THANTHAI HANS ROEVER COLLEGE

(AUTONOMOUS)

(Nationally Re-Accredited by NAAC with B^{++})

(Affiliated to Bharathidasan University, Tiruchirappalli)

B.Sc. BOTANY

Course Structure and Syllabus

(For the candidates admitted from the academic year 2025-2026 onwards)

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

By

DEPARTMENT OF BOTANY

THANTHAI HANS ROEVER COLLEGE (AUTONOMOUS)

ELAMBALUR, PERAMBALUR – 621 220, TAMILNNADU, INDIA.

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, theirinteractions 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 andtheir products and to promote entrepreneurship skill.
5. To enable the students to take up various qualifying examinations concerning Botanyand 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

Choice-Based Credit System – Learning Outcome-Based Curriculum Framework

(For the candidate admitted from the academic year 2025 -2026)

Sem	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
I	I	25UT1/H1/F1	Language	6	3	3	25	75	100
	II	25UE1	English-I	6	3	3	25	75	100
	III	25UBO1CC1	Plant Diversity – I (Algae, Fungi & Bryophytes)	5	5	3	25	75	100
		25UBO1CP1	Plant Diversity - I (Algae, Fungi & Bryophytes) Practical – I	4	4	3	40	60	100
		25UZO1AC1	Allied Zoology I	4	3	3	25	75	100
		25UZO2AP1	Allied Zoology – Practical I	**3**	--	--	--	--	--
	IV	25UBO1SE1	Value Education	2	2	3	25	75	100
			Value Added Course	--	2*	3	50	50	100*****
Total				**30**	**20**	**-**	**-**	**-**	**600**
II	I	25UT2/H2/F2	Language – II	6	3	3	25	75	100
	II	25UE2	English-II	6	3	3	25	75	100
	III	25UBO2CC2	Plant Diversity – II (Pteridophytes, Gymnosperm & Paleobotany)	5	5	3	25	75	100
		25UBO2CP2	Plant Diversity – II (Pteridophytes, Gymnosperm & Paleobotany) Practical – II	3	3	3	40	60	100
		25UCH2AC2	Allied Zoology II	4	3	3	25	75	100
		25UCH2AP1	Allied Zoology – Practical II	2	2	3	40	60	100
	IV	25UBO2SE2	Biofertilizer (NME-1)	2	2	3	25	75	100
		25UBO2SE3	Environmental Studies	2	2	3	25	75	100
		25UES	Value Added Course		2*	3	50	50	100*
Total				**30**	**23**	**-**	**-**	**-**	**800**
III	I	25UT3/H3/F3	Language	6	3	3	25	75	100
	II	25UE3	English-III	6	3	3	25	75	100
	III	25UBO3CC3	Anatomy and Embryology	4	4	3	25	75	100
		25UBO3CP3	Anatomy and Embryology – Practical	3	3	3	40	60	100
		25UCH3AC3	Chemistry-I	4	3	3	25	75	100
		25UCH3AP2	Chemistry –I Practical	**3**	--	--	--	--	--
	IV	25UBO3SE4	Herbal Cosmetics And Cosmeceuticals	2	2	3	25	75	100
		SE4	Workplace Ethics	2	2	3	25	75	100
			Value Added Course*	--	2*	3	50	50	100*****
				30	**20**	**-**	**-**	**-**	**700**

Sem	Part	Course Code	Title of the Course	Int. Hrs /Week	Credits	End Sem. Exam Hrs	Max. Marks		
							CIA	ESE	Total
IV	I	25UT4/H4/F4	Language	6	3	3	25	75	100
	II	25UE4	English-IV	6	3	3	25	75	100
	III	25UBO4CC4	Cell Biology, Genetics and Evolution	5	**4**	3	25	75	100
		25UBO4CP4	Cell Biology, Genetics and Evolution - Practical	3	**3**	3	40	60	100
		25UCH4AC4	Chemistry-II	4	3	3	25	75	100
		25UCH4AP2	Chemistry-II Practical	**3**	2	3	25	75	100
	IV	SE5(T&P)	Soft Skill Development	2	2	3	25	75	100
		25UHW	Health and Wealth	1	1	--	--	--	100
			Value Added Course*	--	2*	3	50	50	100*****
Total				**30**	**21**	**-**	**-**	**-**	**700**
V	III	25UBO5CC5	Plant Morphology, Taxonomy and Economic Botany	6	**5**	3	25	75	100
		25UBO5CC6	Microbiology & Plant Pathology	6	**5**	3	25	75	100
		25UBO5CC7	Plant Physiology and Biochemistry	5	**5**	3	25	75	100
		25UBO5CP5	Plant Morphology, Taxonomy, Microbiology, Plant Pathology,Plant Physiology and Biochemistry– Practical	3	**3**	3	40	60	100
		25UBO5DE12 25UBO5DE13	Agricultural Botany Aquatic Botany	4	4	3	25	75	100
		25UBO5DE21 25UBO5DE22	Plant Breeding and Horticulture Food Science and Technology	4	4	3	25	75	100
	IV	25USS	Soft Skills	2	2	3	25	75	100
			Summer Internship	--	2*	3	--	--	100
			Value Added Course*	--	2*	3	50	50	100*****
Total				**30**	**28**	**-**	**-**	**-**	**800**
VI	III	25UBO6CC8	Plant Biotechnology and Molecular Biology	5	**5**	3	25	75	100
		25UBO6CC9	Genetic Engineering And Nanotechnogy	5	**5**	3	25	75	100
		25UBO6CC10	Plant Ecology and Phytogeography	5	**5**	3	25	75	100
		25UBO6DE31 25UBO6DE32	Biodiversity and Its Conservation **Ethnobotany**	4	4	3	25	75	100
		25UBO6DE41 25UBO6DE42	Algal Cultivation Techniques for Entrepreneurship **Forestry & Wood Science**	4	4	3	25	75	100
		PW	Project Work	3	3	3	20	80	100
	IV	25UGS	Gender Studies	1	1	3	25	75	100
	V		Extension Activity	--	1	--	--	--	--
			Value Added Course*	--	2*	3	25	75	100*****
Total				**30**	**28**	**-**	**-**	**-**	**800**
Total				**180**	**140**				**4500**

