

B.Sc. BOTANY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2023-2024 onwards)

**CHOICE BASED CREDIT SYSTEM- LEARNING OUTCOMES BASED
CURRICULUM FRAME WORK (CBCS-LOCF)**



THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

(Nationally Re-Accredited by NAAC with B⁺⁺)

(Affiliated to Bharathidasan University, Tiruchirappalli)



ELAMBALUR, PERAMBALUR – 621 220

Vision

- Our vision is to conduct innovative teaching and outreach on the patterns and processes of life with a focus on plants and their environments.
- To be a Centre of Excellence for Plant Science.
- To explore and not to exploit the plant world.

Mission

- To provide a student-centred and professions-oriented higher education that bestows academic environment to demonstrate and promote creative, intellectual inquiry with positive relationships among students, faculty enhance the learning experience a fruitful and outstanding one for future application in a dynamic world.
- The Department seeks to impart quality higher education in life sciences to all with creativity to promote the highest level of academic accomplishment through training and teaching.
- To encourage and enhance the Creative Skills of students and help them in transforming scientific knowledge into reality.

Programme Outcomes (POs)

Upon completion of the programme, the undergraduate will be able to

1. Acquire knowledge, understand concepts and apply new ideas which enable them to be employable or self employed
2. To provide up to date theoretical knowledge on various forms of plants, their interactions with biotic and abiotic entities in the ecosystem and relevant practical skills.
3. Exploration of diverse plant life-forms and to nature the conservation of biodiversity.
4. To impart knowledge on the economic importance of plant/microbial resources and their products and to promote entrepreneurship skill.
5. To enable the students to take up various qualifying examinations concerning Botany and to face the challenges in career opportunities.

Program Specific Outcomes (PSOs)

Undergraduate Programme:

1. Inculcate strong fundamentals on modern and classical aspects of Botany
2. Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany
3. Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings
4. Design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations
5. Create platform for higher studies in and facilitate students to take-up successful career in Botany.

Thanthai Hans Roever College (Autonomous), Elambalur, Perambalur - 621 220

B.Sc., Botany - UG Course Structure under CBCS

(For the candidates admitted from the academic year 2023-2024 onwards)

Semester	Part	Course Code	Title of the Course	Ins. Hours/ Weeks	Credits	Exam Hours	CIA (Max)	ESE (Max)	Total (Max)
1	I	23UT1/H1/F1	Language	6	3	3	25	75	100
1	II	23UE1	English-I	6	3	3	25	75	100
1	III	23UBO1CC1	Plant Diversity I	5	5	3	25	75	100
1	III	23UBO1CC2P	Plant Diversity I - Practical	3	3	-	40	60	100
1	III	23UZO1AC1	Allied Zoology I	5	4	3	25	75	100
1	III	23UZO2AP1	Allied Zoology -Practical	2	-	-	-	-	-
1	IV	23UBO1SE1	(NME-1)	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	20	-	-	-	600
2	I	23UT2/H2/F2	Language - II	6	3	3	25	75	100
2	II	23UE2	English-II	6	3	3	25	75	100
2	III	23UBO2CC3	Plant Diversity II	5	5	3	25	75	100
2	III	23UBO2CC4P	Plant Diversity II -Practical	3	3	3	40	60	100
2	III	23UCH2AC2	Allied Zoology II	3	3	3	25	75	100
2	III	23UCH2AP1	Allied Zoology - Practical	3	2	3	40	60	100
2	IV	23UBO2SE2	(NME-2)	2	2	3	25	75	100
2	IV	23UBO2SE3	Botanical garden and landscaping	2	2	3	25	75	100
			Value Added Course		2*	2	50	50	100*
Total				30	23	-	-	-	800
3	I	23UT3/H3/F3	Language	6	3	3	25	75	100
3	II	23UE3	English-III	6	3	3	25	75	100
3	III	23UBO3CC5	Bryophytes and Pteridophytes	4	4	3	25	75	100
3	III	23UBO3CC6P	Bryophytes and Pteridophytes – Practical	3	3	3	40	60	100
3	III	23UCH3AC3	Chemistry-I	4	3	3	25	75	100
3	III	23UCH3AP2	Chemistry –I Practical	2	--	--	--	--	--
3	IV	23UBO3SE4	Entrepreneurial opportunities in botany	2	2	3	25	75	100
3	IV	23UBO3SE5	Herbal Technology	2	2	3	25	75	100
3	IV	23UBO3AE3	Gender Studies	1	1	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	21	-	-	-	800

4	I	23UT4/H4/F4	Language	6	3	3	25	75	100
4	II	23UE4	English-IV	6	3	3	25	75	100
4	III	23UBO4CC7	Gymnosperms, Paleobotany and Evolution	5	5	3	25	75	100
4	III	23UBO4CC8P	Gymnosperms, Paleobotany and Evolution - Practical	3	3	3	40	60	100
4	III	23UCH4AC4	Chemistry-II	4	4	3	25	75	100
4	III	23UCH4AP2	Chemistry-II Practical	2	2	3	40	60	100
4	IV	23UBO4SE6	Soft Skill Development	2	2	3	25	75	100
4	IV	23UES	Environmental Studies	2	2	3	25	75	100
			Value Added Course*		2*	2	50	50	100*
Total				30	24	-	-	-	800
5	III	23UBO5CC9	Plant Morphology, Taxonomy and Economic Botany	5	5	3	25	75	100
5	III	23UBO5CC10	Plant Anatomy and Embryology	5	5	3	25	75	100
5	III	23UBO5CC11P	Plant Morphology, Taxonomy and Economic Botany & Plant Anatomy and Embryology – Practical	5	5	3	40	60	100
5	III	23UBO5CC12PW	Project with viva- voce	5	3	3	80	20	100
5	III	23UBO5DE1	Aquatic Botany	4	4	3	25	75	100
5	III	23UBO5DE2	Plant Breeding and Horticulture	4	4	3	25	75	100
5	IV	23UVE	Value Education	2	2	3	25	75	100
5	IV		Internship/ Industrial visit/ Field visit	-	2*	-	-	-	100
			Value Added Course*		2*	2	50	50	100*
Total				30	28	-	-	-	700
6	III	23UBO6CC13	Plant Ecology and Phytogeography	6	5	3	25	75	100
6	III	23UBO6CC14	Plant Physiology and Plant Biochemistry	6	5	3	25	75	100
6	III	23UBO6CC15P	Plant Ecology and Phytogeography & Plant Physiology and Plant Biochemistry – Practical	6	5	3	40	60	100
6	III	23UBO6DE3	Ethno botany	6	4	3	25	75	100
6	III	23UBO6DE4	Forensic Botany	6	4	3	25	75	100
6	IV		Extension activity	-	1	-	-	-	-
			Value Added Course*		2*	2	50	50	100*
Total				30	24	-	-	-	500
Grand Total				180	140				4200

* Extra Credit Courses which will not be included in the total CGPA

- Summer Internship after 4th semester during summer vacation -30 Hours

-Value added course (Outside Instruction hours: 30 hours)

Credit Distribution for UG BOTANY

S.No	Part	Course Details	Credit
1	I&II	Language & English (Lang - 4x3=12 Eng - 4x3=12)	24
2	III	Core, Allied & Elective Course	94
3	IV	NME(2x2)	4
4		Environmental Studies (1x2)	2
5		Value Education(1x2)	2
6		Gender Studies	1
7		• Skill Enhancement (5x2=10)	10
		• Summer internship/ Industrial training (2x1=2 credits)	2
	• Foundation course	2	
	• Professional Competency Skill	2	
8	V	Extension Activity(1x1)	1
			140

Note:

	Internal Marks	External Marks
1. Theory	25	75
2. Practical	40	60
3. Separate passing minimum is prescribed for Internal and External marks		

FOR THEORY

The passing minimum for CIA shall be 40% out of 25 marks [i.e. 10 marks]

The passing minimum for Semester Examinations shall be 40% out of 75 marks [i.e. 30 marks]

FOR PRACTICAL

The passing minimum for CIA shall be 40% out of 40 marks [i.e. 16 marks]

The passing minimum for Semester Examinations shall be 40% out of 60 marks [i.e. 24 marks]

- Project : 100 Marks (The Project will be evaluated by an Internal and an External Examiner)
- Dissertation- 80 Marks
- Viva Voce - 20 Marks

LIST OF CORE COURSES OFFERED

Core Course I: Plant Diversity I –Algae

Core Course II: Plant Diversity I Algae - Practical-I

Core Course III: Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens

Core Course IV: Plant Diversity II - Fungi, Bacteria, Viruses, pathology and Lichens–Practical II

Core Course V: Plant Diversity III - Bryophytes and Pteridophytes

Core Course VI: Plant Diversity III Bryophytes and Pteridophytes – Practical-III

Core Course VII: Plant Diversity IV - Gymnosperms, Paleobotany and Evolution

Core Course VIII: Plant Diversity IV - Gymnosperms, Paleobotany and Evolution – Practical-IV

Core Course IX: Plant Morphology, Taxonomy and Economic Botany

Core Course X: Plant Anatomy and Embryology

Core course XI: Practical V CC IX & CC X

Core Course XII: Project with Viva-Voce - Group Project

Core Course XIII: Plant Ecology and Phytogeography,

Core Course XIV: Plant Physiology and Plant Biochemistry.

