	To know about nursery structure.	
C5	To learn about gardening.	
Course outcomes	On completion of this course, students will;	
CO1	Recognize the basic principles and components of gardening.	K1
CO2	Explain about bio-aesthetic planning and conceptualize flower arrangement.	K2
CO3	Apply techniques for design various types of gardens according to the culture and art of bonsai.	K3
CO4	Compare and contrast different garden styles and landscaping patterns.	K4
CO5	Establish and maintain special types of gardens for outdoor and indoor landscaping.	K5
UNIT	CONTENTS	
I	Introduction, prospects and scope of nursery and landscaping.	
II	Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.	
III	Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.	
IV	Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.	
V	Manures, composting – vermicomposting.	
Recommended Texts	1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi. 2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.	

	3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.
Reference Books	1.Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi. 2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi. 3. Janick Jules. 1979. Horticultural Science. (3 rd Ed.), W.H. Freeman and Co.,San Francisco, USA. 4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers. 5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.
Web Resources	1. https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath 2. https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788 3. https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031 4. https://in.pinterest.com/pin/496733033900458021/?lp=true 5. https://www.gardenvisit.com/ebooks

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Basics of Botany
Course Type: Foundation Course	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 5

Learning Objectives		
C1	To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.	
C2	To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.	
C3	To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.	
C4	Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.	
C5	Understanding of laws of inheritance, genetic basis of loci and alleles.	
Course outcomes	On completion of this course, students will;	
CO1	1. Increase the awareness and appreciation of human friendly algae and their economic importance.	K1
CO2	2.Develop an understanding of microbes and fungi and appreciate their adaptive strategies	K2
CO3	3.Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms.	K3
CO4	4.Compare the structure and function of cells and explain the development of cells.	K4
CO5	5.Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.	K5
UNIT	CONTENTS	
I	BIODIVERSITY Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.	
II	CELL BIOLOGY Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant	

	Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane Plastids, Ribosomes.
III	PLANT MORPHOLOGY Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.
IV	GENETICS Concept of Heredity and Variation - Mendel's Laws of Inheritance.
V	PLANT PHYSIOLOGY Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition
Recommended Texts	<ol style="list-style-type: none"> 1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut. 2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru. 3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi. 4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi. 5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II, S.Chand and Co. New Delhi. 6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany, S. Viswanathan Pvt. Ltd., Madras.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/the-algae-world 2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/ 5. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 6. https://www.us.elsevierhealth.com/medicine/cell-biology 7. https://www.us.elsevierhealth.com/medicine/genetics 8. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SEMESTER II

Class	II SEMESTER	Title of the course	Credit	Hours	Marks		
I B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course III Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens	5	5	25	75	100
		Core Course IV Fungi, Bacteria, Viruses, pathology and Lichens – Practical II	4	4	25	75	100
	Part III	Elective Course EC2 Allied: Zoology Paper – II	2	3	25	75	100
		Allied: Zoology Practical	2	2	25	75	100
	Part - IV	NME-II Mushroom cultivation	2	2	25	75	100
	Skill Enhancement Courses SEC 3	Botanical garden and landscaping	2	2	25	75	100
	Total		23	30			

Programme: B.Sc.,	Subject: Botany
Semester: II Bacteria, Viruses, Plant pathology and Lichens	Course: Plant Diversity- II Fungi,
Course Type: Core Paper - III	Course Code:
Contact Hours: 5 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Objectives		
C1	To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.	
C2	To understand the biology of fungi and to discuss the importance of fungi in various ecological roles	
C3	To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.	
C4	To identify the main groups of plant pathogens, their symptoms.	
C5	To understand the various types of plant diseases.	
Course outcomes	On completion of this course, students will;	
CO1	Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.	K1
CO2	Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.	K2
CO3	Identify the common plant diseases, according to geographical locations and devise control measures.	K3
CO4	Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.	K4
CO5	Determine the economic importance of microbes, fungi and lichens.	K5
UNIT	CONTENTS	
I	FUNGI Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (<i>Pilobolus</i> , <i>Mucor</i> , <i>Rhizopus</i>), Ascomycotina (<i>Aspergillus</i> , <i>Saccharomyces</i> <i>Peziza</i>), Basidiomycotina (<i>Agaricus</i> , <i>Pleurotus</i> , <i>Puccinia</i>) and Deuteromycotina (<i>Cercospora</i> , <i>Alternaria</i>). (Examples may be	

	changed according to the availability of the specimens). Importance of mycorrhizal association.
II	ECONOMIC IMPORTANCE OF FUNGI: Cultivation of mushroom – <i>Pleurotus</i> (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins
III	BACTERIA, VIRUS: Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.
IV	PLANT PATHOLOGY: General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses. Bacterial diseases – Citrus canker and Bacterial wilt of Banana Viral diseases – Tobacco Mosaic and Vein clearing of Papaya Fungal diseases – Blast disease in rice and Tikka disease
V	LICHEN: Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to <i>Usnea</i> . Economic importance of Lichens: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,
Recommend ed Texts	<ol style="list-style-type: none"> 1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology. 2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi. 3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India. 7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.
Reference Books	<ol style="list-style-type: none"> 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.

	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE 2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html 3. http://www.freebookcentre.net/Biology/Mycology-Books.html 4. https://www.kobo.com/us/en/ebook/introduction-to-fungi 5. http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html 6. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: II	Course: Plant Diversity- II Fungi, Bacteria, Viruses, Plant pathology and Lichens Practical II
Course Type: Core Paper - IV	Course Code:
Contact Hours: 4 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To enable students to identify microscopic and macroscopic fungi.	
C2	To prepare microslides of fungi and lichens.	
C3	To know the presence of pathogen inside the plant tissues through microscopic sections.	
C4	To identify the bryophytes based on the morphology, and microslides.	
C5	To know the economic importance of the microbes studied.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Identify microbes, fungi and lichens using key identifying characters	K1
CO2	Develop practical skills for culturing and cultivation of fungi.	K2
CO3	Identify and select suitable control measures for the common plant diseases.	K3
CO4	Analyze the characteristics of microbes, fungi and plant pathogens	K4
CO5	Access the useful role of fungi in agriculture and pharmaceutical industry.	K5
EXPERIMENTS <ol style="list-style-type: none"> 1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides. 2. Identifying the micro slides relevant to the syllabus. 3. Herbarium specimens of bacterial diseases/photograph. 3. Protocol for mushroom cultivation. 4. Inoculation techniques for fungal culture (Demonstration only). 5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (<i>Trichoderma</i>), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins. 6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs) 		

7. Visit to fungal biotechnology laboratories. 8. Ultra structure of bacteria. 9. Structure of bacteriophage. 10. Micro-preparation of <i>Usnea</i> to study vegetative and reproductive structures. 11. Identifying the micro slides relevant to the syllabus. 12. Study of thallus and reproductive structures (apothecium) through permanent slides. 13. Economic importance of Lichens - Dye and perfume.	
Recommended Texts:	1. Chmielewski, J.G and Kravesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA. 2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India. 3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3 rd Ed. Cambridge University Press, Cambridge. 4. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata. 5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata
Reference Books:	1. Alexopoulos, J and Mims, W. 1985. Introductory Mycology, Wiley Eastern Limited New Delhi. 2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany 1 (10 th ed). Rastogi Publications, Meerut. 3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur. 4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer. 5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
Web resources:	1. https://www.amazon.in/Practical-Manual-Fungi-Fungicides/dp/B0025AEFP4 2. https://books.google.co.in/books/about/Practical_Mycology.html?id=5ycJAQAAMAAJ&redir_esc=y 3. https://www.flipkart.com/colour-handbook-practical-plant-pathology/p/itmefsn6dyhfs9b 4. https://books.google.co.in/books/about/Practical_Botany.html?id=T5narQEAACAAMAAJ&redir_esc=y 5. https://www.kobo.com/us/en/ebook/introduction-to-fungi

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: II	Course: Allied Botany-II
Course Type: Elective Course 2	Course Code:
Contact Hours: 3 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To be familiar with the basic concepts and principles of plant systematics.	
C2	Learn the importance of plant anatomy in plant production systems.	
C3	Understand the mechanism underling the shift from vegetative to reproductive phase.	
C4	To learn about the physiological processes that underlie plant metabolism.	
C5	To know the energy production and its utilization in plants.	
Course outcomes	On completion of this course, students will;	
CO1	Understand the fundamental concepts of plant anatomy and embryology.	K1
CO2	Analyze and recognize the different organs of plants and secondary growth.	K2
CO3	Understand water relation of plants with respect to various physiological processes.	K3
CO4	Classify aerobic and anaerobic respiration.	K4
CO5	Classify plant systematics and recognize the importance of herbarium and virtual herbarium.	K5
UNIT	CONTENTS	
I	MORPHOLOGY OF FLOWERING PLANTS: Plant and its parts. Structure and function of root and stem. Leaf and its parts. Leaf types- simple and compound. Phyllotaxy and types. Inflorescence - Racemose, Cymose and Special types. Terminology with reference to flower description.	
II	TAXONOMY: Study of the range of characters and plants of economic importance in the following families: Rutaceae, Caesalpiniaceae, Asclepiadaceae, Euphorbiaceae and Cannaceae	
III	ANATOMY Tissue and tissue systems: Simple and complex tissues. Anatomy of monocot and dicot roots - anatomy of monocot and dicot stems - anatomy of dicot and monocot leaves.	

IV	EMBRYOLOGY Structure of mature anther and ovule - Types of ovules, structure of embryo sac, pollination -double fertilization, structure of dicotyledonous and monocotyledonous seeds.
V	PLANT PHYSIOLOGY Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.
Recommended Texts	<ol style="list-style-type: none"> 1. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies. 2. Bhojwani, S.S. Bhatnagar, S.P and Dantu, P.K. 2015. The Embryology of Angiosperms (6th revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Maheshwari, P. 1963. Recent Advances in Embryology of Angiosperms. Intl. Soc. Plant Morphologists, New Delhi. 4. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont. 5. Ting, I.P. 1982. Plant Physiology. Addison Wesley Pb. Philippines.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y 2. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: II	Course: Allied Botany Practicals
Course Type: Elective Course 2	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of microorganisms, algae, and fungi.	
C2	To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.	
C3	To be familiar with the basic concepts and principles of plant systematics.	
C4	Understanding of laws of inheritance, genetic basis of loci and alleles.	
C5	To learn about the physiological processes that underlie plant metabolism.	
Course outcomes	On completion of this course, students will;	
CO1	To study the internal organization of algae and fungi.	K1
CO2	Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperms..	K2
CO3	To study the classical taxonomy with reference to different parameters.	K3
CO4	Understand the fundamental concepts of plant anatomy and embryology	K4
CO5	To study the effect of various physical factors on photosynthesis.	K5
UNIT	CONTENTS	
EXPERIMENTS		
1.Make suitable micro preparation of the types prescribed in Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms.		
2.Micro photographs of the cell organelles ultra structure.		
3.Simple genetic problems.		
4.To describe in technical terms, plants belonging to any of the family prescribes and to identify the family.		
5.To dissect a flower, construct floral diagram and write floral formula.		
6. Demonstration experiments		
1. Ganong’s Light screen		

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: II	Course: Mushroom Cultivation
Course Type: NME II	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To learn and develop skills in mushroom cultivation.	
C2	To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.	
C3	To cultivate mushroom cultivation in small scale industry.	
C4	To learn about diseases and post harvest technology.	
C5	To study new methods and strategies to contribute to mushroom production.	
Course outcomes	On completion of this course, students will;	
CO1	Recall various types and categories of mushroom.	K1
CO2	Explain about various types of food technologies associated with mushroom industry.	K2
CO3	Apply techniques studied for cultivation of various types of mushroom.	K3
CO4	Analyze and decipher the environmental factors and economic value associated with mushroom cultivation	K4
CO5	Develop new methods and strategies to contribute to mushroom production.	K5 & K6
UNIT	CONTENTS	
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.	
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.	
III	Life cycle of <i>Pleurotus spp</i> and <i>Agaricus spp</i> .	
IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.	
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.	
Recommended Texts	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing	

	and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strainimprovement with their marketing. Daya Publishing House.
Reference Books	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Nita Bahl. 2002. Handbook on Mushroom 4 th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. 5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web Resources	1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/ 5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: II	Course: Botanical Garden and Landscaping
Course Type: SEC3	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To know about the fundamental concepts of gardening and landscaping.	
C2	To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.	
C3	To illustrate the significance of garden adornments and propagation structures.	
C4	To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.	
C5	To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	
Course outcomes	On completion of this course, students will;	
CO1	Recognize fundamental concepts of gardening and landscaping.	K1
CO2	Explain about significance of garden adornments and propagation structures.	K2
CO3	Apply techniques of landscaping for aesthetic purposes and gardening for recreation.	K3
CO4	Distinguish between formal, informal and free style gardens and their applications.	K4
CO5	Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.	K5 & K6
UNIT	CONTENTS	
I	Principles of gardening, garden components, adornments, lawn making, methods of designing rockery, water garden, etc. Special types of gardens, their walk-paths, bridges, constructed features. Greenhouse. Special types of gardens, trees, their design, values in landscaping, propagation, planting shrubs and herbaceous perennials. Importance, design values, propagation, plating, climbers and creepers, palms, ferns, grasses and cacti succulents.	
II	Flower arrangement: importance, production EXPERIMENTS and cultural operations, constraints, postharvest practices. Bioaesthetic planning, definition, need, round country planning, urban planning and planting avenues, schools, villages, beautifying railway stations, dam sites, hydroelectric stations, colonies, river banks, planting material for play grounds.	