Core Course XV: Practical VI CC XIII & CC XIV

LIST OF ALLIED COURSES OFFERED

Allied Course-I: Allied Zoology I

Allied Course II: Allied Zoology II

Allied Course III: Chemistry I

Allied Course IV: Chemistry II

Allied Practical-I: Zoology I & II

Allied Practical-II: Chemistry I & II

LIST OF SKILL ENHANCEMENT COURSES OFFERED

Skill enhancement Course SEC - 1 (NME): Nursery and Landscaping

Skill Enhancement Course SEC-2 (NME): Horticulture

Skill Enhancement Course SEC-3: Botanical garden and landscaping

Skill Enhancement Course SEC -4: Entrepreneurial opportunities in botany

Skill Enhancement Course SEC -5: Herbal Technology

Skill Enhancement Course SEC -6: Soft skill Technology

LIST OF ELECTIVE COURSES OFFERED

Discipline Specific Elective- I: Aquatic Botany

Discipline Specific Elective II: Plant Breeding and Horticulture

Discipline Specific Elective III: Ethno botany

Discipline Specific Elective IV: Forensic Botany

List of Value Added Courses

COURSE CODE	COURSE TITLE
23UVABO1	PRESERVATION TECHNIQUES FOR PLANTS
23UVABO2	BIOINOCULANTS FOR COMMERCIALIZATION
23UVABO3	ORGANIC FARMING
23UVABO4	BIOPESTICIDES
23UVABO5	MUSHROOM CULTIVATION
23UVABO6	ECONOMIC BOTANY

Question Paper Pattern

UG Programme		
Maximum Marks : 75		Duration: 3 Hours
Section - A	i) a- (5 Questions for Multiple Choice) One question from each UNIT	5 x 1 = 5 Marks
	b- (5 Questions for Fill in the Blanks) One question from each UNIT	5 x 1 = 5 Marks
	ii) (5 short answer questions) One question from each UNIT	5 x 2 = 10 Marks
Section - B	5 Questions (Internal Choice: Either or) One set of questions from each UNIT	5 x 5 = 25 Marks
Section - C	3 Questions (Answer any 3 out of 5 Questions) One question from each UNIT	3 x10 = 30 Marks

SEMESTER – I

Course Code: 23UBO1CC1

Instruction Hours: 6

Credits: 6

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE-I PLANT DIVERSITY I ALGAE

Objectives:

1. To provide a comprehensive knowledge on the biology of algae.
2. To provide a basis for better understanding of the evolution higher of plants.
3. To understand reproductive biology, ecology of plants by studying the simpler systems in algae.
4. To understand the role of algae in ecosystems as primary producers of nutrition.
5. To understand importance of algae to animals and humans.

Course outcomes:

On completion of the course, the student will be able to

1. Relate to the structural organization, reproduction and significance of algae.
2. Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth
3. Explain the benefits of various algal technologies on the ecosystem.
4. Compare and contrast the thallus organization and modes of reproduction in algae.
5. Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.

UNIT – I

Classification (Fritsch-1935-1945), criteria for classification, algal distribution.

UNIT – II

Thallus organization (unicellular-*Chlorella*, Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum*, *Gracilaria*).

UNIT – III

Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*) (Examples may be changed according to the availability of the specimens).

UNIT – IV

Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae.

UNIT– 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 CO₂ sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.

Text Books:

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.
5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd.

London.

Reference Books:

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

Web Resources:

1. <https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382>
2. <https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327>
3. <https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678>
4. <https://www.kopykitab.com/Botany-For-Degree-Students-ALGAE-by-B-R-Vashishta-Dr-A-K-Sinha-Dr-V-P-Singh>
5. <https://www.wileyindia.com/a-textbook-of-algae.html>
6. <https://www.kobo.com/in/en/ebook/algae-biotechnology>
7. <https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBO1CC1	Plant Diversity I –Algae					6	6			
Course Outcomes (COs)	Programme Outcomes (Pos)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓	✓	✓				✓	
CO2			✓	✓	✓	✓	✓	✓	✓	✓	
CO3			✓				✓				
CO4	✓	✓	✓	✓	✓	✓		✓	✓	✓	
CO5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Number of Matches(✓) = 36 Relationship: HIGH											
Mapping	1-29%	30-59%			60-69%		70-89%		90-100%		
Matches	1-14	15-29			30-34		35-44		45-50		
Relationship	Very Poor	Poor			Moderate		High		Very High		

HOD & Chairperson

SEMESTER – I

Course code: 23UBO1CC2P

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE-II PLANT DIVERSITY I ALGAE - PRACTICAL-I

Objectives:

1. To develop skills to identify algae based on habitat, thallus structure and the internal organization.
2. To identify microalgae in a mixture.
3. To develop skills to prepare the microslides of algae.
4. To study the economic importance of few species.
5. To understand importance of algae to animals and humans

Course Outcomes:

On completion of this course, the students will be able to:

- Recall and identify algae using key identification characters.
- Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.
- Describe the internal structure of algae prescribed in the syllabus
- Decipher the algal diversity in fresh/marine water and their economic significance.
- Evaluate the various techniques used to culture algae for commercial purposes

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.

Text Books:

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (10th ed).Rastogi Publications, Meerut.
3. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
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, 5th Ed., Cambridge University Press, London.

Web Resources:

1. <https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492>
2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id
3. [https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-\(PDF-21P\).html](https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html)
4. <https://www.ebooks.com/en-in/book/210152662/algae/sachin-kumar-mandotra/>
https://books.google.co.in/books/about/Algae.html?id=s1P855ZWc0kC&redir_esc=y

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBO1CC2P	Plant Diversity I Algae - Practical-I					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓	✓		✓	
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓			✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓		✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – I

Course code: 23UBO1SE1

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: NURSERY AND LANDSCAPING

Objectives:

1. To recognize the importance of growing plants and practice the knowledge gained by developing kitchen garden and ornamental garden.
2. To be able to design gardens and become entrepreneur in Horticulture.
3. To study the methods of propagation.
4. To know about nursery structure.
5. To learn about gardening.

Course outcomes:

On completion of this course, the students will be able to:

- Recognize the basic principles and components of gardening.
- Explain about bio-aesthetic planning and conceptualize flower arrangement.
- Apply techniques for design various types of gardens according to the culture and art of bonsai.
- Compare and contrast different garden styles and landscaping patterns.
- Establish and maintain special types of gardens for outdoor and indoor landscaping.

UNIT I:

Introduction, prospects and scope of nursery and landscaping.

UNIT II:

Methods of Propagation – cutting, layering, grafting, budding, Floriculture – Rose, Chrysanthemum, Jasmine – cultivation.

UNIT III:

Gardening – formal garden, informal garden, vegetable garden, landscaped layout designing – formation and maintenance of lawn.

UNIT IV:

Nursery structures – Green house – Shade house, Mist chamber – Topiary, Bonsai culture.

UNIT V:

Manures, composting – vermicomposting.

Text Books

1. Amarnath V. 2006. Nursery and Landscaping, M/s IBD Publishers, New Delhi.
2. Butts, E and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.
4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.
5. Butts, E. and Stensson, K. 2012.Sheridan Nurseries: One hundred years of People,Plans, and Plants. Dundurn Group Ltd.

Reference Books:

1. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co. New Delhi.
2. Agrawal, P.K. 1993. Hand Book of Seed Technology, Dept. of Agriculture and Cooperation, National Seed Corporation Ltd., New Delhi.
3. Janick Jules. 1979. Horticultural Science. (3rd Ed.), W.H. Freeman and Co., San Francisco, USA.
4. Singh, J. 2018. Fundamentals of Horticulture. Kalyani Publishers.
5. Sharma V. K. 1999. Encyclopaedia of Practical Horticulture, Vol I –IV, Deep And Deep Publ. Pvt. Ltd.

Web Resources:

1. <https://www.kopykitab.com/higher-education-ebooks/higher-education-ebooks/Agricultural-Industry-agriculture-eBooks/Nursery-And-Landscaping-by-V-Amarnath>
2. <https://www.amazon.in/Nursery-Landscaping-Veena-Amarnath/dp/8177542788>
3. <https://www.amazon.in/Gardening/b?ie=UTF8&node=1637077031>
4. <https://in.pinterest.com/pin/496733033900458021/?lp=true>
5. <https://www.gardenvisit.com/ebooks>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
I	23UBO1SE1	Nursery and Landscaping					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓	✓		✓	✓	✓	✓		
CO2	✓	✓	✓	✓		✓	✓	✓		✓	
CO3	✓	✓	✓	✓		✓	✓	✓	✓		
CO4	✓	✓	✓	✓			✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓		✓	✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – II

Course code: 23UBO2CC3

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE-III PLANT DIVERSITY II

FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS

Objectives:

1. To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.
2. To understand the biology of fungi and to discuss the importance of fungi in various ecological roles
3. 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.
4. To identify the main groups of plant pathogens, their symptoms.
5. To understand the various types of plant diseases.

Course Outcomes

On successful completion of the course, the students will be able to:

- Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.
- Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization.
- Identify the common plant diseases, according to geographical locations and devise control measures.
- Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.
- Determine the economic importance of microbes, fungi and lichens.

UNIT I: FUNGI

Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (*Pilobolus*, *Mucor*, *Rhizopus*), Ascomycotina (*Aspergillus*, *Saccharomyces* *Peziza*), Basidiomycotina (*Agaricus*, *Pleurotus*, *Puccinia*) and Deuteromycotina (*Cercospora*, *Alternaria*). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association

UNIT II: ECONOMIC IMPORTANCE OF FUNGI:

Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins

UNIT III: BACTERIA, VIRUS:

Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology - Viruses general characters, structure and reproduction.

UNIT 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

UNIT V: LICHEN:

Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to Usnea.

Economic importance of Lichens: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens.

Text Books:

1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.
7. Mahendra Rai. 2009. Advances in Fungal Biotechnology. I.K. International Publishing House, New Delhi.

Reference Books:

1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
4. Burnett, J.H. 1971. The fundamentals of Mycology. ELBS Publication, London.

- Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
- Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
- Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.
- Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
- Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.
- Pandey, B.P. 2005. College Botany I: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S Chand & Company

Web Resources

- <https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YDFDE>
- <http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html>
- <http://www.freebookcentre.net/Biology/Mycology-Books.html>
- <https://www.kobo.com/us/en/ebook/introduction-to-fungi>
- <http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html>
- [http://www.freebookcentre.net/biology-books-download/Fungi-\(PDF-15P\).html](http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBO2CC3	Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – II

Course code: 23UBO2CC4P

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE-IV PLANT DIVERSITY II

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

Objectives:

1. To enable students to identify microscopic and macroscopic fungi.
2. To prepare microslides of fungi and lichens.
3. To know the presence of pathogen inside the plant tissues through microscopic sections.
4. To identify the bryophytes based on the morphology, and microslides.
5. To know the economic importance of the microbes studied.

Course Outcomes:

On completion of this course, the students will be able to:

- Identify microbes, fungi and lichens using key identifying characters.
- Develop practical skills for culturing and cultivation of fungi.
- Identify and select suitable control measures for the common plant diseases.
- Analyze the characteristics of microbes, fungi and plant pathogens.
- Access the useful role of fungi in agriculture and pharmaceutical industry.

EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides.
2. Identifying the micro slides relevant to the syllabus.
3. Herbarium specimens of bacterial diseases/photograph.
3. Protocol for mushroom cultivation.
4. Inoculation techniques for fungal culture (Demonstration only).
5. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
6. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
7. Visit to fungal biotechnology laboratories.
8. Ultra structure of bacteria.
9. Structure of bacteriophage.
10. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
11. Identifying the micro slides relevant to the syllabus.
12. Study of thallus and reproductive structures (apothecium) through permanent slides.
13. Economic importance of Lichens - Dye and perfume.

Text Books:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers andDistributors

(P) Ltd., New Delhi, India.

3. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge 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 (10th ed). Rastogi Publications, Meerut.
3. Singh, R and U.C. Singh 2020. Modern mushroom cultivation, 3d Edition Agrobios (India), Jodhpur.
4. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
5. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.

Web Resources:

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

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBO2CC4P	Plant Diversity II – Fungi, Bacteria, Viruses, Plant pathology and Lichens -Practical					4	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High											
Mapping	1-29%	30-59%	60-69%	70-89%	90-100%						
Matches	1-14	15-29	30-34	35-44	45-50						
Relationship	Very Poor	Poor	Moderate	High	Very High						

HOD & Chairperson

SEMESTER – II

Course code: 23UBO2SE2

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: HORTICULTURE

Objectives:

1. To increase production and productivity of fruit crops
2. To increase production and productivity of vegetable crops
3. To increase production and productivity of spices crops
4. To establish nurseries both at public & private sector for quality planting materials
5. To transfer technologies from Lab to Land and ensure good Soil health

Course Outcomes

On successful completion of the course, the students will be able to:

- Learn the importance of horticulture – career and occupational opportunities
- Know about hydroponics and its importance
- Learn the techniques of gardening - Types, Methods & Tools
- Learn about Floriculture - Cultivation of commercial flower crops
- To gain knowledge about in green house.

UNIT I

Horticulture: Importance and scope of Horticulture, Classification of horticultural crops – fruits, vegetables crops, climate, soil, water, nutrition needs of horticultural crops,

UNIT II

Plant propagation methods, cutting, layering, grafting, budding, stock-scion relationship. Use of plant regulators in horticulture.

UNIT III

Garden designs, types of gardens – formal, informal and kitchen garden, Units of garden, hedge, border, Topiary arches and lawn maintenance.

UNIT IV

Floriculture, cultivation of commercial flowers – rose and jasmines. Cultivation of important fruit trees – Mangoes and Banana.

UNIT V

Green house, Indoor gardening, Bonsai, flower arrangements, nursery management and maintenance.

Text Books:

1. Author: S. Thamburaj, M. Kannan and V. Kanthaswamy 1997. Horticultural crop varieties released from TamilNadu Agricultural University.
2. Author: D. Veeraragavathatham, M. Jawaharlal, Seemanthini Ramadas , 1998. A Guide on Vegetable culture
3. Author: S. Mohandass, T.N. Balamohan and G. Arjunan, 2000. Nutritional disorders in crop plants

4. Author: D. Veeraragavathatham, M. Jawaharlal, S. Jeeva, R. Rabindran, G. Umapathy, 2004. Scientific fruit culture
5. Author: T.N. Balamohan, K. Soorianathasundaram, P. Jeyakumar, J. Auxcilia, N. Seenivasan, K. Manoranjitham, L. Nalina and M. Kavino, 2008. Papaya production technology

Reference Books:

1. Bose, T.K. and Mukherjee, D. (1972). *Gardening in India*. Oxford & IBH Publishing Co., Kolkatta.
2. Edmond, J.B., Musser, A.M. and Andrews, F.S. (1951). *Fundamentals of Horticulture*. McGraw-Hill Book Company, Inc., New York.
3. Jitendra Singh. (2014). *Basic Horticulture*. Kalyani Publishers, Chennai.
4. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil.
5. Lex Lauries and Victor, H.R. (1950). *Floriculture – Fundamental and Practices*. McGraw Hill Publishers, New York.
6. Naik, K.C. (1963). *South Indian Fruits and Their Culture*. Vardhachary & Co., Madras.
7. Randhawa, G.C. (1973). *Ornamental Horticulture in India*. Today & Tomorrow Publishers, New Delhi.
8. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., New Delhi.

Web Resources

1. <https://www.amazon.in/Horticulture-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://agritech.tnau.ac.in/horticulture/horti_books%20and%20publications.html

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBO2SE2	Horticulture					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – II

Course code: 23UBO2SE3

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: BOTANICAL GARDEN AND LANDSCAPING

Objectives:

1. To know about the fundamental concepts of gardening and landscaping.
2. To provide an overview of various gardening styles and its scope in recreation and bio-aesthetic planning.
3. To illustrate the significance of garden adornments and propagation structures.
4. To inculcate entrepreneurial skills in students for creative landscaping design using CAD software.
5. To create the design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

Course Outcomes:

On completion of this course, the students will be able to:

1. Recognize fundamental concepts of gardening and landscaping.
2. Explain about significance of garden adornments and propagation structures.
3. Apply techniques of landscaping for aesthetic purposes and gardening for recreation.
4. Distinguish between formal, informal and free style gardens and their applications.
5. Develop and design outdoor and indoor gardens and inculcate entrepreneurial skills for landscaping.

UNIT 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.

UNIT 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.

UNIT 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.

UNIT 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.

UNIT V:

Computer Aided Designing (CAD) for outdoor and indoorscaping Exposure to CAD (Computer Aided Designing).

Text Books:

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

Reference Books

1. Berry, F. and Kress, J. 1991. Heliconia: An Identification Guide . Smithsonian Books.
2. Butts, E. and Stensson, K. 2012. Sheridan Nurseries: One hundred years of People, Plans, and Plants. Dundurn Group Ltd.
3. Russell, T. 2012. Nature Guide: Trees: The world in your hands(Nature Guides).
4. Acquaah, J. 2009. Horticulture – principles and practices, 4th edition, PHI learning Pvt. Ltd.
5. Edment Senn Andrews. 1994. Fundamentals of Horticulture. Tata. McGraw Hill Publishing Co., Ltd., Delhi.

Web Resources

1. https://www.amazon.in/Gardening-Landscape-Design-and-Botanical-Garden/s?rh=n%3A1318122031%2Cp_27%3Aand+Botanical+Garden
2. <https://www.overdrive.com/subjects/gardening>
3. <https://www.scribd.com/book/530538456/OpportUNITies-in-Landscape-Architecture-Botanical-Gardens-and-Arboreta-Careers>
4. <https://www.scribd.com/book/305542619/Botanic-Gardens>
5. <https://www.overdrive.com/subjects/gardening>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
II	23UBO2SE3	Botanical garden and landscaping					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – III

Course code: 23UBO3CC5

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE-V BRYOPHYTES AND PTERIDOPHYTES

Objectives:

1. To enable the students to have an overview of Non-vascular and Vascular cryptogams.
2. To understand the morphological diversity of Bryophytes and Pteridophytes.
3. To know the evolution of Bryophytes and Pteridophytes.
4. To understand the economic importance of the Bryophytes and Pteridophytes.
5. To understand anatomy and reproduction of Bryophytes and Pteridophytes.