III	Vertical gardens, roof gardens. Culture of bonsai, art of making bonsai. Parks and public gardens. Landscape designs, Styles of garden, formal, informal and free style gardens, types of gardens, Urban landscaping, Landscaping for specific situations, institutions, industries, residents, hospitals, roadsides, traffic islands, damsites, IT parks, corporate.
IV	Establishment and maintenance, special types of gardens, Bio-aesthetic planning, ecotourism, theme parks, indoor gardening, therapeutic gardening, non-plant components, water scaping, xeriscaping, hardscaping.
V	Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).
Recommended Texts	<ol style="list-style-type: none"> 1. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd. 2. Rao Manibhushan K. 1991. Textbook of horticulture. MaC Millan India Ltd. 3. Gangulee H. C. and Kar A. K. 2004. College Botany Vol II, New Central Book Agency 4. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd. 5. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden 2. https://www.overdrive.com/subjects/gardening 3. https://www.scribd.com/book/530538456/Opportunities-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers 4. https://www.scribd.com/book/305542619/Botanic-Gardens 5. https://www.overdrive.com/subjects/gardening

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SEMESTER III

Class	III SEMESTER	Title of the course	Credit	Hours	Marks		
II B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I						
	Part - II	English	3	6	25	75	100
	Part III	Core Course V Plant Diversity III – Bryophytes and Pteridophytes	4	4	25	75	100
		Core Course VI Plant Diversity III Bryophytes and Pteridophytes – Practical- III	4	4	25	75	100
	Part III	Elective Course EC3 Allied: Chemistry Paper – III	2	3	25	75	100
		Allied Chemistry Practical	2	2	25	75	100
	Skill Enhancement Course SEC 4	*Entrepreneurial Skill Entrepreneurial opportunities in botany	2	2	25	75	100
	Skill Enhancement Courses SEC 5	Herbal Technology	2	2	25	75	100
	Part IV	Environmental studies	-	1	-	-	-
Total			22	30			

Programme: B.Sc.,	Subject: Botany
Semester: III	Course: Plant Diversity- III Bryophytes and Pteridophytes
Course Type: Core Paper - V	Course Code:
Contact Hours: 4 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To enable the students to have an overview of Non-vascular and Vascular cryptogams.	
C2	To understand the morphological diversity of Bryophytes and Pteridophytes.	
C3	To know the evolution of Bryophytes and Pteridophytes.	
C4	To understand the economic importance of the Bryophytes and Pteridophytes.	
C5	To understand anatomy and reproduction of Bryophytes and Pteridophytes.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize morphological variations of Bryophytes and Pteridophytes.	K1
CO2	Explain the anatomy and reproduction of Bryophytes and Pteridophytes.	K2
CO3	Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.	K3
CO4	Decipher the stages of plant evolution and their transition to land habitat.	K4
CO5	Access the useful role of Bryophytes and Pteridophytes.	K5
UNIT	CONTENTS	
I	BRYOPHYTES General characters of Bryophytes, classification (Watson, 1971) (up to family). 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 (<i>Riccia/Marchantia</i>); Anthocerotopsida (<i>Anthoceros</i>) and Bryopsida (<i>Funaria/Polytrichum</i>). (Examples may be changed	

	according to the availability of the specimens). Evolution of Bryophytes
III	PTERIDOPHYTES General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homospory and heterospory.
IV	Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (<i>Psilotum</i>), Lycopsidea (<i>Lycopodium/Selaginella</i>), Sphenopsida (<i>Equisetum</i>), Pteropsida (<i>Adiantum/Marsilea</i>). (Examples may be changed according to the availability of the specimens).
V	Origin and evolution of Pteridophytes. Stellar Evolution. Economic importance of Pteridophytes.
Recommended Texts	<ol style="list-style-type: none"> 1. Sharma, O.P. 2017. Bryophyta, MacMillan 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.
Reference Books	<ol style="list-style-type: none"> 1. Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai. 2. Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteridophyta, 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. 6. Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad. 7. Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
Web Resources:	<ol style="list-style-type: none"> 1. http://www.bryoecol.mtu.edu/ 2. https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NFWQK 3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm 4. http://www.bsienviis.nic.in/Database/Pteridophytes-in-India_23432.aspx 5. http://www.botany.ubc.ca/bryophyte/mossintro.html 6. aeTIUC&redir_esc=y

Mapping with Programme Outcomes:

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

CO 3	2	2	3	3	1	2	2	1	2	2
CO 4	3	3	3	3	3	2	3	3	2	3
CO 5	3	3	2	2	2	1	3	3	1	3

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: III Pteridophytes Practical III	Course: Plant Diversity- III Bryophytes and
Course Type: Core Paper - VI	Course Code:
Contact Hours: 4 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To enable students gain expertise in hand sectioning technique.	
C2	To study diversity of Bryophytes and Pteridophytes.	
C3	To understand the anatomical structure of the Bryophytes and Pteridophytes.	
C4	Develop comprehensive skills in sectioning and micro preparation.	
C5	Describe the structure of fossil forms prescribed in the syllabus.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize the major groups of Non-vascular and Vascular cryptogams	K1
CO2	Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.	K2
CO3	Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes.	K3
CO4	Develop comprehensive skills in sectioning and micro preparation.	K4
CO5	Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.	K5

EXPERIMENTS

Bryophytes

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

Pteridophytes

- Study of morphology, anatomy and structure of the vegetative and reproductive organs of Pteridophytes genera and fossils included in the theory syllabus.
Psilotopsida (*Psilotum*), Lycopsida (*Lycopodium/Selaginella*), Sphenopsida (*Equisetum*),

<p>Pteropsida (<i>Adiantum/Marsilea</i>). (Examples may be changed according to the availability of the specimens).</p> <p>4. Identifying the micro slides relevant to the syllabus.</p> <p>5. Botanical excursion.</p>	
Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 resources	<ol style="list-style-type: none"> 1. https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4 2. https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883 3. http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html 4. https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual 5. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,		Subject: Botany
Semester: III	Course: Entrepreneurial Opportunities in Botany	
Course Type: SEC 4	Course Code:	
Contact Hours: 2 Hours/Week	Credits: 2	
CIA: 25	CE: 75	

Learning Objectives		
C1	To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.	
C2	To create a mindset among students to start their own companies for income generation.	
C3	The students may understand about various fields of botany.	
C4	To develop the concept of Entrepreneurial Opportunities in Botany.	
C5	Describe the new strategies to describe marketing and business management strategy.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to how various fields of botany could be understood with an entrepreneurial approach.	K1
CO2	Explain the concept of Entrepreneurial Opportunities in Botany.	K2
CO3	Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations	K3
CO4	Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.	K4
CO5	Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.	K5 & K6
UNIT	CONTENTS	
I	INTRODUCTION TO ENTREPRENEURSHIP Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.	
II	TOOLS AND TECHNIQUES Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages,	

	enzymes, antibiotics.
III	NEW VENTURE CREATION Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, Spirulina and Azolla cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.
IV	PRODUCT DEVELOPMENT AND COMMERCIALIZATION Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.
V	BIO-BUSINESS PLANS, IPR AND BIOETHICS Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.
Recommended Texts	<ol style="list-style-type: none"> 1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India. 2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India. 3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA. 4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture. 5. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.
Reference Books	<ol style="list-style-type: none"> 1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK. 2. Peter F. Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US. 3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi. 4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge
Web Resources:	<ol style="list-style-type: none"> 1. https://www.brainkart.com/article/Entrepreneurial-Botany_38321/ 2. https://www.youtube.com/watch?v=hnBla1FfcLo 3. https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation 4. http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301 4. https://www.ebooks.com/en-us/subjects/gardening/ 5. https://www.amazon.in/Preservation-Techniques-Publishing-Technology-Nutrition-ebook/dp/B00RXCXB3Q

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: III	Course: Herbal Technology
Course Type: SEC 5	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.	
C2	To gain an insight into the commercially important secondary products and significance of bioprospecting.	
C3	To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.	
C4	To apply the knowledge to cultivate medical plants.	
C5	To know the pharmacological importance of medicinal plants.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Define and describe the principle of cultivation of herbal products.	K1
CO2	List the major herbs, their botanical name and chemical constituents.	K2
CO3	Apply techniques for monitoring drug adulteration through the biological testing.	K3
CO4	Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.	K4
CO5	Develop the skills for cultivation of plants and their value added processing / storage	K5 & K6
UNIT	CONTENTS	
I	Herbal Technology: Definition and scope; Herbal medicines: history and scope; Traditional systems of medicine, and overview of AYUSH (Traditional Indian Systems of Medicine); Cultivation - harvesting - processing - storage of herbs and herbal products.	
II	Value added plant products: Herbs and herbal products recognized in India; Major herbs used as herbal medicines, nutraceuticals, cosmetics and biopesticides, their Botanical names, plant parts used, major chemical constituents.	
III	Pharmacognosy - Systematic position, botany of the plant part used and active principles of the following herbs: Tulsi, Ginger, Curcuma, Fenugreek, Indian Gooseberry, Catharanthus roseus, Withania somnifera, Centella asiatica, Achyranthes aspera, Kalmegh, Giloe (Tinospora), Saravar. Herbal foods, future of pharmacognosy.	

IV	Analytical pharmacognosy: Morphological and microscopic examination of herbs, Evaluation of drug adulteration - types, methods of drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).
V	Plant gene banks, Cultivation of Plants and their value added processing / storage / quality control for use in herbal formulations, Introductory knowledge of Tissue culture and Micro propagation of some medicinal plants (<i>Withania somnifera</i> , neem and tulsi),
Recommended Texts	<ol style="list-style-type: none"> 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. 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.
Reference Books	<ol style="list-style-type: none"> 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. Arber, Agnes. 1999. Herbal Plants and Drugs. Mangal Deep Publications, Jaipur. 3. Varzakas, T., Zakyntinos, 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. 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:	<ol style="list-style-type: none"> 1. https://www.kopykitab.com/Herbal-Science 2. https://kadampa.org/books/free-ebook-download-howtotyl?gclid=CjwKCAiA6vXwBRBKEiwAYE7iS5t8yenurCIUCTdV9olKo9TbyAh4fsoFqPYWGs5qBTbytD22z7lo0BoCYnUQAvD_BwE 3. https://www.barnesandnoble.com/b/free-ebooks/nook-books/alternative-medicine-natural-healing/herbal-medicine/_/ry0Z8qaZ11iu N- 4. http://cms.herbalgram.org/heg/volume8/07July/HerbalEBooks.html?t=1310004932&ts=1579066352&signature=1dd0d5aef818b19bcdcd6c063a78e404 5. https://www.dattanibookagency.com/books-herbs-science.html 6. https://www.springer.com/gp/book/9783540791157

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SEMESTER IV

Class	IV SEMESTER	Title of the course	Credit	Hours	Marks		
II B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part - I	Tamil	3	6	25	75	100
	Part - II	English	3	6	25	75	100
	Part III	Core Course VII Plant Diversity IV - Gymnosperms, Paleobotany and Evolution	5	5	25	75	100
		Core Course VIII Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV	4	3	25	75	100
	Elective Course EC4	Allied: Chemistry Paper – IV	2	3	25	75	100
		Allied Chemistry Practical	2	2	25	75	100
	Skill Enhancement Course SEC 6	Fermentation technology	2	2	25	75	100
	Skill Enhancement Courses SEC 7	Environmental impact analysis	2	2	25	75	100
	Part IV	Environmental studies	2	1	25	75	100
Total			25	30			
*Road map for SE5: Workshop on Entrepreneurship with hands-on training special lectures by experts/industrialists on entrepreneurial schemes and funding available from Central/State Government							
Second Year Vacation – Internship - 40 hours 2 credit							

Programme: B.Sc.,	Subject: Botany
Semester: IV Paleobotany and Evolution	Course: Plant diversity IV- Gymnosperms,
Course Type: Core Paper - VII	Course Code:
Contact Hours: 5 Hours/Week	Credits: 5
CIA: 25	CE: 75

Learning Objectives		
C1	To enable the students to understand thallus organization,	
C2	To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.	
C3	to acquaint students with evidences of the past history of plant groups and significance of the fossilization.	
C4	To know the scope of pleobotany, types of fossils and geological time scale.	
C5	Understand the various fossil genera representing different fossil groups.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the general characteristics of Gymnosperms and fossil forms	K1
CO2	Explain about the morphology and anatomy Gymnosperms.	K2
CO3	Compare and contrast the reproductive structures of Gymnosperms & fossil forms.	K3
CO4	Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance.	K4
CO5	Determine the various fossilization methods and their significance in paleobotany.	K5
UNIT	CONTENTS	
I	GYMNOSPERMS Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.	
II	GYMNOSPERMS Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (<i>Cycas</i>), Coniferales (<i>Pinus</i>). Gnetales (<i>Gnetum</i>).	
III	PALEOBOTANY Introduction to fossils and fossilization processes such as compression, casts, molds, petrification, impressions and coal balls. Geological time scale. Radiocarbon dating. Contribution of Birbal Sahni	
	PALEOBOTANY	

IV	Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.
V	EVOLUTION Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamark and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.
Recommended Texts	<ol style="list-style-type: none"> 1. Gupta, M.N. 1972. The Gymnosperms (2nd Edition) Shiva Lal Agarwala & Co., Agra. 2. Vashista, P.C. 1976. Gymnosperms, S.Chand & Co. New Delhi. 3. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India. 4. Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi. 5. Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.
Reference Books	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 1. https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false 2. https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multi_color.html?id=HTdFYFNxnWQC&redir_esc=y 3. https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC 4. https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf 5. https://www.palaeontologyonline.com/

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: IV Paleobotany and Evolution Practical IV	Course: Plant diversity IV- Gymnosperms,
Course Type: Core Paper - VIII	Course Code:
Contact Hours: 3 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To enable students observe and record the morphological features of selected species of Gymnosperms.	
C2	To enable students observe and record the anatomical features of selected species of Gymnosperms.	
C3	To develop the skill of preparation of microslides of the gymnosperm samples.	
C4	To enable students to gain insights into the basics of paleobotany and methods of fossilization.	
C5	To understand the anatomy of the fossil plants through microscopy.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Analyze and observe and record the morphological features of selected species of Gymnosperms..	K1
CO2	Describe the structure of fossil forms prescribed in the syllabus.	K2
CO3	Identify and Illustrate the morphological and anatomical features of gymnosperms.	K3
CO4	Develop comprehensive skills in sectioning and micro preparation.	K4
CO5	Interpret the significance of reproductive structures in gymnosperms.	K5

EXPERIMENTS

- Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas*, *Pinus* and *Gnetum*.
 - Identifying the micro slides relevant to the syllabus.
 - Field visit to study the habitat (Hill station).
- Study the following fossil members: *Rhynia*, *Lepidodendron*, *Lepidocarpon*, *Calamites* and *Williamsonia seawardiana* through permanent slides.
- Photograph of evolution scientists.

Recommended Texts	<ol style="list-style-type: none"> 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	<ol style="list-style-type: none"> 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 resources	<ol style="list-style-type: none"> 1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover 2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721 3. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ 4. https://trove.nla.gov.au/work/11471742?q&versionId=46695996 5. http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html.

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: IV	Course: Fermentation Technology
Course Type: SEC 6	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To appreciate the significance of microbes synthesizing fermented products.	
C2	To gain insights on safety and quality control in large scale production of fermentative products.	
C3	To design and operation of industrial practices in mass production of fermented products.	
C4	To know about the various fermentation technology.	
C5	To learn about the bioproduct recovery.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Enumerate the significance of industrially useful microbes.	K1
CO2	Explain the design and operation of industrial practices in mass production of fermented products.	K2
CO3	Explain the process of maintenance and preservation of microorganisms.	K3
CO4	Analyze the various aspects of the fermentation technology and apply for fermentative production.	K4
CO5	Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.	K5 & K6
UNIT	CONTENTS	
I	Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.	
II	Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.	
III	Scope and opportunities of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.	
IV	Fermentative production of vinegar, alcohol (ethanol, wine, beer), acids (citric acid and gluconic acid), amino acids (lysine and glutamic acid) and antibiotics (penicillin and streptomycin).	
V	Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.	
Recommen	1. Waites M.J. 2008. Industrial Microbiology: An Introduction, 7th Edition,	

ded Texts	<p>Blackwell Science, London, UK.</p> <ol style="list-style-type: none"> 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.
Reference Books	<ol style="list-style-type: none"> Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK. Pepler, 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. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.
Web Resources:	<ol style="list-style-type: none"> https://ebooks.foodtechlearning.xyz/2020/12/principial-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/

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: IV	Course: Environmental Impact Analysis
Course Type: SEC 7	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To understand about the theory and practice of environmental impact assessment.	
C2	To develop skills in identifying and solving problems of environmental concerns.	
C3	Define and classify Environmental Impacts and the terminology.	
C4	Understands the environmental Impact assessment procedure.	
C5	List and describe environmental audits.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Enumerate the fundamental concepts and significance of environmental impact assessment.	K1
CO2	Explain the important steps of EIA process.	K2
CO3	Interpret the environmental appraisal and procedures in India.	K3
CO4	Decipher how to prepare the various documents required by state and federal regulations.	K4
CO5	Develop their own perspectives on impact assessment and be able to solve problems related to environment.	K5 & K6
UNIT	CONTENTS	
I	Origin and Development Purpose and aim, core values and principles, History of EIA development, Environmental Management Plan, Environmental Impact Statement, Scope of EIA in Project planning and Implementation.	
II	EIA Process Components of EIA, EIA Methodology- Screening, Scoping, Baseline data, Impact Identification, Prediction, Evaluation and Mitigation, Appendices and Forms of Application,	
III	Techniques of Assessment-Cost-benefit Analysis, Matrices, Checklist, Overlays, Impact on Environmental component: air, noise, water, land, biological, social and environmental factors. EIA Document.	
IV	Main participants in EIA Process Role of Project proponent, environmental consultant, PCBs, PCCs, public and IAA. Public participation.	
V	Environmental Appraisal and Procedures in India and EIA Methodology,	

	indicators and mitigation, Environmental Audit of different environmental resources, Risk Analysis, Strategic environmental assessment, ecological impact assessment: legislation.
Recommended Texts	<ol style="list-style-type: none"> 1. Morris, P. and Therivel, R. 1995. Methods of Environmental Impact Assessment, UCL Press, London. 2. Petts, J. 1999. Handbook of Environmental Impact Assessment, volume 1 and 2, Blackwell Science, Oxford. 3. Therivel, R. and Partidario, M.R. 1996. The Practice of Strategic Environmental Assessment, Earthscan, London. 4. Vanclay, F. and Bronstein, D.A. 1995. Environmental and Social Impact Assessment, Wiley & Sons, Chichester. 5. Rau, J.G. and Wooten, D.C., Environmental Impact Assessment, McGraw Hill Pub. Co., New York, 1996
Reference Books	<ol style="list-style-type: none"> 1. Kulkarni, V. and Ramachandra, T.V. 2006. Environmental Management, Capital Pub. Co. New Delhi. 2. Petts, J. 2005. Handbook of Environmental Impact Assessment- Volume 1 and 2. Blackwell Publishers, UK. 3. Glasson, J. Therivel, R. and Chadwick. 2006. A. Introduction to Environmental Impact Assessment. Routledge, London. 4. Canter, W.L. 1995. Environmental Impact Assessment, McGraw-Hill Science/ Engineering/ Math, New York. 5. Jain, R.K., Urban, L.V., Stracy, G.S., Environmental Impact Analysis, Van Nostrand Reinhold Co., New York, 1991.
Web Resources:	<ol style="list-style-type: none"> 1. https://www.amazon.in/Environmental-Impact-Assessment-Gajbhiye-Khandeshwar-ebook/dp/B06XTNQ5PW 2. https://www.ikbooks.com/books/book/earth-environmental-sciences/environmental-impact-assessment/9789382332930/ 3. https://www.elsevier.com/books/environmental-impact-assessment/mareddy/978-0-12-811139-0 4. https://link.springer.com/book/10.1007/978-3-030-80942-3 5. https://onlinelibrary.wiley.com/doi/book/10.1002/0471722022

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

SEMESTER V

Class	V SEMESTER	Title of the course	Credit	Hours	Marks		
	Part			Theory/ Practical	Internal	External	Total
III B.Sc.	Part III	Core Course IX Plant Morphology, Taxonomy and Economic Botany	4	5	25	75	100
		Core Course X Plant Anatomy, Embryology, Plant Morphology, Taxonomy And Economic Botany - Practical-V	4	5	25	75	100
		Core Course XI Plant Anatomy and Embryology	4	5	25	75	100
		Core Course XII Project with Viva-voce	4	5	25	75	100
		Elective course 5	3	4	25	75	100
	Elective Course 6	EC6 – 1. Entrepreneurial Botany 2. Forestry	3	4	25	75	100
	Part IV	Value Education	2	2	25	75	100
	Part V	Internship	2	-	100	-	-
	Total		26	30			

Programme: B.Sc.,	Subject: Botany
Semester: V Economic Botany	Course: Plant Morphology, Taxonomy and
Course Type: Core Paper - IX	Course Code:
Contact Hours: 5 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.	
C2	Students will know about the basic concepts of classification of plants.	
C3	Understand major evolutionary trends in Angiospermic plants.	
C4	To know the characteristic features of the selected families.	
C5	To know the economic importance of plants.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.	K1
CO2	Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.	K2
CO3	Describe the core concepts of economic Botany and relate its applications in human life.	K3
CO4	Analyze the characters of the families according to the Bentham and Hooker's system of classification.	K4
CO5	Assess terms and concepts related to Phylogenetic Systematics.	K5
UNIT	CONTENTS	
I	Morphology – root system – modifications. Shoot system – modifications – (Aerial, sub-aerial and underground). Leaf-Types-simple and compound-phyllotaxy, modifications (phyllode, pitcher), tendrils, stipules. Inflorescences – definition and types – racemose, cymose, mixed and special types. Fruits - classification.	
II	History of Angiosperm classification – Artificial, Natural and Phylogenetic system of classification. An outline of Bentham and Hooker system of classification, an overview of APG Classification. Herbarium technique– collection, pressing, drying, mounting and preservation of plant specimens, digital herbarium. Botanical Survey of India. Botanical nomenclature–rules, typification and author citation.	

III	Study of the following families based on the Natural system and their economic importance: Anonaceae, Nymphaeaceae, Capparidaceae, Rutaceae, Caesalpinaceae, Cucurbitaceae, Asteraceae, Apocynaceae and Asclepiadaceae.
IV	Study of the following families based on the natural system and their economic importance: Convolvulaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Liliaceae, Orchidaceae and Poaceae.
V	Source, cultivation method (brief) and the extraction/processing of the economically important products of the following – Cereal (Rice), Pulses (Black gram), Sugar (Sugarcane), Beverage (Coffee), Oil seed (Groundnut), spices (Cardamom), essential oil (Rose), natural rubber and timber plants (Teak) and Fibre (Cotton).
Recommended Texts	<ol style="list-style-type: none"> 1. Lawrence, G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad. 2. Porter, C.L. 1982. Taxonomy of Flowering Plants, Eurasia Publications House, New Delhi 3. Solbrig, O.T. 1970. Principles and Methods of Plant Biosystematics. The MacMillan Co-collier-MacMillan Ltd., London. 4. Solbrig, O.T and Solbrig, D.J. 1979. Population Biology and Evolution, Addison-Wesley Publishing Co. Ind USA. 5. Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. 6. Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey. 7. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Hutchinson, J. 1973. The Families of Flowering plants , Oxford University press, London. 2. Gamble, J.S., Fisher, L.E.F.1967. The Flora of The presidency of Madras (Vol-III) BSI, Calcutta 3. Davis, P.H and Heywood, V.M. 1965. Principles of Angiosperm Taxonomy, Oliver and Boyd Edinburgh. 4. Clive AS.1989. Plant Taxonomy and Biosystematics, Chapman and Hall Inc. New York. 5. Harborne, J.B and Turner, B.L. 1984. Plant Chemosystematics, Acad. Press, London. 6. Lawrence, G.H. 1955. Taxonomy of Vascular Plants, MacMillan Co., USA. 7. Jones, S.B. Jr. and Luchsinger, A.E. 1986. Plant Systematics (2nd edition). McGraw-Hill Book Co., New York.
Web Resources	<ol style="list-style-type: none"> 1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=px_WAwHiZIC&redirhttps://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y_esc=y

	2. https://books.google.co.in/books/about/PLANT TAXONOMY 2E.html?id=Roi0lwSXFuUC&redir_esc=y
	3. https://books.google.co.in/books/about/Plant Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
	4. https://books.google.co.in/books/about/Economic Botany.html?id=2ahsDQA AQBAJ&redir_esc=y
	5. https://books.google.co.in/books/about/Textbook Of Economic Botany.html?id=XmZFI0_JHv8C&redir_esc=y

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V Economic Botany Practical V	Course: Plant Morphology, Taxonomy and
Course Type: Core Paper - X	Course Code:
Contact Hours: 5 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To study morphological characters of the families.	
C2	Able to describe the plant technically using the floral characteristics.	
C3	To preserve the plants and prepare herbarium sheets.	
C4	To be able to identify the local flora.	
C5	To understand the economic importance of the plants.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize the distinguishing plant morphological characters.	K1
CO2	Identify locally available plants to their respective families.	K2
CO3	Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.	K3
CO4	Construct floral diagram and write floral formula for a given flower.	K4
CO5	Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.	K5

EXPERIMENTS

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

Recommended Texts

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.
4. Pandely, B.P. 1987. Taxonomy of Angiosperms.
5. Nordenstam, B., El Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st 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://www.amazon.in/Practical-Taxonomy-Angiosperms-R-Sinha/dp/9380578210>
2. <https://www.wileyindia.com/plant-science/practical-taxonomy-of-angiosperms-2ed.html>
3. <https://www.flipkart.com/practical-taxonomy-angiosperms/p/itm194794e7a76e8>
4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=uWg76r

	CqA68C 5. https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592 6. https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook .
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Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Plant Anatomy and Embryology
Course Type: Core Paper - XI	Course Code:
Contact Hours: 5 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objectives		
C1	To know fundamental concepts of plant anatomy and embryology.	
C2	To understand the internal tissue organization of various plant organs.	
C3	To differentiate normal and abnormal secondary growth.	
C4	To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.	
C5	To know embryology of plants.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the fundamental concepts of plant anatomy and embryology.	K1
CO2	Describe the internal tissue organization of various plant organs.	K2
CO3	Elucidate the stages of normal and abnormal secondary growth.	K3
CO4	Compare the structural organization of flower in relation to the process of pollination and fertilization.	K4
CO5	Access the various anatomical adaptations in plants.	K5
UNIT	CONTENTS	
I	Cell wall - structure, and function. Tissues - Definition, types - Simple tissue system - parenchyma, collenchyma and sclerenchyma (fibers and sclereids). Complex tissue system - xylem and phloem. Meristem: definition, structure, function and classification. Apical organization and theories: Apical cell theory, Histogen theory and Tunica-Corpus theory. Root apex: Histogen theory and Korper-Kappe theory.	
II	Primary structure of root and stem (Dicot and monocot). Epidermal tissue system: epidermis, cuticle, trichome, bulliform cells, periderm and silica cells. Ground tissue systems: cortex, endodermis, pericycle, pith and pith rays. Vascular tissue systems: different types of vascular bundles and their arrangement in oot and stem. Nodal anatomy: leaf trace, leaf gap, branch trace and branch gap-types	
III	Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- <i>Boerhaavia</i> , <i>Nyctanthes</i> and <i>Dracaena</i> . Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.	

IV	Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule, types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (<i>Polygonum</i> type); Organization and ultra structure of mature embryo sac.
V	Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarp. Seed structure and its importance.
Recommended Texts	<ol style="list-style-type: none"> 1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas. 2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi. 3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge. 4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York. 5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi. 6. Pandey, B.P. 2015. Plant Anatomy S. Chand Publ. New Delhi. 7. Bhatnagar, S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi. 8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.
Reference Books	<ol style="list-style-type: none"> 1. Esau, K. 1985. Anatomy of Seed Plants –John Willey. 2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co.. 3. Maheswari, P. 1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd., 4. Swamy, B.G.L and Krishnamoorthy. K.V. 1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd. 5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA. 6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA. 7. Mauseth, J.D. 1988. Plant Anatomy. The Benjamin/Cummings Publisher, USA. 8. Evert, R.F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function and Development. John Wiley and Sons, Inc. Any local/state/regional flora published by BSI or any other agency. 9. Swamy, B.G.L and Krishnamurthy, K.V. 1980. From flower to fruit .Tata McGraw Hill Co. Pvt. Ltd, New Delhi
Web Resources	<ol style="list-style-type: none"> 1. https://www.amazon.in/PLANT-ANATOMY-EMBRYOLOGY-BIOTECHNOLOGY-ebook/dp/B07H5JYFBJ/ref=asc_df_B07H5JYFBJ/?tag=googleshopdes-2

	2. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-anatomy 3. https://archive.org/EXPERIMENTS/plantanatomy031773mbp 4. https://www.amazon.in/Embryology-Angiosperms-6th-S-P-Bhatnagar-ebook/dp/B00UN5KPQG 5. https://www.worldcat.org/title/embryology-of-angiosperms/oclc/742342811 6. https://books.google.co.in/books/about/Embryology_of_angiosperms.html?id=uYfwAAAAMAAJ&redir_esc=y .
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Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Project with viva voce
Course Type: Core Paper - XII	Course Code:
Contact Hours: 5 Hours/Week	Credits: 4
CIA: 25	CE: 75

Learning Objective:

Other than class room teaching through theory and practical lectures, internships, field visits, assignments and seminars, the learners are put in the practice of doing research at the Under-Graduation level itself.

Methodology:

Every individual learner has to carry out a minor research work

The area of focus can be related to the core subjects

Inter-disciplinary research works are encouraged.