Course Outcomes:

On completion of this course, the students will be able to:

- Recognize morphological variations of Bryophytes and Pteridophytes.
- Explain the anatomy and reproduction of Bryophytes and Pteridophytes.
- Compare and contrast the variations in the internal cellular organization, gametophyte and sporophyte of Bryophytes and Pteridophytes.
- Decipher the stages of plant evolution and their transition to land habitat.
- Access the useful role of Bryophytes and Pteridophytes.

UNIT 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.

UNIT II:

Structure, reproduction and life histories of the following classes each with a suitable example: Hepaticopsida (*Riccia/Marchantia*); Anthocerotopsida (*Anthoceros*) and Bryopsida (*Funaria/Polytrichum*). (Examples may be changed according to the availability of the specimens). Evolution of Bryophytes

UNIT III: PTERIDOPHYTES

General Characters of Pteridophytes - Classification (Reimer, 1954). Apogamy and apospory, homosporous and heterosporous.

UNIT IV:

Morphology, anatomy and reproduction of reproduction of the taxa belonging to each of the following classes: Psilotopsida (*Psilotum*), Lycopodiopsida (*Lycopodium/Selaginella*), Sphenopsida (*Equisetum*), Pteropsida (*Adiantum/Marsilea*). (Examples may be changed according to the availability of the specimens).

UNIT V:

Origin and evolution of Pteridophytes. Stellar Evolution. Economic importance of Pteridophytes.

Text Books:

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.

- Alam, A. 2020. Contemporary Research on Bryophytes Book Series: Recent Advances in Botanical Science. 10.2174/97898114337881200101.
- Alain Vanderpoorten. 2009. Introduction to Bryophytes, 1st Edition, Cambridge University Press.
- Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.
- Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.

Reference Books:

- Eames, A. 1963. Morphology of lower vascular plant, McGraw Hill, Chennai.
- Parihar. N.S. 1967. An introduction of Embryophyta, Vol.III – Pteridophyta, Central book depot, Allahabad.
- Smith, G.M. 1955. Cryptogamic Botany, Volume-II– McGraw Hill, Chennai
- Sporne, K.L. 1976. Morphology of Pteridophytes, 4th edition, B.I. Publication. Chennai.
- Watson, E.V. 1963. The structure and Life of Bryophytes. Hutchinson & Co, UK.
- Parihar, N.S. 1991. Bryophytes. Central Book Depot, Allahabad.
- Parihar, N.S. 1996. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

Web Resources:

- <http://www.bryoecol.mtu.edu/>
- <https://www.amazon.in/Introduction-Bryophytes-Alain-Vanderpoorten-ebook/dp/B007NWFQK>
- <http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm>
- http://www.bsiervis.nic.in/Database/Pteridophytes-in-India_23432.aspx
- <http://www.botany.ubc.ca/bryophyte/mossintro.html>
- [aeTIUC&redir_esc=y](#)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBO3CC5	Bryophytes and Pteridophytes					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓		✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – III

Course code: 23UBO3CC6P

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE-VI: BRYOPHYTES AND PTERIDOPHYTES –PRACTICAL-III

Objectives:

1. To enable students gain expertise in hand sectioning technique.
2. To study diversity of Bryophytes and Pteridophytes.
3. To understand the anatomical structure of the Bryophytes and Pteridophytes.
4. Develop comprehensive skills in sectioning and micro preparation.
5. Describe the structure of fossil forms prescribed in the syllabus.

Course Outcomes:

On successful completion of this course the student will be able to:

- Recognize the major groups of Non-vascular and Vascular cryptogams.
- Describe the structure of Bryophytes and Pteridophytes forms prescribed in the syllabus.
- Identify and illustrate the morphological and anatomical features of bryophytes and Pteridophytes.
- Develop comprehensive skills in sectioning and micro preparation.
- Interpret the significance of reproductive structures in Bryophytes and Pteridophytes.

EXPERIMENTS

Bryophytes

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

Pteridophytes

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

Text Books:

1. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
2. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
3. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
4. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.

5. Tuba Z., Slack N.G. and Stark L.R. 2011. Bryophyte Ecology and Climate Change. Cambridge university press, Cambridge.

Reference Books:

1. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
2. Mohammed Gufran Khan, Shite Gatew and Bedilu Bekele. 2012. Practical manual for Bryophytes and Pteridophytes. Lambert Academic Publishing.
3. Puri, P. 1980. Bryophytes. Atma Ram and Sons, New Delhi.
4. Sporne, K.R. 1991. The Morphology of Pteridophytes. B.I. Publ. Pvt. Ltd. Chennai.
5. Vashista.P.C. 1971. Botany for Degree students: Pteridophyta. S.Chand & Co. New Delhi.

Web Resources

1. <https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4>
2. <https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/dp/8126106883>
3. <http://www.eeb.uconn.edu/people/goffinet/Classificationmosses.html>
4. <https://www.vitalsource.com/products/introduction-to-bryophytes-alain-vanderpoorten-v9780511738951?duration=perpetual>
5. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBO3CC6P	Bryophytes and Pteridophytes – Practical					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1		✓	✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – III

Course code: 23UBO3SE4

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: ENTREPRENEURIAL OPPORTUNITIES IN BOTANY

Objectives:

1. To enable students to understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.
2. To create a mindset among students to start their own companies for income generation.
3. The students may understand about various fields of botany.
4. To develop the concept of Entrepreneurial OpportUNITies in Botany.
5. Describe the new strategies to describe marketing and business management strategy.

Course Outcomes

On completion of this course, the students will be able to:

- Relate to how various fields of botany could be understood with an entrepreneurial approach.
- Explain the concept of Entrepreneurial OpportUNITies in Botany.
- Make of the knowledge gained to start new venture using Plant tissue culture and plant products for commercial exploitations
- Decipher effective ways of making bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc.
- Develop new strategies to describe marketing and business management strategy including the role of IPR and bioethics regulations for licensing.

UNIT 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.

UNIT II: TOOLS AND TECHNIQUES

Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.

UNIT 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.

UNIT IV: PRODUCT DEVELOPMENT AND COMMERCIALIZATION

Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products.

UNIT 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.

Text Books:

1. Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life

Science Revolution, Pearson Prentice Hall, New Delhi, India.

2. Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India.

3. Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA.

4. Adams, C.R. Banford, K.M. and Early, M.P. 1993. Principles of Horticulture.

5. Sathe, T.V. 2004. Vermiculture and Organic farming, Daya Publishers.

Reference Books:

1. Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.

2. Peter F. Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.

3. Russell, T. 2012. Nature Guide: Trees: The world in your hands (Nature Guides). Mukherjee D. Gardening in India, Oxford IBH publishing co, New Delhi.

4. Kumar, N. 1997. Introduction to Horticulture, Rajalakshmi Publications, Nagercoil.

5. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge

Web Resources

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBO3SE4	Entrepreneurial opportunities in botany					2	2			
Course Outcomes (COs)	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1		✓	✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓		✓	✓	✓		✓	✓	✓	
CO3	✓	✓		✓		✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – III

Course code: 23UBO3SE5

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: HERBAL TECHNOLOGY

Objectives:

1. To provide students with knowledge of herbal drug industry, the quality of raw material, and guidelines for quality maintenance.
2. To gain an insight into the commercially important secondary products and significance of bioprospecting.
3. To understand various plants based drugs used in ayurvedha, unani, homeopathy, siddha etc.
4. To apply the knowledge to cultivate medical plants.
5. To know the pharmacological importance of medicinal plants.

Course Outcomes

On completion of this course, the students will be able to:

- Define and describe the principle of cultivation of herbal products.
- List the major herbs, their botanical name and chemical constituents.
- Apply techniques for monitoring drug adulteration through the biological testing.
- Analyze and decipher the significance of various methods of harvesting, drying and storage of medicinal herbs.
- Develop the skills for cultivation of plants and their value added processing / storage

UNIT 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.

UNIT 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.

UNIT 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.

UNIT 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).

UNIT 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 (*Withania somnifera*, neem and tulsi).

Text Books:

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

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

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/> / N-ry0Z8qaZ1liu
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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
III	23UBO3SE5	Herbal Technology					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓		
CO3	✓		✓	✓	✓		✓		✓	✓	
CO4		✓	✓	✓	✓	✓	✓	✓		✓	
CO5		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – IV

Course code: 23UBO4CC7

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE-VII: GYMNOSPERMS, PALEOBOTANY AND EVOLUTION

Objectives:

1. To enable the students to understand thallus organization.
2. To enable the students to understand internal and the reproductive structures of Gymnosperms and the importance of evolution.
3. To acquaint students with evidences of the past history of plant groups and significance of the fossilization.
4. To know the scope of paleobotany, types of fossils and geological time scale.
5. Understand the various fossil genera representing different fossil groups.