The project work must retain its originality and avoidance of plagiarism is mandatory

Evaluation Pattern:

After completion of eighty percent of the working days in the concerned semester, the candidate has to submit the research/ project work to the Examination section of the institution for evaluation.

The final product of the research work must be duly signed by the candidate, the Research Supervisor and the Head of the Department

The Examination section of the institution will fix a date for Viva-voce examination. Each individual has to appear for the Viva-voce.

Allocation of Marks:

CIA – 25 marks

The research supervisor will award the marks assessing the performance of the researcher throughout the process of research.

Viva-voce – 75 marks

The student will appear for Viva-voce examination. The examiner will assess the quality of the research, subject knowledge and the presentation of the learner.

Thrust Areas for Research:

- 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

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Bio-Analytical Techniques
Course Type: EC 5	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To understand the principle, operation and maintenance of various tools/equipment in the laboratory.	
C2	Perform experiments using the laboratory instruments, formulate experiments for project work and evaluate critically the acquisition of data.	
C3	To equip students to collect, analyze and evaluate data generated by their own inquiries in a scientific manner.	
C4	To give an exposure to various forms of field research and data analysis techniques.	
C5	To provide an overview on modern equipments that they would help students gain confidences to instantly commence research careers and/or start entrepreneurial ventures.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the various biological techniques and its importance.	K1
CO2	Explain the principles of Light microscopy, compound microscopy, Fluorescence microscopy and electron microscopy.	K2
CO3	Apply suitable strategies in data collections and disseminating research findings.	K3
CO4	Compare and contrast the significance of different types of chromatography techniques.	K4
CO5	Develop methodologies for extraction and analysis of biochemical compounds.	K5
UNIT	CONTENTS	
I	I MICROSCOPY: Principles of microscopy; Light microscopy; compound microscopy, bright field microscope, dark field microscope, phase-contrast microscope, Fluorescence microscopy; Transmission and Scanning electron microscopy. Microscopic measurements-micrometry, Microscopy drawing: Camera Lucida.	
II	CHROMATOGRAPHIC PRINCIPLES AND APPLICATIONS: Principle; Paper chromatography, Thin Layer Chromatography (TLC), Column chromatography, Gas chromatography – Mass spectrometry (GCMS), High Performance Liquid Chromatography (HPLC).	
III	ELECTROPHORESIS AND PH METER: Basic principle, construction and operation of pH meter. Polyacrylamide gel electrophoresis (PAGE), Agarose Gel Electrophoresis.	

IV	IV SPECTROPHOTOMETRY AND CENTRIFUGATION TECHNIQUE: Principle and law of absorption, construction, operation and uses of colorimeter and UV–Visible spectrophotometer, Principles, methods of centrifugation, types of centrifuge and applications.
V	BIostatISTICS: Data collection methods, population, samples, parameters; 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.
Recommended Texts	<ol style="list-style-type: none"> 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 Publishing House. 3. Asokan, P. 2001. Basics of analytical biochemistry. Chinna Publications. 4. Bajpai, P.K. 2006. Biological instrumentation and methodology. S. Chand & Company, New Delhi. 5. Veerakumari, L. 2009. Bioinstrumentation. MJP Publications. 6. Palanivelu, P. 2013. Analytical Biochemistry and Separation techniques, 20th century publications, Palkalai nagar, Madurai.
Reference Books	<ol style="list-style-type: none"> 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. 7. Dey, P.M and Harborne, J.B. 2000. Plant Biochemistry Harcourt Asia Pvt. Ltd. 8. Plummer, D.T. 2003. An introduction to practical Biochemistry. 3rd Edn. Tata McGraw Hill Publishing Company Ltd. New Delhi. 9. Zar, J.H. 1984. Biostatistics Analysis, Prentice Hall International, England Cliffs, New Jersey.
Web Resources	<ol style="list-style-type: none"> 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/B01JP3M9TW 4. https://www.amazon.in/Handbook-Biomedical-Instrumentation-R-S-Khandpur-ebook/dp/B0129ZDO9W?ref=kindlecontentin50-21&tag=kindlecontentin50-21&gclid=CjwKCAiAx_DwBRAfEiwA3vwZYkqkwRb_EGf73exaWpY8D9JNpJZsOcXQCQ4pZlRzTrYH2lopaVP1xxoCIPgQAvD_BwE 5. https://www.kobo.com/us/en/ebooks/biostatistics 6. https://www.amazon.in/Biostatistics-Veer-Bala-Rastogi-ebook/dp/B07LDCPXDG

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Aquatic Botany
Course Type: EC 5	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To give an overview of the distribution of lower plants forms and its ecological significance.	
C2	To enable students to understand the ecological functions and economic uses of aquatic plants.	
C3	To equip students to collect, analyze and identify the planktons.	
C4	To give an exposure to various forms seaweeds.	
C5	To know about the values and uses of aquatic plants.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize aquatic plants and their ecological importance.	K1
CO2	Explain about commonly occurring marine and limnetic algae of the Indian coasts.	K2
CO3	Apply techniques for conservation of aquatic plants for value addition.	K3
CO4	Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.	K4
CO5	Develop new strategies to conserve mangroves and device innovative methods for cultivation of aquatic plants.	K5 & K6
UNIT	CONTENTS	
I	MARINE AND LIMNETIC MACRO ALGAE: Common seaweeds of Indian subcontinent: <i>Ulva</i> , <i>Caulerpa</i> , <i>Sargassum</i> , <i>Gracilaria</i> , etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: <i>Anabaena</i> , <i>Chlorella</i> , <i>Scenedesmus</i> .	
II	MANGROVES: Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including <i>Avicennia</i> , <i>Rhizophora</i> , <i>Acanthus</i> and <i>Aegiceras</i> . Ecological significance of mangroves.	
III	PHYTOPLANKTONS, CYANOBACTERIA, DINOFLAGELLATES AND DIATOMS: Common marine microalgae of India, including phytoplanktons and picoplanktons, Common diatoms and dinoflagellates of Indian Ocean, Common	

	limnetic and terrestrial cyanobacteria of India.
IV	AQUATIC ANGIOSPERMS: Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.
V	VALUES AND USES OF AQUATIC PLANTS: Economic importance of aquatic plants, Ecosystem services of aquatic plants, including biogeochemical cycles, oxygen production and carbon sequestration and so on, edible seaweed and algal resources of India, aesthetic, cultural, spiritual importance of aquatic plants.
Recommended Texts	<ol style="list-style-type: none"> 1. Lee, R.E. 2008. Phycology. 4th edition. Cambridge University Press, Cambridge. 2. Wile, J.M, Sherwood, L.M and Woolverton, C.J. 2013. Prescott's Microbiology. 9th Edition. Mc Graw Hill International. 3. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi. 4. Hoek, C. Van, D. 1999. An Introduction to Phycology. Cambridge University Press. 5. Daubenmire, R.F.1973. Plant and Environment. John Willey. 6. Sharma, J.P.2004. Environmental Studies, Laxmi Publications (P) Ltd. New Delhi. 7. Bast, F. 2014. Seaweeds: Ancestors of land plants with rich diversity. Resonance, 19(2) 1032-1043 ISSN: 0971-8044.
Reference Books	<ol style="list-style-type: none"> 1.Kathiresan, K and S.Z. Qasim 2005. Biodiversity of Mangrove Ecosystems. Hindustan Lever Limited. 2. Allan, J.D. and Castillo, M.M. 2009. Stream Ecology (Second Ed.). Springer, Netherlands. 3. Barnes, R.S.K. 1974. Fundamentals of Aquatic Ecosystems, (R.S.K. Barnes & K.H. Mann,eds.), Blackwell Sci. Publ., London, 229 pp. 4. Bennet, G.W. 1971 Management of Lakes and Ponds. von Nostrand Reinhold Co.,NY.375 pp. 5. Goldman, C.R. & A.J. Horne 1983. Limnology.McGraw Hill Internat.Book.Co.Tokyo,464 pp. 6. Boney, A.D., 1975. Phytoplankton. Edward, Arnold, London.
Web Resources	<ol style="list-style-type: none"> 1. http://kyry6.gq/73447c/aquatic-botany-published-by-elsevier-science.pdf 2. http://fuls7.gq/82442e/aquatic-botany-published-by-elsevier-science.pdf 3. https://www.springer.com/gp/book/9788132221777 4. http://dwit21.cf/7744a1/aquatic-botany-published-by-elsevier-science.pdf 5. https://www.amazon.in/Aquatic-Plants-iFlora-Plant-Guide-ebook/dp/B07NS9V7LN

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Entrepreneurial Botany
Course Type: EC 6	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To enable students to develop innovative ideas to exploit the economically useful plant products for commercial purposes.	
C2	To inculcate entrepreneurial values to start a new business. To enlighten people about bioventure.	
C3	To comprehend the molecular processes.	
C4	To expose the students a fundamental of the various value added products.	
C5	To introduce the entrepreneurial opportunities.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize the significance of government agencies for entrepreneurship development.	K1
CO2	Explain about entrepreneurial values, risk assessment and solutions	K2
CO3	Make use of entrepreneurial opportunities.	K3
CO4	Analyze and decipher the significance of bioventure and value added products.	K4
CO5	Devise innovative methods for making value added products.	K5 & K6
UNIT	CONTENTS	
I	INTRODUCTION: Need - definition and concept - Types and characterization - entrepreneurial values- motivation and barriers-entrepreneurship as innovation, risk assessment and solutions.	
II	BIOVENTURE: Industry - overview of <i>Spirulina</i> , <i>Pleurotus</i> , 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	VALUE ADDED PRODUCTS: 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, nutraceuticals, standards and quality management.	
IV	ORGANIZATIONS AND AGENCIES: TIIC, DIC, NABARD, MICROSTAT, DBT - case study - sarvodaya – SIDCO –	

[illegible]

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Forestry
Course Type: EC 6	Course Code:
Contact Hours: 4 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To study the distribution pattern, composition and diversity of forest ecosystem	
C2	To understand the method of forest management principles and conservation.	
C3	To enable them to meaningfully contribute in the forest conservation.	
C4	To raise student awareness of the need to create a sustainable way of living and the current global issues with forestry caused by human interference.	
C5	To provide a platform to appreciate biodiversity and the importance.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the basic concepts related to forest distribution, degradation, protection, management and resource utilization.	K1
CO2	Understand complex interactions of humans and forest ecosystems in a global context.	K2
CO3	Demonstrate skills for ecological measurements and interpretation of forest ecology management.	K3
CO4	Examine and decipher the factors influencing forest vegetation, forest degradation and methods of wood preservation	K4
CO5	Develop new strategies and apply the knowledge gained for problem-solving analysis in the conservation and management of forest ecosystems.	K5 & K6
UNIT	CONTENTS	
I	SILVICULTURE: Forests - definition. Extent of forests in India and other countries. Forest types of India and Tamil Nadu - revised classification - pure and mixed stands - even and uneven aged stands. Role of forests. Factors of locality - climatic - edaphic - topographic - biotic - interaction of forest with the environment. Silviculture - objectives - scope - general principles. Regeneration - natural and artificial. Nursery techniques - containerized seedling production - techniques and methods. Vegetative and clonal propagation techniques and methods - macro and micro propagation techniques.	
II	FOREST MENSURATION AND MANAGEMENT: Forest Mensuration - Definition and objectives. Measurement of diameter, girth,	

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

	interactions - above and below ground - competition for space, water, light and nutrients. Microclimatic modifications - nutrient cycling and soil fertility improvement - Allelopathy and allelochemicals. - Ecological aspects of agro forestry - benefits and limitations of agro forestry. Agro forestry practices for different agro-climatic zones of Tamil Nadu. Agro forestry practices for wasteland reclamation. Social forestry - objectives and scope and necessity - its components and implementation in local and national levels - social attitudes and community participation. JFM - principles, objectives and methodology - choice of species for agro forestry and social forestry. Urban Forestry - definition and scope - benefits - choice of tree species - planting techniques and management.
Recommended Texts	<ol style="list-style-type: none"> 1. Manikandan, K and S. Prabhu. 2013. Indian forestry, a breakthrough approach to forest service. Jain Bros. 2. Roger Sands. 2013. Forestry in a global context, CAB international. 3. Balakathiresan. S.1986. Essentials of Forest Management. Natraj Publishers, Dehradun. 4. Agarwala, V.P. 1990. Forests in India, Environmental and Protection Frontiers. Oxford & IBH Publishing Co. New Delhi. 5. Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agro forestry. Oxford and IBH publisher, New Delhi. 6. Singhi, G.B. 1987. Forest Ecology of India, Publisher: Rawat. 7. Ramprakash. 1986. Forest management. IBD Publishers, Debra Dun. 8. Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun. 9. Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi. 10. Nair, N.C and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
Reference Books	<ol style="list-style-type: none"> 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 the bamboo and rattan sectors in Asia. In: Wollenberg, E and A. Ingles (Eds.). Incomes from the forest: methods for the development and conservation of forest products for local communities. Center for International Forestry Research (CIFOR), Bogor, Indonesia. 6. Chomitz, K.M., with P. Buys, G. De Luca, T.S. Thomas, and S. Wertz Kanounnikoff. 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	<ol style="list-style-type: none"> 1. http://www.wds.worldbank.org/external/default/WDSContentServer/WD

Resources	SP/IB/2006/10/19/000112742_2006 1019150049/Rendered/PDF/367890Loggerheads0Report.pdf. 2. https://www.britannica.com/science/forestry 3. https://en.wikipedia.org/wiki/Forestry . 4. https://www.biologydiscussion.com/forest/essay-forest-importance.major-products-and-its-conservation/25119 5. https://academic.oop.com 6. https://www.cbd.int/development/doc . 7. https://www.sciencedirect.com/topics/agriculture-and-biological-science-forest-product .
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Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Course Code		Value Education	Hrs	Credits	CIA	CE
Sem-V / Part- IV			2	2	25	75

Unit I - Yoga and Physical Health

- 1.1 Physical Structure – Three bodies – Five limitations
- 1.2 Simplified Physical Exercises – Hand Exercises -Leg Exercises – Breathing Exercises – Eye Exercises – Kapalapathi
- 1.3 Maharasanas 1-2 – Massages – Acu-puncture – Relaxation
- 1.4 Yogasanas – ~~Padma & Bhujangasana~~ – Padmasana – Vajrasanas – Chakrasanas (Side) – Viruchasanas – Yoga muthra – Patchimothasanas – Ustrasanas – Vakkarasanas – Salabasanas

Learning Objectives:

Unit II - The Art of Nurturing the life force and Mind

- LO1 – Maintaining the youthfulness. Postponing the ageing process
- LO2 – Sex and Spirituality. Significance of sexual vital fluid – Married life – Chastity
- LO3 – Ten stages of Mind
- LO4 – Mental frequency. Methods for concentration

COURSE CONTENT

Unit III - Sublimation

- 3.1 Purpose and Philosophy of life
- 3.2 Introspection – Analysis of Thought
- 3.3 Moralization of Desires
- 3.4 Neutralization of Anger

Unit IV – Human Resources Development

- 4.1 Eradication of worries
- 4.2 Benefits of Blessings
- 4.3. Greatness of Friendship
- 4.4 Individual Peace and World Peace

Unit V – Law of Nature

- 5.1 Unified force – Cause and Effect system
- 5.2 Purity of Thought and Deed and Genetic Centre
- 5.3 Love and Compassion
- 5.4 Cultural Education – Five fold Culture

1) யோகமும் உடல்நலமும்

(16 hours)

- 1.1 உடலமைப்பு - 3 உடல்கள் - ஐந்தில் அளவுமுறை
- 1.2 எளியமுறை உடற்பயிற்சி - கைப்பயிற்சி - கால் பயிற்சி - முச்சுப்பயிற்சி - கண் பயிற்சி - கபாலபதி
- 1.3 மகராசனம் 1-2 - உடல் தேய்த்தல் - அக்குபிரஷர் பயிற்சி - உடல் தளர்த்தல்
- 1.4 யோகாசனங்கள்: ~~சூரியநமஸ்கார்~~ - பத்மாசனம் - வஜ்ராசனம் - சக்கராசனம் (பக்கவாட்டில்) - விருச்சாசனம் - யோக முத்ரா - பச்சி மோத்தாசனம் - உஸ்ட்ராசனம் - வக்கராசனம் - சலபாசனம்

2) உயிர்வளமும் - மனவளமும்

(16 hours)

- 2.1 இளமை காதல் - முதுமையைத் தள்ளிப்போடுதல்
- 2.2 பாலுணர்வும் ஆன்மீகமும் - வித்தின் மகிமை - இல்லற வாழ்வு - கற்பநெறி
- 2.3 மனதின் பத்து படிநிலைகள்
- 2.4 மன அலைச்சுழல் - மன ஓர்மைக்கான பயிற்சிகள்

3) குணநலப்பேறு

(16 hours)

- 3.1 வாழ்வின் நோக்கம் - வாழ்க்கைத் தத்துவம்
- 3.2 அகத்தாய்வு - எண்ணம் ஆராய்தல்
- 3.3 ஆசை சீரமைத்தல்
- 3.4 சினம் தவிர்த்தல்

4) மனிதவள மேம்பாடு

(16 hours)

- 4.1 கவலை ஒழித்தல்
- 4.2 வாழ்த்தும் பயனும்
- 4.3 நட்பு நலம்
- 4.4 தனிமனித அமைதி - உலக அமைதி

5) இயற்கை நியதி

(16 hours)

- 5.1 ஒருங்கிணைப்பு ஆற்றல் - செயல்விளைவுத் தத்துவம்
- 5.2 மனத்தூய்மை, வினைத்தூய்மை - கருமையம்
- 5.3 அன்பும் கருணையும்
- 5.4 பண்பாட்டுக் கல்வி - ஐந்தொழுக்கப் பண்பாடு

Reference Book:

Manavalakalai Yoga, Vethathri Publications, Tamil Nadu, 2008.

Evaluation Pattern:

Practical [Performing Yoga & Meditation] – 25 marks

Theory [End-Semester Examination] – 75 marks

Question Pattern:

Section – A:

Ten objective type questions with multiple answers are to be given. (10X1=10)

Section – B:

Five short essay type questions in ‘Either – or’ pattern are to be given. (5X7=35)

Section – C:

Five long essay type questions are to be given. Three questions are to be answered. (5X10=30)

Course Code		Summer Internship / Industrial	Hrs	Credits	CIA	CE
Sem–V / Part– IV		Training	-	2	25	75

Learning Objectives:

LO1 – To offer a hands-on-learning experience, that allows the learners to maximize the outcome and benefits of their theoretical knowledge through practical implementation.

LO2 – By adding technical skills, soft skills and professional experience to the learners’ resume, they can enhance their chances of securing the job they desire

LO3 – To provide the learners an experience of the real corporate world and thus help them understand the expectations and requirements of the industry

LO4 – To enable the learners build their network and professional relationships, which turns them into confident future professionals.

Duration of the Training:

- * The learners of all the Under-Graduation Programmes are to undergo the Internship / Industrial Training during the summer vacation, after completion of the IV Semester examinations. The training period is 30 working days.
- * Evaluation:
- * After completion of the training, the evaluation of the performance of the learners will be done in the V semester.
- * Two credits will be awarded for the best performers.
- * Viva-voce examination will be conducted and the learners have to appear for the Viva-voce individually.
- * At the time of Viva-voce, the learners have to submit the given records to the examiner.
 - Work Diary, endorsed by the trainer
 - A complete report on the objectives, modules and outcomes.
 - A certificate, duly signed and issued by the trainer

SEMESTER VI

Class	VI SEMESTER	Title of the course	Credit	Hours	Marks		
III B.Sc.	Part			Theory/ Practical	Internal	External	Total
	Part III	Core Course XIII Plant Ecology and Phytogeography	3	5	25	75	100
		Core Course XIV Plant Biotechnology and Molecular Biology	3	5	25	75	100
		Core Course XV Plant Physiology and Plant Biochemistry	3	5	25	75	100
		Core Course XVI Plant Biotechnology, Molecular Biology, Plant Physiology and Plant Biochemistry Practical VI	3	3	25	75	100
	Elective course 7	EC 7 1. Horticulture 2. Natural Resource Management	3	5	25	75	100
	Elective Course 8	EC 8 1. Forensic Botany 2. Bionanotechnology	3	5	25	75	100
	Skill Enhancement Courses Professional Competency Enhancement	Training for Competitive examinations Botany for Competitive examinations (2 hours)	2	2	25	75	100
	Part IV	Extension activity	1	-	100	-	100
Total			21	30			
TOTAL CREDITS			140	---			

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Plant Ecology and Phytogeography
Course Type: Core XIV	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To relate to the significance of the biotic and abiotic components of the ecosystems.	
C2	To understand the energy flow in ecosystem.	
C3	To conceptualize the biodiversity.	
C4	To know implication of pollution on the environment.	
C5	To familiarize with the phytogeography.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.	K1
CO2	Summarize the phytogeographical division of India.	K2
CO3	Explain the implication of pollution on the environment.	K3
CO4	Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.	K4
CO5	Develop mitigations for the effective conservation of biodiversity and disaster management.	K5
Unit	CONTENTS	
I	Biotic and abiotic factors and their influence on vegetation – a brief account of microbes, plants, animals, soil, wind, light, temperature, rainfall, and fire. Autecology and Synecology – Vegetation – Units of Vegetation – Formation, Association, Consociation, Society – development of vegetation. Migration – ecesis, colonization, Methods of study of vegetation (Quadrat and transect). Plant succession –Hydrosere and Xerosere. Ecological classification of plants: Morphological and anatomical features of plants and their correlation to the habitat factors.	
II	Structure, trophic organization; food chains and food web, energy flow in an ecosystem. Types of ecosystems: pond, forest and grassland. Ecological pyramids and Biogeochemical cycles of carbon and nitrogen and phosphorus.	
III	Biodiversity: Ecosystem/community, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (<i>In situ</i> and <i>ex situ</i>).	
IV	Pollution: Types of pollution: Primary and secondary and their impacts: Air - Green house effect, global warming, ozone depletion, acid rain, Water, soil-causes and consequences. Remedial measures – Green building. Disaster management.	

V	<p>Phytogeography Introduction, continuous and discontinuous distribution, Phytogeography of India, Vegetational regions of India,. Plant indicators. Diversification of land plants. Speciation Changing Earth. Island Biogeography. Plant Biodiversity and its importance.</p> <p>Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation (<i>In situ</i> and <i>ex situ</i> methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.</p>
Recommended Texts	<ol style="list-style-type: none"> 1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India. 2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition. 3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd., 4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd., 5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi. 6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.
Reference Books	<ol style="list-style-type: none"> 1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition. 2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A. 3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd., 4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems. 5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons. 6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA. 7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi. 8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK. 9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland. 10. <u>Ambasht, R.S.</u> 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.
Web Resources	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/plant-ecology-3. 2. https://www.worldcat.org/title/plant-ecology/oclc/613206385 3. https://books.google.co.in/books/about/Plant_Ecology.html? 4. https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-PP 5. http://www.freebookcentre.net/Biology/Ecology-Books.html 6. https://www.amazon.in/Plant-Ecology-Ernst-Detlef-Schulze/dp/354020833X 7. https://www.tandfonline.com/toc/tped20/current (Plant Ecology and Diversity) 8. https://link.springer.com/journal/11258 (Plant Ecology)

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Plant Biotechnology and Molecular biology
Course Type: Core XV	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To know various aspects of biotechnology	
C2	To know the concept and techniques of plant tissue culture.	
C3	To familiarize with the gene transfer techniques.	
C4	To know about DNA replication and repair.	
C5	To familiarize with gene regulation.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize the fundamentals concepts of plant biotechnology and genetic engineering.	K1
CO2	Explain various steps in transcription, protein synthesis and protein modification.	K2
CO3	Elucidate gene cloning and evaluate different methods of gene transfer.	K3
CO4	Analyze the major concerns and applications of transgenic technology.	K4
CO5	Develop their competency on different types of plant tissue culture.	K5
Unit	CONTENTS	
I	Biotechnology – definition, history and scope. Application of plant biotechnology in various fields. Agriculture - Biofertilizers, Biopesticides. Medicine – Antibiotics (Penicillin) Recombinant vaccines, insulin and interferons. Environment – Bioremediation and Biofuel. Industry – ethanol production (yeast), citric acid production (<i>Aspergillus niger</i>) and Proteases production (<i>Bacillus sps</i>).	
II	Plant tissue culture - introduction, scope and importance, concept of totipotency, aseptic techniques in plant tissue culture. Composition of media, types of media, sterilization, explant preparation and inoculation. Callus induction and micropropagation. Application of plant tissue culture in agriculture, horticulture and forestry. Synthetic seed technology.	
III	Vectors; plasmid, bacteriophage, viral vectors, cosmids. Restriction enzymes. Recombinant DNA technology, gene transfer – indirect method, <i>Agrobacterium</i> mediated gene transfer. Direct method – Biolistic method. Development of transgenic plants with reference to insect resistance, Pros and cons of GM food.	

IV	Nature and function of genetic materials, Nucleic acid – base pairing – Chargaff's rule, DNA – structure. Types, denaturation - renaturation. Replication of DNA in prokaryotes. RNA structure and types. DNA repair mechanism.
V	Transcription – Enzymology – RNA polymerase – classes of RNA molecules – transcription in prokaryotes. Protein synthesis – Genetic code – characters – codons and anticodons. Gene regulation in Prokaryotes – <i>lac</i> operon and <i>trp</i> operon
Recommended Texts	<ol style="list-style-type: none"> 1. Bhajwani, S and Razdan, 1984. Plant tissue culture. Theory and practice. 2. Verma P.S and Agarwal V.K. 2010. Molecular Biology. S Chand Publishers. 3. Ignacimuthu, S.J. 2003. Plant Biotechnology. Oxford & IBH Publishing, New Delhi. 4. Bhojwani, S.S and Razdan, M.K. 2004. Plant Tissue Culture, Read Elsevier India Pvt. Ltd. 5. Purohit, S.S. 2010. Plant tissue culture, Student edition, Jodhpur. 6. Bajaj, Y.P.S. 1987. Biotechnology in agriculture and forestry. Springer – Verlag
Reference Books	<ol style="list-style-type: none"> 1. Bernard R Glick and Jack J Pasternak. 2001. Molecular biotechnology-principles and applications of recombinant DNA, (2nd Edition), ASM Press, Washington, D.C. 2. Jogdand, SN. 1997. Gene biotechnology, Himalaya Publishing House, New Delhi. 3. Ernst L. Winnaccker. 2002. From Genes to Clones-introduction to gene technology, VCR Pub., Weintein. 1. James, D Watson et al., 1992. Recombinant DNA (2nd Edition), WH Freeman and Co., New York. 5. Maniatis and Sambrook. 2003. Molecular Cloning- A lab manual Vol.I, II & III, Coldspring Harbor Laboratory Press, New York. 6. Old, RW and Primrose, SB. 2001. Principles of Gene Manipulation-an introduction to genetic engineering, Black Well Science Ltd., New York. 7. Halder, T and Gadgil, V.N.1981. Plant cell culture in crop improvement. Plenum, New York. 8. Neuman, K.H., Barz, W and E. Reinhard. 1985. Primary and secondary metabolism of plant cell cultures – Springer – Verlag, Berlin. 9. Barz, W., Reinhard, E and Zenk, M.H. 1977. Plant tissue culture and its biotechnology application – Springer – Verlag, Berlin. 10. Hu, C.Y and P.J.Wang. 1984. Handbook of plant cell culture Vol.1. Mac millan, New York. 11. Hammond, J.C. McGarvey and V. Yusibov. 2009. Plant Biotechnology, Springer Verlag. New York.
Web Resources	<ol style="list-style-type: none"> 1. http://www.freebookcentre.net/Biology/BioTechnology-Books.html 2. https://books.google.co.in/books/about/Introduction_to_Plant_Biotechnology.html?id=RgQLISN8zT8C 3. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 4. https://www.kobo.com/us/en/ebook/plant-biotechnology-1 5. https://www.worldcat.org/title/molecular-biology/oclc/1062496183 6. http://www.freebookcentre.net/Biology/Molecular-Biology-Books.html 7. https://www.amazon.in/Molecular-Biology-Multicolour-Verma-Agarwal-ebook/dp/B06XKVVT3