Course Outcomes:

On completion of this course, the students will be able to:

- Relate to the general characteristics of Gymnosperms and fossil forms.
- Explain about the morphology and anatomy Gymnosperms.
- Compare and contrast the reproductive structures of Gymnosperms & fossil forms.
- Analyze the anatomy and reproduction Gymnosperms along with their ecological and economical importance.
- Determine the various fossilization methods and their significance in paleobotany.

UNIT I GYMNOSPERMS

Classification of Gymnosperms (Sporne, 1954) (up to family). General characteristics, Economic importance of Gymnosperms with special reference to oil, resin, timber, etc.

UNIT II GYMNOSPERMS

Morphology, anatomy and reproduction of the taxa belonging to each of the following orders: Cycadales (Cycas), Coniferales (Pinus). Gnetales (Gnetum).

UNIT 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

UNIT IV PALEOBOTANY

Study of the following fossils: Rhynia, Lepidodendron, Lepidocarpon, Calamites and Williamsonia sewardiana.

UNIT V EVOLUTION

Evolution - origin of life, chemosynthetic theory - evidences (any five). Theories of evolution - Darwin, Lamarck and De veries, modern synthetic theory. Variation - analysis and sources, adaptive radiation, Concept of species - Allopatric and sympatric.

Text Books:

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.

- Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.
- Anil Kumar. 2006. Gymnosperms. S. Chand & Company Pvt. Ltd. New Delhi.
- Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Reference Books:

- Sporne, K.R.1991. The Morphology of Gymnosperme. B.I. Publications, New Delhi.
- Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms, New Age Int. Pvt. Ltd., New Delhi.
- Stewart, W.N and Rathwell, G.W. 1993. Paleobotany and the Evolution of Plants. Cambridge University Press.
- Raup, D.M and Steven, M. Stanley. 2004. Principles of paleontology. San Francisco: W.H. Freeman, 1971.
- Bhatnagar S.P and Alok Moitra. 2013. Gymnosperms. Publisher: New Age International Pvt Ltd Publishers. New Delhi.

Web Resources

- 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
- https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y
- <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>
- <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
- <https://www.palaeontologyonline.com/>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBO4CC7	Gymnosperms, Paleobotany and Evolution					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓		✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – IV

Course code: 23UBO4CC8P

Instruction: Hours: 3

Credit: 3

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE-VIII: GYMNOSPERMS, PALEOBOTANY AND EVOLUTION - PRACTICAL-IV

Objectives:

1. To enable students observe and record the morphological features of selected species of Gymnosperms.
2. To enable students observe and record the anatomical features of selected species of Gymnosperms.
3. To develop the skill of preparation of microslides of the gymnosperm samples.
4. To enable students to gain insights into the basics of paleobotany and methods of fossilization.
5. To understand the anatomy of the fossil plants through microscopy.

Course Outcomes:

On completion of this course, the students will be able to:

- Analyze and observe and record the morphological features of selected species of Gymnosperms.
- Describe the structure of fossil forms prescribed in the syllabus.
- Identify and Illustrate the morphological and anatomical features of gymnosperms.
- Develop comprehensive skills in sectioning and micro preparation.
- Interpret the significance of reproductive structures in gymnosperms.

EXPERIMENTS

1. Study of morphology, anatomy and structure of the vegetative and reproductive organs of *Cycas*, *Pinus* and *Gnetum*.
2. Identifying the micro slides relevant to the syllabus.
3. Field visit to study the habitat (Hill station).

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

2. Photograph of evolution scientists.

Text Books

1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
5. Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India.

Reference Books :

1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.
2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant

families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, UNITED Kingdom.

- Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
- Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
- Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.

Web Resources

- <https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover>
- <https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721>
- <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>
- <https://trove.nla.gov.au/work/11471742?q&versionId=46695996>
- <http://www.freebookcentre.net/Biology/Evolutionary-Biology-Books.html>.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBO4CC8P	Gymnosperms, Paleobotany and Evolution - Practical					3	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓		
CO3	✓	✓	✓		✓	✓		✓		✓	
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – IV

Course code: 23UBO4SE6

Instruction: Hours: 2

Credit: 2

Exam Hours: 3

Internal Marks: 25

External Marks: 75

SKILL ENHANCEMENT COURSE: FERMENTATION TECHNOLOGY

Objectives:

1. To appreciate the significance of microbes synthesizing fermented products.
2. To gain insights on safety and quality control in large scale production of fermentative products.
3. To design and operation of industrial practices in mass production of fermented products.
4. To know about the various fermentation technology.
5. To learn about the bioproduct recovery.

Course Outcomes

On completion of this course, the students will be able to:

- Enumerate the significance of industrially useful microbes.
- Explain the design and operation of industrial practices in mass production of fermented products.
- Explain the process of maintenance and preservation of microorganisms.
- Analyze the various aspects of the fermentation technology and apply for fermentative production.
- Validate the experimental techniques for microbial production of enzymes: amylase and protease, bio product recover.

UNIT I:

Preparation of microbial culture, Preparation and sterilization of fermentation media. Isolation and improvement of industrially important microorganisms.

UNIT II:

Maintenance and preservation of microorganisms, Metabolic regulations and overproduction of metabolites. Kinetics of microbial growth and product formation.

UNIT III:

Scope and opportUNITies of fermentation technology. Principles of fermentation: Submerged, solid state, batch, fed-batch and continuous culture.

UNIT 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).

UNIT V:

Microbial production of enzymes: Amylase and Protease. Bioproduct recovery.

Text Books:

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

5. Waites M.J., Morgan N.L., Rockey J.S. and Higton G. 2001. Industrial Microbiology: An Introduction. 1st Edition, Blackwell Science, London, UK.
6. Pelczar M.J., Chan E.C.S. and Krieg N.R. 2003. Microbiology. 5th Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi.

Reference Books

1. Peter F Stanbury, Allan Whitaker, Stephen J Hall. 2016. Principles of Fermentation Technology. Butterworth-Heinemann Press. UK.
2. Peppler, H. J. D. Perlman. 2014. Microbial Technology: Fermentation Technology. Academic Press.
3. T. El-Mansi, C. Bryce, Arnold L. Demain, A.R. Allman. Fermentation Microbiology and Biotechnology. Second Edition. 2006. CRC Press, USA.
4. Hongzhang Chen. Modern Solid State Fermentation: Theory and Practice. 2013. Springer Press, Germany.
5. John E. Smith. Biotechnology. 2009. Cambridge University Press. UK.
6. Celeste M. Todaro, Henry C. Vogel. 2014. Fermentation and Biochemical Engineering Handbook. William Andrew Press. Norwich, NY.
7. Lancini, G. R. Lorenzetti. 2014. Biotechnology of Antibiotics and other Bioactive Microbial Metabolites. Springer publications, Germany.

Web Resources

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

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
IV	23UBO4SE6	Fermentation technology					2	2			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1		✓	✓	✓		✓	✓	✓		✓	
CO2	✓	✓	✓	✓		✓	✓		✓	✓	
CO3	✓	✓		✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓		✓	✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – V

Course code: 23UBO5CC9

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE IX PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY

Objectives:

1. Students will have extensive knowledge of the morphology (vegetative structures and floral structures) of flowering plants.
2. Students will know about the basic concepts of classification of plants.
3. Understand major evolutionary trends in Angiospermic plants.
4. To know the characteristic features of the selected families.
5. To know the economic importance of plants.

Course Outcomes:

On completion of this course, the students will be able to:

- Define the concepts in plant morphology and rules of IUCN in botanical nomenclature.
- Classify systems of plant classification and recognize the importance of herbarium and virtual herbarium.
- Describe the core concepts of economic Botany and relate its applications in human life.
- Analyze the characters of the families according to the Bentham and Hooker's system of classification.
- Assess terms and concepts related to Phylogenetic Systematics.

UNIT 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.

UNIT 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.

UNIT 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*.

UNIT IV

Study of the following families based on the natural system and their economic importance: *Convolvulaceae*, *Acanthaceae*, *Lamiaceae*, *Amaranthaceae*, *Euphorbiaceae*, *Liliaceae*, *Orchidaceae* and *Poaceae*.

UNIT 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).

Text Books:

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:

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

1. https://books.google.co.in/books/about/Plant_Taxonomy_2E.html?id=px_WAwHiZIC&redir_esc=y
2. https://books.google.co.in/books/about/Plant_Taxonomy_and_Biosystematics.html?id=VfQnuwh3bw8C&redir_esc=y
3. https://books.google.co.in/books/about/PLANT_TAXONOMY_2E.html?id=Roi0lwSXFuUC&redir_esc=y
4. https://books.google.co.in/books/about/Plant_Taxonomy.html?id=0bYs8F0Mb9gC&redir_esc=y
4. https://books.google.co.in/books/about/Economic_Botany.html?id=2ahsDQAAQBAJ&redir_esc=y

5. https://books.google.co.in/books/about/Textbook_Of_Economic_Botany.html?id=XmZFJO_JHv8C&redir_esc=y

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBO5CC9	Plant Morphology, Taxonomy and Economic Botany					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓	✓	✓	✓		✓		
CO3	✓	✓	✓			✓	✓	✓	✓		
CO4	✓	✓		✓	✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 38 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTE – V

Course code: 23UBO5CC10

Instruction: Hours: 5

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE XI PLANT ANATOMY AND EMBRYOLOGY

Objectives:

1. To know fundamental concepts of plant anatomy and embryology.
2. To understand the internal tissue organization of various plant organs.
3. To differentiate normal and abnormal secondary growth.
4. To comprehend the structural organization of flower with relevance to the process of pollination and fertilization.
5. To know embryology of plants.