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Plant Physiology and Plant Biochemistry
Course Type: CORE XVI	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To relate to water relation of plants with respect to various physiological phenomenon.	
C2	To know the pathways of photosynthesis.	
C3	To familiarize with respiration and nitrogen metabolism.	
C4	To know about plant growth regulators.	
C5	To familiarize with plant biochemistry.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to water relation of plants with respect to various physiological phenomenon.	K1
CO2	Explain the process and significance of photosynthesis and respiration.	K2
CO3	Elucidate properties of nutrients and their deficiency symptoms in plants.	K3
CO4	Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.	K4
CO5	Decipher the phenomenon of seed dormancy and germination in plants.	K5
Unit	CONTENTS	
I	WATER RELATIONS: Properties of water—imbibition, diffusion, osmosis and plasmolysis- ascent of sap, mechanism of water absorption – active and passive, apoplast and symplast pathway. Transpiration – types and factors affecting transpiration and significance. Opening and closing of stomata- mechanisms and theories of transpiration.	
II	PHOTOSYNTHESIS: Radiant energy, Photosynthetic unit, photosynthetic pigments and their role, photo systems, path of carbon in photosynthesis - Light reaction, electron transport system in the chloroplast (Z-Scheme). Dark reaction - C3 cycle, C4 cycle, CAM	

	pathway, Photorespiration
III	<p>RESPIRATION</p> <p>Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient.</p> <p>NITROGEN METABOLISM</p> <p>Biological nitrogen fixation, nitrogen cycle.</p>
IV	<p>GROWTH:</p> <p>Growth – plant growth regulators (auxins, gibberellins, cytokinins, ethylene and abscisic acid) - Practical applications - Photo morphogenesis – photoperiodism – vernalization – dormancy- phytochromes. Stress Physiology: Concepts of plant responses to stresses (water, salt, temperature).</p>
V	<p>PLANT BIOCHEMISTRY:</p> <p>Classification, properties and biological role of carbohydrates, proteins, lipids and nucleic acids. Enzyme – properties – classification – nomenclature of enzymes – mode of enzyme action – factors influencing enzyme action.</p>
Recommended Texts	<ol style="list-style-type: none"> 1. Noggle and Fritz. 1976. Introductory Plant Physiology, Prentice Hall, New Delhi. 2. Pandey, SN and Sinha, BK. 1989. Plant Physiology, Vikas Publishing House Ltd., New Delhi. 3. Robert M. Devlin. 1970. Plant Physiology, East West Press, New Delhi. 4. Westhoff, P. 1998. Molecular Plant Development from Gene to Plant. Oxford University Press, Oxford, UK. Jain, JL. 1979. Fundamentals of Biochemistry, Chand & Co. Ltd., New Delhi. 5. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi. 6. Conn, E and Stumpf, PK. 1979. Outline of Biochemistry Niley Easdtern Ltd., New Delhi. 7. Metz, E.T. 1960. Elements of Biochemistry. V.F & S (P) Ltd., Bombay. 8. Verma,V. 2008. Textbook of plant Physiology, Ane's student edition, New Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Buchanan, B.B., Gruissem, W and Jones, R.L. 2000. Biochemistry and Molecular Biology of Plants, American Society of Plant Physiologists, Maryland, USA. 2. Dennis, D.T., Turpin, D.H., Lefebvre, D.D and Layzell, D.B. (Eds) 1997. Plant

	<p>Metabolism (second edition). Longman Essex, England.</p> <ol style="list-style-type: none"> 3. Galston, A.W. 1989. Life Processes in Plants. Scientific American Library, Springer-Verlag, New York, USA. 4. Hooykaas, P.J.J., Hall M.A and Libbenga, K.R. (eds). 1999. Biochemistry and Molecular Biology of Plant Hormones, Elsevier, Amsterdam, The Netherlands. 5. Hopkins, W.G. 1995. Introduction to Plant Physiology. John Wiley & Sons, Inc., New York, USA. 6. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (second edition). Springer-Verlag, New York, USA. 7. Nobel, P.S. 1999. Physiochemical and Environmental Plant Physiology (second edition), Academic Press, San Diego, USA. 8. Salisbury, F.B and Ross, C.W. 1992. Plant Physiology (4th edition). Wadsworth Publishing Co., California, USA. 9. 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. 10. Taiz, L and Zeiger, E. 1998. Plant Physiology (2nd edition). Sinauer Associates, Inc., Publishers, Massachusetts, USA. 11. Thomas, B and Vince-Prue, D. 1997. Photoperiodism in Plants (second edition). Academic Press, San Diego. USA.
Web Resources	<ol style="list-style-type: none"> 1. https://www.kobo.com/us/en/ebook/biochemistry-and-molecular-biology-of-plants 2. https://www.amazon.in/Plant-Biochemistry-Hans-Walter-Heldt-ebook/dp/B004FV4RS6 3. https://www.kobo.com/us/en/ebook/plant-biochemistry 4. https://www.kobo.com/us/en/ebook/a-textbook-of-plant-physiology-1 5. https://www.amazon.in/Advances-Plant-Physiology-P-Trivedi-ebook/dp/B01JP5L0YA 6. https://www.crcpress.com/Plant-Physiology/Stewart-Globig/p/book/9781926692692 7. https://www.amazon.com/Introduction-Plant-Physiology-William-Hopkins-ebook/dp/B006R6I850

Mapping with Programme Outcomes:

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

S-Strong (3)**M-Medium (2)****L-Low(1)****Mapping with Programme Specific Outcomes:**

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Core XIV, XV and XVI - Practical-VII
Course Type: CORE XVII	Course Code:
Contact Hours: 3 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To study morphological and anatomical adaptations of plants of various habitats.	
C2	To demonstrate techniques of plant tissue culture.	
C3	To familiarize with the structure of DNA, RNA.	
C4	To carryout experiments related with plant physiology.	
C5	To perform biochemistry experiments.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the distribution and adaptations of plants pertaining to their habitat	K1
CO2	Demonstrate skills in green planning and callus culture.	K2
CO3	Elucidate the basic principles involved in the plant physiology and biochemistry experiments.	K3
CO4	Appreciate the structure and functions of DNA and RNA.	K4
CO5	Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.	K5
EXPERIMENTS		
Plant Ecology and Phytogeography		
1. Study of morphological and anatomical adaptations of locally available hydrophytes, xerophytes, mesophytes and halophytes and correlate to their particular habitats.		
<p>Hydrophytes : <i>Nymphaea</i>, <i>Hydrilla</i> Xerophytes : <i>Nerium</i>, <i>Casuarina</i> Mesophytes : <i>Tridax</i>, <i>Vernonia</i> Halophytes : <i>Avicennia</i>, <i>Rhizophora</i> Epiphytes : <i>Vanda</i></p>		
2. Map of the phytogeographical regions of India.		
3. Quadrature study and line transect.		
4. Plan for a green building.		
5. Field trip to any one scrub jungle or wetland (Guindy National park/Nanmangalam Scrub		

jungle/Pallikaranai Marsh/Siruthavur Scrub/Vedanthangal Bird Sanctuary/Kelampakkam Marsh/Adyar Poonga).	
Plant Biotechnology - Demonstration 1. Sterilization techniques in plant tissue culture. 2. MS - Media preparation. 3. Explant sterilization, Callus induction, Plantlet, hardening.	
Molecular Biology – Photographs 1. DNA Structure 2. tRNA 3. DNA – Replication 4. DNA – Repair 5. Genetic code	
Plant Physiology and Plant Biochemistry 1. Determination of water potential by plasmolytic method. 2. Effect of chemicals on membrane permeability. 3. Effect of environmental factors on rate of transpiration by gravimetric method. 4. Separation of plant pigments by paper chromatography. 5. Study the rate of photosynthesis under different light intensities by using Willmott's bubble counter. 6. Study of rate of photosynthesis under different wavelengths (red & blue) of light. 7. Comparison of rate of respiration of different respiratory substrates. 8. Measurement of pH of expressed cell sap and different soils using pH meter. 9. Enzyme activity – catalase. 10. Biochemical test for carbohydrates, proteins and lipids	
Demonstration – Experiments 1. Study the rate of transpiration by using Ganong's photometer 2. Demonstration of stomatal movement. Induction of roots in leaves by auxins.	
Recommended Texts	1. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut. 2. Bhojwani, S.S and Razdan, M.K. 1996. Plant Tissue Culture: Theory and Practice. Elsevier Science Amsterdam. The Netherlands. 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. Plummer, D. 1988. An introduction to Practical Biochemistry, Tata McGraw-Hill Publishing Company Ltd., New Delhi. 5. Palanivelu, P. 2004. Laboratory Manual for analytical biochemistry and

	<p>separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.</p> <p>6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Wiley Eastern Limited, New Delhi.</p> <p>7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.</p>
Reference Books	<p>1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.</p> <p>2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.</p> <p>3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.</p> <p>4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).</p> <p>5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.</p> <p>6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.</p> <p>7. Manju Bala, Sunita Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.</p>
Web resources	<p>1. https://www.amazon.com/Practical-plant-ecology-beginners-communities/dp/B00088FDQK</p> <p>2. https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009</p> <p>3. https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9</p> <p>4. https://www.amazon.in/Practical-Physiology-Biochemistry-Sunita-Sangha/dp/9386102633</p> <p>5. https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318</p>

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Horticulture
Course Type: EC7	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To gain an understanding of the fundamentals of horticulture and techniques needed to grow and maintain plants.	
C2	To develop skills in students to work as gardeners, therapists, designers, growers and technical advisors in the food and non-food sectors of horticulture.	
C3	To know about hydroponic culture.	
C4	To develop the various horticultural crop protection.	
C5	To impart the knowledge on market preparation.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Enumerate the concepts in horticulture and nursery management.	K1
CO2	Demonstrate a working knowledge on biology of soil, compost making, designing and planning of garden, pest, diseases and nutrient management practices.	K2
CO3	Appraise the importance of floriculture and evaluate the contribution of spices and condiments on economy.	K3
CO4	Analyze different methods of weed control in horticultural crops.	K4
CO5	Develop their competency on pre and post-harvest technology in horticultural crops.	K5 & K6
Unit	CONTENTS	
I	Importance and scope of horticulture. Classification of horticultural crops –fruits and vegetables. Essentials of nursery Management - Soil management: Garden soil, Physical and chemical properties of soil, Organic matter, Compost, Cultural practices; Water management: Water quality, Irrigation, Mulching. Nursery structures: Protected cultivation (greenhouses), environment controls.	
II	Hydroponic culture-types of container. Use of manures and fertilizers in Horticultural crop production. Principles of organic farming. Environmental factors influencing vegetable and fruit production.	
III	Horticultural crop protection; physical control - pruning. Chemical control- pesticides, fungicides. Plant propagation - cutting, layering, budding, grafting. Types of gardens: formal, informal, kitchen and Terrace. Indoor gardening-bottle garden. Floriculture, ornamental gardening.	

IV	A brief account of annual, biennials and perennials with reference to ornamental gardens. Green house, terrarium, water garden, rockery plants, bonsai techniques. Landscaping, principles and basic components.
V	Technology of horticultural crops - market preparation: harvesting and handling, packaging and transport, storage; chemical treatment. Economics of cultivation Crops: Cardamom, pepper, clove. Food processing - freezing, bottling and canning, drying and chemical preservation.
Recommended Texts	<ol style="list-style-type: none"> 1. Hartmann, H.T and D.E. Kester. 1989. Plant propagation – principles and practices. Half of India. New Delhi. 2. Bose, T.K and Mitra and Sadhu. 1991. Propagation of tropical and subtropical horticultural crops. Naya Prakash. 3. Singh, S.P. 1989. Mist propagation Metropolitan book Co., New Delhi. 4. Chadha, K.L. 1986. Ornamental horticulture in India ICAR, Krishi Bhavan, New Delhi. 5. Bose, T.K and Mukharjee, D. 1977. Gardening in India. Oxford & IBH Pub., Co., Calcutta. 6. Gopalswamy Iyyangar. 1970. Complete gardening in India, Kalyan Printers, Bangalore. 7. Rangaswami, G and Mahadevan, A. 1999. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi
Reference Books	<ol style="list-style-type: none"> 1. Arditti, A. 1977. Orchid biology, Cornell Univ., Press. Ithaca. 2. Bailey, S. 1971. Perpetual flowering carnation, Fabner and Fabner, London. 3. Laurie, A., Kiplinger, D.D and Nelson, K.S. 1968. Commercial flower forcing. Mc Graw-Hill Book, London. 4. Cumming, R.W. 1964. The chrysanthemum Book. D. Van., Nostrand Inc. 5. Biswas, T.D. 1984. Rose growing – Principles and Practices – Assoc., Pub., Co., New Delhi. 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, Trivandrum. 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 Jercey.
Web Resources	<ol style="list-style-type: none"> 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/ 4. https://www.worldcat.org/title/handbook-of-horticulture/oclc/688653648 5. https://cbseportal.com/ebook/vocational-books-horticulture 6. http://www.digitalbookindex.org/_search/search010agriculhortigardena.asp

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Natural Resource Management
Course Type: EC7	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To develop an appreciation for the natural resources and their ecological and economic impact.	
C2	To gain an understanding of various strategies of natural resource management.	
C3	To understand the concept of different natural resources and their utilization.	
C4	To create the models of natural resource conservation and maintenance.	
C5	To study the significance of natural resources pertaining to economy and environment.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to significance of natural resources pertaining to economy and environment	K1
CO2	Understand the concept of different natural resources and their utilization.	K2
CO3	Evaluate the management strategies of different natural resources.	K3
CO4	Critically analyze the sustainable utilization land, water, forest and energy resources.	K4
CO5	Design new models of natural resource conservation and maintenance.	K5 & K6
Unit	CONTENTS	
I	Introduction to Natural Resource Bases: Concept of resource, classification of natural resources. Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Ecological, social and economic dimension of resource management.	
II	Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, forest management. Developing and developed world strategies for forestry. Land resources: Land as a resource. Dry land, land use classification, land degradation,	

	man induced landslides, soil erosion and desertification.
III	Landscape impact analysis, wetland ecology & management. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply, new prospects.
IV	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Resource Management Paradigms: Resource management the evolution and history of resource management paradigms. Resource conflicts: Resource extraction, access and control system. Approaches in Resource Management: Ecological approach; economic approach; ethnological approach; implications of the approaches; integrated resource management strategies. Poverty and implications in Resource Management in developing countries – Poverty in developing countries, causes and link with resources scarcity and poverty.
V	Management of Common International Resources: Ocean, climate, International fisheries and management commissions; Antarctica: the evolution of an international resource management regime. Case Studies: 1. Resource management in mountain ecosystem 2. Dry-land ecosystem 3. The management of marine and coastal resources 4. Case study of shifting Cultivation 5. Mangrove ecosystem and their management.
Recommended Texts	<p>1. Vasudevan, N. 2006. Essentials of Environmental Science. Narosa Publishing House, New Delhi.</p> <p>2. Singh, J. S., Singh, S.P. and Gupta, S. 2006. Ecology, Environment and Resource Conservation. Anamaya Publications, New Delhi.</p> <p>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.</p> <p>4. United States Government Accountability Office.2008. Natural Resource Management. Nova Science Publishers Inc, 10th Edition</p> <p>5. Stacy Keach. 2016. Natural Resources Management. Syrawood Publishing House</p> <p>6. Rathor, V.S. and Rathor B. S. 2013. Management of Natural Resource for Sustainable Development. Daya Publishing House, New Delhi.</p>
Reference Books	<p>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.</p> <p>2. Global Change and Natural Resource Management, Vitousek, P.M. 1994. Beyond global warming: Ecology and global change. Ecology 75, 1861-1876.</p> <p>3. Agarwal, K.C., 2001. Environmental Biology, Nidhi Publication Ltd. Bikaner.</p> <p>4. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publishing House.</p>

	<p>5. Heywood, V.H. & Watson, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.</p> <p>6. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB).</p> <p>7. Townsend C., Harper J, and Michael Begon. Essentials of Ecology, Blackwell Science.</p> <p>8. Francois Ramade 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.</p> <p>9. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p.</p>
Web Resources	<ol style="list-style-type: none"> 1. https://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDMhttps://books.google.co.in/books/about/Natural_Resource_Management.html?id=Tz9iDM6crLIC&redir_esc=y 2. https://books.google.co.in/books/about/Natural_Resource_Conservation_and_Enviro.html?id=T2SRuhxpUW8C&redir_esc=y 3. https://www.amazon.in/MANAGING-NATURAL-RESOURCES-FOCUS-WATER-ebook/dp/B00OPTWHOE 4. https://www.kobo.com/us/en/ebooks/natural-resources 5. https://www.igi-global.com/chapter/natural-resources-management/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.kobo.com/us/en/ebooks/natural-resources 9. https://www.igi-global.com/chapter/natural-resources-management/195183 10. https://www.igi-global.com/chapter/natural-resources-management/195183

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Forensic Botany
Course Type: EC8	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	The provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.	
C2	To provide students with knowledge of palynology, dendrology, plant anatomy, pharmacognosy, molecular biology and toxic compounds from plants that could serve as leads in crime spots.	
C3	To learn classification of plants from forensic point of view.	
C4	To understand forensic importance of different parts of plants.	
C5	To develop and identify main morphological and anatomical features of plants, which could be useful for forensic investigations.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.	K1
CO2	Summarize the forensic importance of different parts of plants.	K2
CO3	Apply techniques for the collection and preserve of botanical evidences of crime.	K3
CO4	Analyze and decipher the significance of classic and DNA based	K4

	forensic botany cases.	
CO5	Interpret and deduce new methods for the detection of plant poisons used in crime.	K5 & K6
Unit	CONTENTS	
I	General plant classification schemes, Sub specialization of forensic botany- plant morphology, plant anatomy, plant systematic, palynology, plant ecology, limnology, Plant architecture- roots, stems, flowers, leaves. Practical plant classification schemes: vegetables and herbs, fruits bearing trees and plants, landscaping plants: trees, shrubs and vines, grasses, plant cell structure and functions.	
II	Various types of woods, timbers, seeds and leaves and their forensic importance, Identification and matching of various types of wood, timber varieties, seeds and leaves. Types of fibers – forensic aspects of fiber examinations, Identification and comparison of man-made and natural fibres. Various types of planktons and diatoms and their forensic importance. Study and identification of pollen grains, Identification of starch grains, powder and stains of spices etc. Paper and Paper Pulp identification.	
III	Various types of poisonous plants: <i>Abrus precatorius</i> , <i>Aconitum napellus</i> , <i>Anacardium occidentale</i> , <i>Argemone mexicana</i> , <i>Cannabis sativa</i> , <i>Claviceps purpuria</i> , <i>Croton tiglium</i> , <i>Atropa belladonna</i> , <i>Gloriosa superba</i> , <i>Jatropha curcas</i> , <i>Lathyrus sativus</i> , <i>Nerium indicum</i> , <i>Nicotiana tabacum</i> , <i>Strychnos nux vomica</i> , <i>Thevetia nerifolia</i> . Types of plants yielding drugs of abuse – opium, cannabis, coco, tobacco, datura, <i>Psilocybin</i> mushrooms.	
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.	
Recommended Texts	<ol style="list-style-type: none"> 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. Elsevier. 5. Patricia E. J. Wiltshire.2012. Forensic Ecology, Botany, and Palynology: Some Aspects of Their Role in Criminal Investigation. Criminal and Environmental Soil Forensics pp 129–149 	
Reference Books	<ol style="list-style-type: none"> 1. Hall, D.W and Byrd, J. 2012. Forensic Botany: a practical guide. Wiley-Blackwell, 1edition. 2. Bock, J.H and Norris, D.O. 2016. Forensic Plant Science, Academic Press. 3. Nicholas Marquez Grant, John Wiley. 2012. Forensic Ecology Handbook. Wiley Backwell. 4. David W. Hall, Jason Byrd. 2012. Forensic Botany: A Practical Guide. Wiley-Blackwell. 	

	5. Heather Miller Coyle.2007.Forensic Botany: Principles and Applications to Criminal Casework is packed with details — David M. Jarzen, Florida Museum of Natural History, University of Florida, in AASP Newsletter, Vol. 40, No. 2.
Web Resources	1. https://www.kobo.com/us/en/ebook/forensic-botany 2. https://www.worldcat.org/title/forensic-botany-a-practical-guide/oclc/796086574 3. https://www.buecher.de/shop/pflanzenoekologie/forensic-botany-ebook-pdf/hall-david-w--byrd-jason/products_products/detail/prod_id/37354547/ 4. https://www.crcpress.com/Forensic-Botany-Principles-and-Applications-to-Criminal-Casework/Miller-Coyle/p/book/9780849315299 5. http://docshare02.docshare.tips/files/25818/258183613.pdf

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	1
CO 2	3	3	2	1	1	3	2	3	1	3
CO 3	2	1	2	3	1	2	1	3	1	2
CO 4	3	3	3	3	2	1	3	3	2	1
CO 5	3	3	2	3	2	3	1	2	2	3
S-Strong (3)		M-Medium (2)			L-Low(1)					

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Bionanotechnology
Course Type: EC8	Course Code:
Contact Hours: 5 Hours/Week	Credits: 3
CIA: 25	CE: 75

Learning Objectives		
C1	To provide students with comprehensive knowledge of basics in nanotechnology.	
C2	To enable the students understand and appreciate the various applications of nanoparticles.	
C3	To give perspective to researchers and students who are interested in nanoscale physical and biological systems and their applications in medicine.	
C4	To introduce the concepts in nanomaterials and their use with biocomponents to synthesize and interact with larger systems.	
C5	To impart knowledge on the most recent molecular diagnostic and therapeutic tools used to treat various diseases.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Relate to the essential features of biology and nanotechnology that are converging to create the new area of bionanotechnology	K1
CO2	Explain the synthesis of nanomaterials and their applications.	K2
CO3	Apply the knowledge gained to develop nanomaterials	K3
CO4	Compare the advantages and disadvantages of nanoparticles in health, medicine and environment.	K4
CO5	Construct various types of nanomaterial for application and evaluate the impact on environment.	K5 & K6
Unit	CONTENTS	
I	INTRODUCTION TO NANOTECHNOLOGY: History, Concepts, Prospects and Challenges. Scope of nanotechnology in Indian and global perspectives. Definition - Nanoscience, Nanotechnology. Classification based on the dimensionality- basic understanding of 1D, 2D and 3D nanostructures. Overview of nanoparticles, nanoclusters - nanotubes, nanowires and nanodots. Biotemplates – DNA to build nanocubes and hinges – smart glue, DNA as wire template.	
II	SYNTHESIS OF NANOPARTICLES: Synthesis of nanoparticles - Top down and bottom up approach. Methods of synthesis: Physical, Chemical reduction – reducing agents, capping agents, stabilizing of nanoparticles and Biological – Novel synthetic methods using plant extracts, bacteria and fungi.	

III	FOREST UTILIZATION AND WOOD TECHNOLOGY: PROPERTIES & CHARACTERIZATION OF NANOPARTICLES: Nano size effects - optical, electrical, mechanical, magnetic and catalytic activity. Characterization of nanoparticles using UV-Visible spectroscopy, SEM, TEM, Atomic force microscopy, Scanning tunnel microscopy, NMR, X-ray Crystallography and Photoluminescence.
IV	NANOCARRIERS: Introduction. Nanocarriers for drug delivery (DDS) – Polymeric nanotubes and solid lipid nanoparticles (SLN) as carriers, controlled release, site specific targeting. Magnetic nanoparticles as drug carriers and its applications.
V	APPLICATIONS OF NANOPARTICLES: Textiles, Food industry - nutraceutical, Medicine - antimicrobial activity, wound healing and dressing; Environment – green manufacturing. Agriculture - nanofertilizers and nanopesticides. Smart biosensors – Components and its application.
Recommended Texts	<ol style="list-style-type: none"> 1. Charles, P. Poole, Jr. & Frank J. Owens. 2003. Introduction to Nanotechnology, A John Wiley & Sons, INC., Publication. 2. George, K. Knopf & Amarjeet S. Bassi. 2006. Smart Biosensors. CRC Press. 3. Pradeep, T. 2007. Nano: The Essentials, Understanding Nanoscience and 4. Sulabha, K. Kulkarni. 2007. Nanotechnology: Principles and Practices. Capital 5. Christof, M. Niemayer, Chad A. Mirkin. 2004. Nanobiotechnology: Concepts, applications and perspectives, Wiley VCH publishers. 6. Jain, K.K. 2001. Nanobiotechnology: Molecular Diagnosis, Taylor Francis Group. 7. Sharma P.K. 2008. Understanding Nanotechnology. Vista International Publishing House, Delhi. 8. Viswanathan B. 2009. Nano Materials. Narosa Publishing House, New Delhi.
Reference Books	<ol style="list-style-type: none"> 1. Claudio Nicolini. 2009. Nanotechnology Nanosciences, Pon Stanford Pub.Pvt.Ltd, 2. Robert, A and Ferias, Jr. 1999. Nanomedicine, Volume I: Basic capabilities, Landes Bioscience. 3. Barbara Panessa-Warren. 2006 Understanding cell-nanoparticle interactions making nanoparticles more biocompatible. Brookhaven National Laboratory. 4. European Commission, SCENIHR. 2006. Potential risks associated with engineered and adventitious products of nanotechnologies, European Union. 5. Gysell Mortimer, 2011. The interaction of synthetic nanoparticles with biological systems PhD Thesis, School of Biomedical Sciences, Univ.of Queensland. 6. Murty, B.S., Shankar, P., Raj, B., Rath, B.B., Murday, J. 2013. Textbook of Nanoscience and Nanotechnology. Springer Publication. 7. Prashant Kesharwani. 2019. Nanotechnology-Based Targeted Drug Delivery

	Systems for Lung Cancer. Academic Press. An imprint of Elsevier.
Web Resources	<ol style="list-style-type: none"> 1. https://onlinelibrary.wiley.com/doi/book/10.1002/3527602453 2. https://www.elsevier.com/books/nanobiotechnology/ghosh/978-0-12-822878-4 3. https://www.routledge.com/Nanobiotechnology-Concepts-and-Applications-in-Health-Agriculture-and/Tomar-Jyoti-Kaushik/p/book/9781774635179 4. https://www.nanowerk.com/nanotechnology/periodicals/ebook_a.php 5. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html 6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC419715/ 7. https://phys.org/news/2014-10-endless-possibilities-bio-nanotechnology.html 8. http://www.particle-works.com/applications/controlled-drug-release/Applications

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: VI	Course: Botany For Competitive Examinations
Course Type: Skill Enhancement Course	Course Code:
Contact Hours: 2 Hours/Week	Credits: 2
CIA: 25	CE: 75

Learning Objectives		
C1	To develop the student for competitive examination.	
C2	To select the important topics as far as possible, with reference to the examination point of view. It gives a comprehensive account of botany.	
C3	To understand not only the basics of botany and also gives the broader perspective to prepare for the competitive examinations.	
C4	The essays give a detailed account of each aspect of botany to help students preparing for IAS, IFS and state civil services.	
C5	General understanding of plants around us, the different biophysical and biochemical processes that occur within them and their importance to human life.	
Course outcomes	On completion of this course, the students will be able to:	
CO1	Identify and define different groups of plants with their taxonomic position Compare the different groups of plants and evaluate their economic importance	K1
CO2	List down the general characters of Bryophytes, Pteridophytes and Gymnosperms Classify the types of fossils and recognize the fossil beds of Tamil Nadu Analyse and trace the origin of different plant groups using Geological Time scale	K2
CO3	Appreciates the morphology of plant and analyse different modifications of plant organs. Explore the major Herbaria of the world and recognize the importance.	K3
CO4	Differentiate Prokaryotic and Eukaryotic cell. Evaluate the significance of cell division. Justify the cause for the sex linked inheritance. Tabulate the different cell organelles with their functions.	K4
CO5	Define and appreciates biodiversity. Identify the cause and solve environmental related issues . Design eco friendly approaches to protect earth and generate new conservation strategies.	K5 & K6
	GENERAL STUDIES FOR COMPETITIVE	

	EXAMINATIONS (2 hours) Physical Geography Indian and World Geography Indian and World History International Organizations Everyday Science Awards and Honors Indian Economy Indian Polity	
Unit	CONTENTS	
I	PLANT WORLD: Plant science and its branches . Five kingdom classification. Outline of Kingdom plantae General characters and Economic importance of Algae, Fungi and Lichens.	
II	GENERAL CHARACTERS OF PLANT GROUPS: General characters and Economic importance of Bryophytes, Pteridophytes and Gymnosperms .Palaeobotany- Types of fossils, Geological time scale ,Fossil beds of Tamil Nadu.	
III	PLANT MORPHOLOGY AND TAXONOMY: Root system and shoot system. Modifications (Pneumatophore, Stilt root, Epiphytic root, Cladode, Phylloclade ,Pitcher and Phyllode) Parts of a flower - Fruits types(Outline) Parthenocarpy- Pollination – types, Seed dispersal – types, Seed Germination types. Taxonomy –definition. Types of classification- Taxonomic hierarchy, ICN, Binomial nomenclature and BSI. Herbarium and Major Herbaria of the world.	
IV	CYTOLOGY AND GENETICS: Cell –Prokaryotic and Eukaryotic – Cell organelles with functions . DNA and RNA (Basic concepts) -Cell division and its significance -Mitosis and Meiosis (outline) Mendelism – Monohybrid and Dihybrid cross, Sex linked inheritance	
V	ECOLOGY AND BIODIVERSITY: Ecosystem – abiotic and biotic components. Energy flow in an ecosystem, Aforestation, Deforestation- Chipko movement –Forest Conservation act- Pollution types and effects- Eutrophication, Global warming ,Ozone depletion, Climate change. Biodiversity and types- Hot spots, Mega diversity countries, Conservation – <i>ex situ</i> and <i>in situ</i> methods. Endangered plants and Red data Book. Rio -Earth summit. Biodiversity Management Policies - IUCN, UNEP, WWF, ICSU, WCMC.	
Recommended Texts	1. Pullaiah, T & D, Varalakshmi Narayana, P, Suresh. 2021. Botany for Competitive Examinations: (Useful for UPSC-Indian Forest Service, Civil Services, PCS, ASRB CSIR - NET, ICAR-NET and Other Competitive Exams.) Astral Cracker. 2. Mitra, S. 2016. Botany for competitive examinations, Academic Publishers. 3. Mohd Akil Shahezad. 2018. M.C.Qs. in Botany, Library Book House. 4.Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi. 5. Sharma, O.P. 2017. Plant Taxonomy. (II Edition).The McGraw Hill Companies	