Course Outcomes:

On completion of this course, the students will be able to:

- Relate to the fundamental concepts of plant anatomy and embryology.
- Describe the internal tissue organization of various plant organs.
- Elucidate the stages of normal and abnormal secondary growth.
- Compare the structural organization of flower in relation to the process of pollination and fertilization.
- Access the various anatomical adaptations in plants.

UNIT 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.

UNIT 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.

UNIT III

Secondary thickening in monocots and dicots, Secondary thickening in monocot and dicot root. Anomalous secondary growth of stem- Boerhaavia, Nyctanthes and Dracaena. Leaf - anatomy of dicot and monocot leaf. Periderm structure and development: Phellem, Phellogen, Phelloderm, Rhytidome and lenticels. Stomatal types.

UNIT IV

Structure and development of anther - development of male gametophyte. Ovule: Structure of mature ovule, types of ovules; female gametophyte– megasporogenesis (monosporic, bisporic and tetrasporic) and megagametogenesis (Polygonum type); Organization and ultra structure of mature embryo sac.

UNIT V

Double fertilization and triple fusion. Endosperm and its types - free nuclear, cellular, helobial, endosperm haustoria. Polyembryony - types, apomixis, parthenogenesis and parthenocarpy. Seed structure and its importance.

Text Books:

1. Bhojwani, S.S and Bhatnagar, S.P. 1994. Embryology of Angiosperms, Vikas.
2. Bhojwani, S.S and Bhatnagar, S.P. 2000. The Embryology of Angiosperms (4th revised and enlarged edition). Vikas Publishing House, New Delhi.
3. Burgess, J. 1985. An Introduction to Plant Cell Development. Cambridge University Press, Cambridge.
4. Raghavan, V. 1999. Developmental Biology of Flowering Plants. Springer-Verlag, New York.
5. Vimla Singh and Alok Abhishek. 2019. Plant Embryology and Experimental Biology. Educational Publishers and Distributors. New Delhi.
6. Pandey, B.P.2015. Plant Anatomy S. Chand Publ. New Delhi.
7. Bhatnagar,S.P., Dantu, P.K, Bhojwani, S.S. 2014. The Embryology of Angiosperms 6th edition Vikas Publishing House. Delhi.
8. Waisel, Y., Eshel, A and Kafkaki, U. (eds.). 1996. Plant Roots : The Hidden Hall (2nd edition). Marcel Dekker, New York.

Reference Books:

1. Esau, K. 1985. Anatomy of Seed Plants –John Willey.
2. Cutter, E.G. 1989. Plant Anatomy – Part I – Addison – Wesley Publishing Co..
3. Maheswari, P.1991. An Introduction to Embryology of Angiosperms, Tata McGraw Hill Publishing Co. Ltd.,
4. Swamy, B.G.L and Krishnamoorthy. K.V.1990. From Flower to Fruits, Tata McGraw Hill Publishing Co. Ltd.
5. Dickison, W.C. 2000. Integrative Plant Anatomy. Harcourt Academic Press, USA.
6. Fahn, A. 1974. Plant Anatomy. Pergmon Press, USA.
7. Mauseth, J.D. 1988. Plant Anatomy. The 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

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=uYfwAAAA_MAAJ&redir_esc=y.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBO5CC10	Plant Anatomy and Embryology					5	5			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓		✓	
CO3	✓	✓		✓	✓	✓		✓	✓	✓	
CO4	✓	✓		✓	✓	✓	✓		✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓		
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – V

Course code: 23UBO5CC11P

Instruction: Hours: 5

Credit: 4

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE X PLANT MORPHOLOGY, TAXONOMY AND ECONOMIC BOTANY & PLANT ANATOMY AND EMBRYOLOGY - PRACTICAL-V

Objectives:

1. To study morphological characters of the families.
2. Able to describe the plant technically using the floral characteristics.
3. To preserve the plants and prepare herbarium sheets.
4. To be able to identify the local flora.
5. To understand the economic importance of the plants.

Course Outcomes:

On completion of this course, the students will be able to:

- Recognize the distinguishing plant morphological characters.
- Identify locally available plants to their respective families.
- Develop comprehensive skills in field identification, collection of specimens, writing technical description, botanical drawings and herbaria preparation.
- Construct floral diagram and write floral formula for a given flower.
- Validate the plant specimen by analyzing and dissecting the vegetative and floral characters.

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.

Anatomy

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

Embryology

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

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

Text Books:

1. Subramaniam, N.S. 1996. Laboratory Manual of Plant Taxonomy. Vikas Publishing House Pvt. Ltd., New Delhi.
2. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition. ISBN: 9351642062.
3. Rendle, A.B. 1980. The Classification of Flowering Plants (Vol. I & II), Vikas Students Education.
4. Pandely, B.P. 1987. Taxonomy of Angiosperms.
5. Nordenstam, B., EI Gazaly, G and Kassas, M. 2000. Plant Systematics for 21st Century. Portlant Press Ltd., London.

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. Ramasastry 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=uWg76rCqA68C
5. <https://www.amazon.in/PLANT-TAXONOMY-Sharma/dp/0070141592>
6. <https://www.kopykitab.com/Economic-Botany-By-Manoj-Kumar-Sharma-eBook>
1. <https://www.amazon.in/Practical-Anatomy-Adriance-1901-1973-Foster/dp/1341784509>
2. https://books.google.co.in/books/about/Practical_Manual_Of_Plant_Anatomy_And_Em.html?id=Cq1KPwAACAAJ&redir_esc=y
3. <https://www.amazon.in/Cell-Biology-Dr-Renu-Gupta/dp/8193651219>
4. <https://www.amazon.in/Practical-Handbook-Genetics-Vikas-Pali/dp/932727248X>
5. <https://www.amazon.in/Practical-Handbook-Plant-Breeding-Vikas/dp/9327272498>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBO5CC11P	Plant Morphology, Taxonomy and Economic Botany & Plant Anatomy and Embryology – Practical					5	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓		✓	✓	✓	✓		✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓		✓	
CO4	✓	✓	✓	✓	✓	✓	✓		✓	✓	
CO5	✓	✓		✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – V

Course code: 23UBO5DE1

Instruction: Hours: 4

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE ELECTIVE COURSE: AQUATIC BOTANY

Objectives:

1. To give an overview of the distribution of lower plants forms and its ecological significance.
2. To enable students to understand the ecological functions and economic uses of aquatic plants.
3. To equip students to collect, analyze and identify the planktons.
4. To give an exposure to various forms seaweeds.
5. To know about the values and uses of aquatic plants.

Course Outcomes

On completion of this course, the students will be able to:

- Recognize aquatic plants and their ecological importance.
- Explain about commonly occurring marine and limnetic algae of the Indian coasts.
- Apply techniques for conservation of aquatic plants for value addition.
- Analyze and decipher the significance and properties of mangroves, other aquatic angiosperms and microalgae.
- Develop new strategies to conserve mangroves and devise innovative methods for cultivation of aquatic plants.

UNIT I: MARINE AND LIMNETIC MACRO ALGAE:

Common seaweeds of Indian subcontinent: *Ulva*, *Caulerpa*, *Sargassum*, *Gracilaria*, etc. Common terrestrial algae, including cyanobacteria and lichen photobionts of Indian subcontinent and its life cycle, ecology and taxonomy: *Anabaena*, *Chlorella*, *Scenedesmus*.

UNIT II: MANGROVES:

Mangrove forests of India, including Sundarbans, Pichavaram, Kerala mangroves, Rathnagiri mangroves. Common species of mangroves and mangrove associated plants, including *Avicennia*, *Rhizophora*, *Acanthus* and *Aegiceras*. Ecological significance of mangroves.

UNIT 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.

UNIT IV: AQUATIC ANGIOSPERMS:

Common aquatic angiosperms of India, including Lotus, Water Lilly, Water hyacinth. Ecology, life cycle, taxonomy and economic importance of aquatic angiosperms.

UNIT 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.

Text Books:

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

- 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

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBO5DE1	Aquatic Botany					4	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓		✓	✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓		✓	
CO3	✓	✓	✓		✓	✓	✓	✓	✓		
CO4	✓	✓	✓		✓	✓	✓	✓	✓		
CO5	✓	✓		✓	✓	✓		✓	✓	✓	
Number of Matches(✓) = 41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – V

Course code: 23UBO5DE2

Instruction: Hours: 4

Credit: 3

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE ELECTIVE COURSE: PLANT BREEDING AND HORTICULTURE

Objectives:

1. The various methods of plant breeding and plant propagation
2. Teaches students the art of growing plants for a pre-defined purpose and pleasure and facilitates students to become an entrepreneur
3. To increase the crop yield and develop a disease-resistant crop.
4. To develop plants that can tolerate extreme environmental stress.
5. To promote educational and training opportunities and encourage the development of all disciplines within horticulture

Course outcomes:

- Students able to explain about plant breeding
- To gain knowledge about mutation breeding
- Students get acquire knowledge on horticultural crops.
- Students get acquire knowledge on classification of horticulture,
- To understand planning, designing, principles in laying out a garden.

UNIT I

Plant Breeding: Objectives, Plant introduction, selection, hybridization techniques, Hybrid Vigor, heterosis, Interspecific and intergeneric.

UNIT II

Mutation -Polyploidy and its applications in plant breeding. Breeding for crop improvement- Paddy, Groundnut and Sugarcane.

UNIT III

Horticulture - scope and importance. Horticultural crops - climate, soil, water and nutritional needs. Plant propagation methods – cutting, layering, grafting and budding. Plant growth regulators in horticulture.

UNIT IV

Classification of horticultural crops- Pomology, Olericulture, Floriculture, Spices and Plantation crops. Green house, Indoor gardening, Bonsai. Flower arrangements – Nursery management and Maintenance.

UNIT V

Landscaping: Principles, elements and design and layout - formal garden, Informal garden, Special types of gardens (bog garden, sunken garden, terrace, rock garden), and specific areas.

Text Books:

1. Roy Choudhry, N. and Mishra, H.P. (2001). *Text book on Floriculture and Landscaping*. Raja Infotech Enterprise, India.
2. Bose, T.K., Maiti, R.G., Dhua, R.S. and Das, P. (1999). *Floriculture and Landscaping*. Naya Prakash, Calcutta.

Reference Books:

1. Allard, R.W. (1960). *Principles of Plant Breeding*. John Wiley & Sons, New York.
2. Chopra, V.L. (1989). *Plant Breeding*. Oxford IBH, New Delhi.
3. Kumar, N. (1997). *Introduction to Horticulture*. Rajalakshmi Publication, India.
4. Manibhushan Rao, K. (1991). *Text Book of Horticulture*. Macmillan Publications, New Delhi.S
5. Sandhu, M.K. (1989). *Plant Propagation*. Wiley Eastern Ltd., New Delhi.
6. Sharma, J.R. (1994). *Principles and Practice of Plant Breeding*. Tata McGraw Hill, New Delhi.

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
V	23UBO5DE2	Plant Breeding and Horticulture					4	3			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓	✓		✓	✓	✓		✓	✓	
CO2	✓	✓	✓		✓	✓	✓	✓	✓		
CO3	✓		✓	✓	✓	✓	✓		✓	✓	
CO4	✓	✓		✓	✓	✓	✓	✓		✓	
CO5	✓	✓		✓	✓	✓	✓	✓		✓	
Number of Matches(✓) = 40 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – VI

Course code: 23UBO6CC13

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE XIV PLANT ECOLOGY AND PHYTOGEOGRAPHY

Objectives:

1. To relate to the significance of the biotic and abiotic components of the ecosystems.
2. To understand the energy flow in ecosystem.
3. To conceptualize the biodiversity.
4. To know implication of pollution on the environment.
5. To familiarize with the phytogeography.

Course Outcomes:

On the completion of the course, the students will be able to:

- Relate to the significance of the biotic and abiotic components of the ecosystems and energy flow.
- Summarize the phytogeographical division of India.
- Explain the implication of pollution on the environment.
- Analyze the implications of functional and behavioral ecology in natural and man-made areas, biodiversity and conservation.
- Develop mitigations for the effective conservation of biodiversity and disaster management.

UNIT 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.

UNIT 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.

UNIT III

Biodiversity: Ecosystem/commUNITY, species and genetic diversity. Endemism and hotspots, Natural resources and its conservation (*In situ* and *ex situ*).

UNIT 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.

UNIT V:

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.

Definition, levels of biodiversity-genetic, species and ecosystem. Biodiversity hotspots- Criteria, Biodiversity hotspots of India. Loss of biodiversity – causes and conservation (In situ and ex situ methods). Seed banks - conservation of genetic resources and their importance. Consequences of deforestation and exploitation of targeted species; Forest conservation, Social forestry and Participatory Management of Forest. Concept of degeneration and regeneration of plants.

Text Books:

1. Singh, J.S., Singh, S.P., Gupta, S. 2006. Ecology Environment and Resource Conservation. Anamaya Publications, New Delhi, India.
2. Sharma, P.D. 2010. Ecology and Environment. Rastogi Publications, Meerut, India.8th edition.
3. Krishna Iyer.V.R. 1992. Environmental protection and legal defence. Sterling Publishers Pvt. Ltd.,
4. Shukla, R.S and Chandel,PS.1990. Plant Ecology, S.Chand & Co. Pvt. Ltd.,
5. Krishnamurthy, K.V. 2003. An advanced text book on Biodiversity - Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
6. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications.

Reference Books:

1. Odum, E.P. 2005. Fundamentals of ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Wilkinson, D.M. 2007. Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Kumar,H.D. 1990. Modern concepts of Ecology, Vikas Publishing House Pvt. Ltd.,
4. Smith,W.H. 1981. Air pollution and forest : Interactions between air contaminants and forest ecosystems.
5. Vickery, M.L. 1984. Ecology of Tropical plants, John Wiley and Sons.
6. Melchias, G., 2001. Biodiversity and Conservation, Science Publishers Inc. USA.
7. Asthana, D.K and Meera Asthana. 2006. A text book of Environmental studies. S.Chand and Company Ltd. New Delhi.
8. Brian Groombridge. 1992. Global Biodiversity, Chapman and Hall, UK.
9. IUCN. 1985. The World Conservation Strategy, IUCN, Switzerland.
10. [Ambasht, R.S.](#) 2017. A textbook of plant ecology 15ed (pb 2019). CBS Publishers Distributors.

Web Resources

1. <https://www.kobo.com/us/en/ebook/plant-ecology-3>.
2. <https://www.worldcat.org/title/plant-ecology/oclc/613206385>
3. https://books.google.co.in/books/about/Plant_Ecology.html?
4. <https://www.kopykitab.com/Plant-Ecology-by-Agrawal-AK-And-Deo-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)

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBO6CC13	Plant Ecology and Phytogeography					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓		✓	✓	✓	
CO2	✓	✓	✓	✓		✓	✓	✓	✓		
CO3	✓		✓	✓	✓		✓		✓	✓	
CO4		✓	✓	✓	✓	✓	✓	✓		✓	
CO5		✓	✓	✓	✓	✓	✓	✓	✓		
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – VI

Course code: 23UBO6CC14

Instruction: Hours: 6

Credit: 5

Exam Hours: 3

Internal Marks: 25

External Marks: 75

CORE XVI PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY

Objectives:

1. To relate to water relation of plants with respect to various physiological phenomenon.
2. To know the pathways of photosynthesis.
3. To familiarize with respiration and nitrogen metabolism.
4. To know about plant growth regulators.
5. To familiarize with plant biochemistry.

Course Outcomes:

On completion of this course, the students will be able to:

- Relate to water relation of plants with respect to various physiological phenomenon.
- Explain the process and significance of photosynthesis and respiration.
- Elucidate properties of nutrients and their deficiency symptoms in plants.
- Analyze the biological role of plant growth regulators, carbohydrates, proteins, lipids, nucleic acids and enzymes.
- Decipher the phenomenon of seed dormancy and germination in plants.

UNIT 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.

UNIT 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.

UNIT III: RESPIRATION

Aerobic, Glycolysis, Krebs Cycle, Electron Transport System, oxidative phosphorylation, respiratory quotient, Anaerobic- fermentation - Respiratory quotient.

NITROGEN METABOLISM

Biological nitrogen fixation, nitrogen cycle.

UNIT IV: GROWTH:

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).

UNIT V: PLANT BIOCHEMISTRY:

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.

Text Books:

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:

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 Metabolism (second edition). Longman Essex, England.
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

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits				
VI	23UBO6CC14	Plant Physiology and Plant Biochemistry					6	5				
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)						
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5		
CO1	✓		✓	✓	✓	✓	✓	✓	✓			
CO2	✓	✓		✓	✓	✓	✓	✓		✓		
CO3	✓	✓	✓	✓		✓	✓	✓		✓		
CO4	✓	✓		✓	✓	✓		✓	✓			
CO5	✓	✓	✓		✓	✓	✓		✓	✓		
Number of Matches(✓) = 39 Relationship: High												

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – VI

Course code: 23UBO6CC15P

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 40

External Marks: 60

CORE XVII PRACTICAL COVERING – PLANT ECOLOGY AND PHYTOGEOGRAPHY & PLANT PHYSIOLOGY AND PLANT BIOCHEMISTRY – PRACTICAL -VII

Objectives:

1. To study morphological and anatomical adaptations of plants of various habitats.
2. To demonstrate techniques of plant tissue culture.
3. To familiarize with the structure of DNA, RNA.
4. To carryout experiments related with plant physiology.
5. To perform biochemistry experiments.