	Taxonomy: Nair Datta 6. Thieman. 2014. Introduction to Biotechnology 3rd Edition. Pearson Education India.
Reference Books	1. De Robertis and De Robertis. 1990. Cell and Molecular Biology, Saunders College, Philadelphia, USA. 2. Gardner, E.J., Simmons, M.J and Snustad, D. 1991. Principles of Genetics, John Wiley Sons Inc., 8 th Edn., New York. 3. Salisbury, F. B.C.W. Ross.1991. Plant Physiology. Wassworth Pub. Co. Belmont. 4. Sharma, P.D. 2017. Ecology and Environment- Rastogi Publication, Meerut. 5. Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd. New Delhi. 6. Power, C.B and Dagainawa, H.F. 2010. General Microbiology : Himalaya Publishing House Pvt Ltd , 7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi. 8. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut. 9. 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.
Web Resources	1. https://www.amazon.in/BOTANY-COMPETITIVE-EXAMINATIONS-SUNIT-MITRA/dp/9383420898 2. https://www.amazon.in/Botany-Competitive-Examinations-UPSC-Indian-Competive/dp/B08VWB64BC 3. https://www.ssclatestnews.com/botany-book-pdf-free-download-for-competitive-exams/ 4. https://sscstudy.com/botany-for-competitive-exams-pdf/ 5. https://www.amazon.in/Botany-Entrance-Examination-Anupam-Rajak-ebook/dp/B089S1GLMP

Mapping with Programme Outcomes:

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

S-Strong (3)

M-Medium (2)

L-Low(1)

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

EXTRA CREDIT PAPERS

Programme: B.Sc.,	Subject: Botany
Semester: I	Course: Dietary and Nutritional Value of Fruits and Vegetables
Course Type: Extra Credit Paper	Course Code:
Contact Hours: Self Study	Credits: 2
CIA: --	CE: 100

COURSE OBJECTIVE

- To make the students to have a wide knowledge about nutritional value of fruits and vegetables.
- To understand the balanced diet.

COURSE OUTCOME

K1	CO 1	Impart knowledge about balanced diet.
K2	CO 2	Students understand the functions of food.
K2	CO 3	Understand the nutritional classification of foods.
K2	CO 4	Develop knowledge in understanding the diet for various deficiencies.
K3	CO5	Understand the allergic and non allergic foods.

COURSE CONTENT

Unit – I

Importance of balanced diet food groups and nutritive value of foods.

Unit – II

Function of foods – Physiological, Psychological and Social Functions.

Unit – III

Nutritional classification of foods – Energy Yielding Crops, Body Building Crops and Protective foods – Nutraceuticals – Definition and Importance.

Unit – IV

Fruits and Vegetables issued as the diet for Diabetes, Fever, Hyper tension, Hormonal Imbalance – Arthritis and Obesity Immunity Enhancements.

Unit – V

Allergic foods – Remedial Crops for Deficiency Disease and Allergic Symptoms.

Reference books

- Swaminathan, M. Advanced Text Book on Food and Nutrition (Vol. II), 2nd Edition. The Bangalore printing and publishing CO., Ltd., Bangalore. 1978.
- Wilson, E.D., Fischer, K.H., and Fuqua, M.E. Principles of nutrition 2nd Edition, Wiley Eastern Pvt, Ltd. 1971.
- Sri Lakshmi, B. Dietetics. New Age International Pvt, Ltd., Publishers New Delhi. 2006.

Bloom's Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	S	H	M	H	H	S
CO2	S	H	S	H	M	M	M
CO3	H	H	M	H	M	M	H
CO4	H	S	M	M	H	S	L
CO5	M	H	H	H	M	S	S

S – Strong

H – High

M- Medium

L - Low

Programme: B.Sc.,	Subject: Botany
Semester: III	Course: Commercial Plant Products
Course Type: Extra Credit Paper	Course Code:
Contact Hours: Self Study	Credits: 2
CIA: --	CE: 100

COURSE OBJECTIVE

- To make the students to have a wide knowledge about economically important plant products
- To understand the extraction processes of plant products.

COURSE OUTCOME

K1	CO 1	Impart knowledge about balanced diet.
K2	CO 2	Students understand the functions of food.
K2	CO 3	Understand the nutritional classification of foods.
K2	CO 4	Develop knowledge in understanding the diet for various deficiencies.
K3	CO5	Understand the allergic and non allergic foods.

COURSE CONTENT

Unit - I

Importance of economically important plant products – a brief Introduction about any two - Food Grains, Pulses, Spices and Wood.

Unit – II

Economically important plant products – Rubber, Coir Industry – Agave and Banana, Oil Industry – Sunflower oil.

Unit – III

Processing of Coffee – Types of Coffee – Grading of Coffee.

Unit - IV

Sugar Industry – Extraction of sugar from Sugarcane.

Unit – V

Paper Making Industry – Preparation of Pulp – Types of Paper Making.

Reference Books:

- B.P. Pandey, S. Chand. Economic Botany. 1999.
- Sampat Nehra. Economic Botany. 2007.
- Dr. S. Sundararajan. Morphology and Economic Botany of Angiosperms – Anmol publications P. Ltd. 1997.
- Robert Hill. Economic Botany.
- K.C. Casida. Industrial biotechnology

Bloom's Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	S	H	M	H	H	S
CO2	S	H	S	H	M	M	M
CO3	H	H	M	H	M	M	H
CO4	H	S	M	M	H	S	L
CO5	M	H	H	H	M	S	S

S – Strong

H – High

M- Medium

L - Low

Mapping with Programme Specific Outcomes:

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
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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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme: B.Sc.,	Subject: Botany
Semester: V	Course: Biodiversity Conservation and Management
Course Type: Extra Credit Paper	Course Code:
Contact Hours: Self study	Credits: 2
CIA: ---	CE: 100

COURSE OBJECTIVE

- To make the students to have a thorough knowledge about natural resources, ecosystem biodiversity and its conservation
- To understand the plant management

COURSE OUTCOME

K1	CO 1	Impart knowledge about environment.
K2	CO 2	Students understand the natural resources.
K2	CO 3	Understand the threats and natural calamities.
K2	CO 4	Develop knowledge in understanding biodiversity and its conservation.
K3	CO5	Understand the environment, In situ and Ex situ Conservation.

COURSE CONTENT

Unit – I

Concept and value of plant – Diversity classification types of Biodiversity consumptive, productive, social ethical and aesthetic values – Importance of Plant Diversity.

Unit – II

Centers of plant diversity in India, Ethno Botanical Survey, ICN – Types of Categories Endangered, Vulnerable, Threatened, Rare, Extinct – Major plant species in Red Data Book and Green Book.

Unit – III

Major Threats Climatic (Light, Temperature, Rain), Edaphic (Soil Types P^H Soil Nutrients), Natural Calamities (Cyclone, Tsunami, Earth quake).

Unit - IV

Conservation of plant diversity – principles types – Insitu and Exsitu Conservation – Conservation management – methods.

Unit - V

Insitu: National Parks, Nurseries and Botanical Gardens.

Exsitu: Plant Tissue Culture, Germ Plasm Storage, Cryopreservation – (Gene Banks), Needs / Methods of plant management – Forest Production Act/ Biodiversity Act any two important.

Reference books:

- Kumar, U. and Mahendra Jeet Asiya. Biodiversity, Principles and Conservation. Agrobios (India), Jodhpur India. 2005.
- Kartikeya, K. Biodiversity – Extinction and Conservation. Avavishkar Publishers, Distributors, Jaipur, India. 2005.
- Agarwal, K.C. Biodiversity. Agrobios (India), Jodhpur, India. 2000.

Bloom's Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	H	S	H	M	H	H	S
CO2	S	H	S	H	M	M	M
CO3	H	H	M	H	M	M	H
CO4	H	S	M	M	H	S	S
CO5	M	H	H	H	M	S	S

➤ **S – Strong H – High M- Medium L - Low**

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

VALUE ADDED COURSES

Programme Code: B.Sc	Programme Title Botany
Course Code	Title: Value added course I - Organic Farming Batch: 2022 - 2025
Hours/week 6	Semester: II
	Credits:

COURSE OBJECTIVE

- To make the students understand the organic farming
- To make the students study the concept and simple techniques in organic farming

COURSE OUTCOME

K1	CO 1	Understands the merits of organic farming over conventional farming
K2	CO 2	Students learn the preparation of various organic manures and panchakavya
K2	CO 3	Imparts knowledge to analyse the water and weed management practices
K2	CO 4	Understands to prepare herbal pest repellents
K5	CO 5	Students gain knowledge by visiting organic farms

Unit: I

6 hours

Organic farming – Introduction – concept – conventional vs organic farming

Unit:II

6hours

Organic manuring – farmyard manure – green manure – panchakavya – fish tonic – horn manure – composting - vermicomposting

6 hours

Unit : IV

6 hours

Unit : V

6 hours

Text Books

- ## Reference Books

- ## Bloom's Mapping

PO CO \	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	S	S	H	S	H	M
CO2	H	M	S	H	S	H	M
CO3	M	S	S	S	S	S	S
CO4	M	H	S	S	S	S	S
CO5	S	H	H	S	M	H	H

S – Strong

H – High

M- Medium

L - Low

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme Code: B.Sc	Programme Title Botany
Course Code	Title: Value added course II - Landscape Gardening Batch: 2022 - 2025
Hours/week 6	Semester: IV
	Credits:

COURSE OBJECTIVE

- To make the students understand the basic principles of landscape gardening
- To get familiarized with common ornamental and flowering plants

COURSE OUTCOME

K1	CO 1	Understands the merits of garden designing
K2	CO 2	Students learn the various components of garden

K2	CO 3	Imparts knowledge about the soil, organic and inorganic fertilizers
K2	CO 4	Understands the propagation and plant protection
K5	CO 5	Students gain knowledge by visiting different landscapes

Unit: I

6 hours

Introduction – formal gardening – informal gardening – planning – designing – principles in laying out a garden – parts of modern garden

Unit:II

6hours

Establishment of garden – lawn making – green houses (simple, commercial and conservatories) – indoor gardening – kitchen garden – indoor garden – rockery and water gardens - bonsai

Unit: III

6 hours

Soil and climatic factors – irrigation (normal and special types) – fertilizers (organic and inorganic) fertilizer application

Unit: IV

6 hours

Plant propagation methods – cutting, layering, grafting, budding - micropropagation – plant protection – causative agents and control measures – integrated pest management

Unit: V

6hours

Practical - Field visit to a landscape garden

Text Books

1. Kumaresan V. Horticulture and Plant Breeding (first edition), Saras publications, Nagercoil, 2009.
2. Kumar N. Introduction to Horticulture. Rajalakshmi Publications, Nagercoil, India, 1977.

Reference Books

1. Edmond JB, Sen TL, Andrews FS Halfacre RG. Fundamentals of Horticulture (fourth edition). Tata McGraw Hill Publishing Co., New Delhi, 1979.
2. Jitendra Sing, Basic Horticulture. Kalyani Publishers, Hyderabad, 2002.

Bloom's Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	S	S	H	S	H	M
CO2	H	M	S	H	S	H	M
CO3	M	S	S	S	S	S	S
CO4	M	H	S	S	S	S	S
CO5	S	H	H	S	M	H	H

S – Strong H – High M- Medium L - Low

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

Programme Code: B.Sc	Programme Title Botany
Course Code	Title: Value added course II - Terrace Gardening Batch: 2022 - 2025
Hours/week 6	Semester: VI
	Credits:

COURSE OBJECTIVE

- To help the students to gain knowledge on planning and maintenance of roof garden
- To widen their knowledge to create garden of their own interest.

COURSE OUTCOME

K1	CO 1	Understands the importance of terrace garden
K2	CO 2	Students learn the preparation of potting mixture
K2	CO 3	Imparts knowledge to grow bonsai plants
K2	CO 4	Understands to maintain the shade houses
K5	CO 5	Students gain knowledge by visiting many roof gardens

Unit: I

6 hours

Introduction and importance of terrace gardening – selection of site, size and shape, layout, soil, climate, cropping season, raising of nursery, transplanting, irrigation, manuring, stacking, training, pruning, weeding and harvesting

Unit: II

6 hours

Potting mixture – materials for roof garden – culture aspects of vegetables and fruits (mention any three examples in each group)

Unit: III

6 hours

Bonsai - Introduction, principle and importance. Tools and accessories. Ideal environment – containers and potting compost, methodology – repotting, fixing in shallow pots, dwarfing, watering, weeding and feeding. Different styles. Training of Bonsai – disbudding, pruning, wiring and other methods.

Unit: IV

6 hours

Shade houses – different types – containers – light weight fills – drainage – filter layer – maintenance considerations.

Unit: V

6 hours

Practical - Field visit to a terrace garden.

Text Books

1. Kumar, N. 1986 Introduction to Horticulture, Rajalakshmi Publications, Nagercoil, Kanyakumari.
2. Dey, S. C. 2006. Bonsai – An Art of miniature plant culture. Agrobios.

Reference Books

1. Amarnath, V. 2007. Nursery and Landscaping. Agrobios, Jodhpur, India.
2. Sheela, V.L. 2011. Horticulture, MJP Publishers, Triplicane, Chennai

Bloom's Mapping

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	M	S	S	H	S	H	M
CO2	H	M	S	H	S	H	M
CO3	M	S	S	S	S	S	S
CO4	M	H	S	S	S	S	S
CO5	S	H	H	S	M	H	H

S – Strong

H – High

M- Medium

L - Low

Mapping with Programme Specific Outcomes:

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
Weightage	15	15	15	15	15
Weighted % of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0