Course Outcomes:

On completion of this course, the students will be able to:

- Relate to the distribution and adaptations of plants pertaining to their habitat
- Demonstrate skills in green planning and callus culture.
- Elucidate the basic principles involved in the plant physiology and biochemistry experiments.
- Appreciate the structure and functions of DNA and RNA.
- Estimate the biochemical components and determine the factors controlling photosynthesis and transpiration of plants.

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.

Hydrophytes : *Nymphaea, Hydrilla*

Xerophytes : *Nerium, Casuarina*

Mesophytes : *Tridax, Vernonia*

Halophytes : *Avicennia, Rhizophora*

Epiphytes : *Vanda*

2. Map of the phytogeographical regions of India.
3. Quadrant study and line transect.
4. Plan for a green building.

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 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.
3. Induction of roots in leaves by auxins.

Text Books:

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 separation techniques, School of Biotechnology, Madurai Kamaraj University, Madurai.
6. Jayaraman.J.1981. Laboratory Manual in Biochemistry. Wiley Eastern Limited, New Delhi.
7. Bendre, A.M. and Ashok Kumar, 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.

Reference Books:

1. Mick Crawley. 1996. Plant Ecology, 2nd Edition Wiley-Blackwell.
2. Gamborg, O.L and G.C. Phillips (eds). 1995. Plant cell, tissue and organ culture. Springer Lab Manual.
3. Glick, B.R and J.E. Thompson. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boca Raton, Florida.
4. Bala, M., Gupta, S., Gupta, N.K and Sangha, M.K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
5. Wilson, K and J. Walker (Eds). 1994. Principles and Techniques of Practical Biochemistry (4th Edition) Cambridge University Press, Cambridge.
6. Bendre, A.M and Ashok Kumar. 2009. A text book of practical Botany. Vol. I & II. Rastogi Publication. Meerut. 9th Edition.
7. Manju Bala, SUNITa Gupta, Gupta, N.K. 2012. Practicals in Plant Physiology and Biochemistry. Scientific Publisher.

Web Resources

1. <https://www.amazon.in/Practical-Biotechnology-Plant-Tissue-Culture/dp/8121932009>
2. <https://www.elsevier.com/books/molecular-biology-techniques/carson/978-0-12-815774-9>
3. <https://www.amazon.in/Practical-Physiology-Biochemistry-SUNITa-Sangha/dp/9386102633>
4. <https://www.amazon.in/Practical-Biochemistry-Muriel-Wheldale-Onslow/dp/1107634318>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course	Hours	Credits						
VI	23UBO6CC15P	Plant Biotechnology and Molecular Biology & Plant Physiology and Plant Biochemistry – Practical	6	4						
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)				
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓	✓	✓	✓		✓	✓	✓		✓
CO2	✓	✓	✓		✓	✓	✓	✓	✓	✓
CO3	✓		✓	✓	✓	✓		✓		✓
CO4	✓	✓	✓		✓	✓	✓	✓	✓	
CO5	✓	✓	✓	✓		✓	✓	✓	✓	
Number of Matches(✓) = 40 Relationship: High										

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – VI

Course code: 23UBO6DE3

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE ELECTIVE COURSE: ETHNOBOTANY

Objectives:

1. To impart basic knowledge on ethnobotany and their therapeutic importance.
2. Proper documentation of indigenous knowledge about medicinal plants.
3. To create awareness about its role in cultural social and health of people.
4. To train people or students for utilization and conservation of medicinal plants.
5. To increase in manufacture of herbal drugs.

Course outcomes:

On completion of this course, the students will be able to:

- Understand the introduction, concept and scope of ethnobotany
- Apply techniques of conservation and propagation of medicinal plants.
- Setup process of harvesting, drying and storage of medicinal herbs
- Propose new strategies to enhance growth of medicinal herbs considering the practical issues pertinent to India
- Get knowledge on pharmacological importance of medicinal plants and its bioactive compounds

UNIT I:

Ethnobotany: Introduction, concept, scope and objectives. Ethnobotany as an interdisciplinary science. The relevance of ethnobotany in the present context. Major ethnic groups in Tamil Nadu. (Any five).

UNIT II:

Methodology of Ethnobotanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places. Plants used by the tribals: a) Food plants b) intoxicants and beverages c) Resins and oils and miscellaneous uses.

UNIT III:

Plants and Tribal medicine: Significance of the following plants in ethno botanical practices (along with their habitat and morphology) a) *Azadiractha indica* b) *Ocimum sanctum* c) *Vitex negundo*. d) *Gloriosa superba*. Role of ethnobotany in modern medicine with special example *Rauwolfia serpentina*, *Trichopus zeylanicus*.

UNIT IV:

Role of ethnic groups in conservation of plant genetic resources. Participatory forest management. Sharing of wealth concept with few examples from India.

UNIT V:

Ethnobotany as a source of drug. a) Reserpine b) Artemisin c) Gugulipid d) Cocaine e) Strychnine.

Text Books:

1. Amritpal Singh Saroya(2017). Ethnobotany . Indian Council of Agricultural Research
2. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.

Reference Books:**Ethnobotany**

1. S.K. Jain, Manual of Ethnobotany, Scientific Publishers, Jodhpur, 1995.
2. S.K. Jain (ed.) Glimpses of Indian. Ethnobotny, Oxford and I B H, New Delhi – 1981.
3. S.K. Jain (ed.) 1989. Methods and approaches in ethnobotany. Society of ethnobotanists, Lucknow, India.
4. S.K. Jain, 1990. Contributions of Indian ethnobotany. Scientific publishers, Jodhpur.
5. Cotton C.M. 1997. Ethnobotany – Principles and applications John Wiley and sons
6. Chichester Rajiv K. Sinha – Ethnobotany The Renaissance of Traditional Herbal Medicine – INA SHREE Publishers, Jaipur-1996
7. Faulks, P.J. 1958. An introduction to Ethnobotany, Moredale pub. Ltd. Lon

Web Resources:

1. <https://www.amazon.in/Textbook-Economic-Botany-Ethnobotany/dp/9386768933>
2. <https://guides.libraries.psu.edu/SK/BIOL424/textbooks>
3. <https://www.amazon.in/Text-Book-Ethnobotany-P-Sharma/dp/9381575207>
4. https://www.aavishkarpublishers.com/index.php?route=product/product&product_id=403
5. <https://www.ibpbooks.com/text-book-of-ethnobotany/p/4395>
6. <https://www.ibpbooks.com/text-book-of-ethnobotany/p/4396>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBO6DE3	Ethnobotany					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓		✓	✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓		✓		✓	✓	✓	
CO3	✓	✓	✓		✓	✓	✓	✓			
CO4	✓	✓	✓	✓		✓	✓	✓	✓		
CO5	✓	✓	✓		✓	✓	✓	✓		✓	
Number of Matches(✓) = 39 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson

SEMESTER – VI

Course code: 23UBO6DE4

Instruction: Hours: 6

Credit: 4

Exam Hours: 3

Internal Marks: 25

External Marks: 75

DISCIPLINE ELECTIVE COURSE: FORENSIC BOTANY

Objectives:

1. To provide basic knowledge about the application of Botany to Forensic investigations and legal disputes.
2. 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.
3. To learn classification of plants from forensic point of view.
4. To understand forensic importance of different parts of plants.
5. 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:

- Recognize morphological and anatomical features of plants, which could be useful for forensic investigations.
- Summarize the forensic importance of different parts of plants.
- Apply techniques for the collection and preserve of botanical evidences of crime.
- Analyze and decipher the significance of classic and DNA based forensic botany cases.
- Interpret and deduce new methods for the detection of plant poisons used in crime.

UNIT 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.

UNIT 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.

UNIT III

Various types of poisonous plants: *Abrus precatorius*, *Aconitum napellus*, *Anacardium occidentale*, *Argemone mexicana*, *Cannabis sativa*, *Claviceps purpuria*, *Croton tiglium*, *Atropa belladonna*, *Gloriosa superba*, *Jatropha curcas*, *Lathyrus sativus*, *Nerium indicum*, *Nicotiana*

tabacum, *Strychnos nux vomica*, *Thevetia nerifolia*. Types of plants yielding drugs of abuse – opium, cannabis, coca, tobacco, datura, *Psilocybin* mushrooms.

UNIT IV

Collection and preservation of botanical evidences: Botanical samples, outdoor crime scene consideration.

UNIT 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.

Text Books:

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:

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>

Relationship Matrix for COs, POs and PSOs

Semester	Code	Title of the Course					Hours	Credits			
VI	23UBO6DE4	Forensic Botany					6	4			
Course Outcomes (COs)	Programme Outcomes(POs)					Programme Specific Outcomes(PSOs)					
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	✓	✓		✓	✓	✓	✓	✓		✓	
CO2	✓	✓	✓	✓	✓	✓	✓	✓	✓		
CO3	✓	✓	✓	✓		✓	✓	✓		✓	
CO4	✓	✓	✓		✓	✓	✓	✓		✓	
CO5	✓	✓	✓		✓	✓	✓	✓	✓		
Number of Matches(✓) =41 Relationship: High											

Mapping	1-29%	30-59%	60-69%	70-89%	90-100%
Matches	1-14	15-29	30-34	35-44	45-50
Relationship	Very Poor	Poor	Moderate	High	Very High

HOD & Chairperson