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		EVS(1x2)	2
5		Value Education(1x2)	2
6		Extension Activity(1x1) Gender Studies	1 1
7		• Skill Enhancement (5x2=10) • Summer internship/ Industrial training (2x1=2 credits) • Foundation course • Professional Competency Skill	10 2 2 2
			140

Credit Distribution for UG BOTANY

LIST OF CORE COURSES OFFERED

Core Course I: Plant Diversity I – Algae, Fungi & Bryophytes
Core Course II: Plant Diversity I Algae, Fungi & Bryophytes - Practical-I
Core Course III: Plant Diversity II – Pterridophytes, Gymnosperm & Paleobotany
Core Course IV: Plant Diversity II - Pterridophytes, Gymnosperm & Paleobotany Practical II
Core Course V: - Anatomy and Embryology
Core Course VI: Anatomy and Embryology – Practical-III
Core Course VII: Cytology, Genetics and Evolution
Core Course VIII: Cytology, Genetics and Evolution – Practical-IV
Core Course IX: Plant Morphology, Taxonomy and Economic Botany
Core Course X: Microbiology and Plant Pathology
Core course XI : Plant Physiology and Biochemistry
Core course XII: Practical Core Course IX, X & CC XI
Core Course XIII: Plant Biotechnology and Molecular Biology
Core Course XIV: Genetic Engineering and Nanotechnology
Core Course XV: Plant Ecology and Phytogeography
Core Course XVI: Project with Viva-Voce - Group Project

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 Value Education
Skill Enhancement Course SEC-2 Biofertilizer
Skill Enhancement Course SEC-3: Environmental Studies
Skill Enhancement Course SEC -4: Herbal Cosmetics And Cosmeceuticals
Skill Enhancement Course SEC -5: Soft Skill Development
Skill Enhancement Course SEC -6: Soft Skills

LIST OF ELECTIVE COURSES OFFERED

Discipline Specific Elective- I: Aquatic Botany

Discipline Specific Elective II: Agriculture Botany

Discipline Specific Elective III: Plant Breeding and Horticulture

Discipline Specific Elective IV: Biodiversity and Its Conservation

Discipline Specific Elective IV: Ethnobotany

Discipline Specific Elective V: Algal Cultivation Techniques for Entrepreneurship

Discipline Specific Elective VI: Food Science & Technology

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 Value Added Courses

COURSE CODE	COURSE TITLE
23UVABO1	Medicinal Plants and Herbal Drug Preparation
23UVABO2	Environmental Impact Assessment (EIA) and Biodiversity Conservation
23UVABO3	Eco-cosmeceuticals: Plants in Natural Skincare and Beauty Products
23UVABO4	Botany Behind Ayurveda and Siddha Medicine
23UVABO5	
23UVABO6	

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 Questionsfor 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

Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/ VE / VAC	Category			Exam.	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
I	25UBO1CC1	5	CORE-I PLANT DIVERSITY (Algae, Fungi and Bryophytes)					3 Hrs.	25	75	100

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To understand the general characteristics, classification, and structural diversity of algae and bryophytes.
2. To study the cell structure of prokaryotic (Cyanophycean) and eukaryotic (Chlorophycean) algal cells.
3. To explore thallus organization, reproductive methods, and life cycle patterns in algae and bryophytes.
4. To examine the morphology, occurrence, and reproduction of selected representative genera from algae and bryophytes.
5. To appreciate the ecological and economic importance of algae (e.g., Spirulina, *Azolla*-BGA) and bryophytes in sustainable practices

Course Outcomes:

CO1: Explain the general characteristics, classification, and structural features of major algal and bryophyte groups.

CO2: Differentiate between prokaryotic and eukaryotic algal cell structures with reference to Cyanophyceae and Chlorophyceae.

CO3: Describe various thallus organizations, reproductive strategies, and life cycle types in algae and bryophytes.

CO4: Analyze the morphological features and reproductive methods of representative genera such as *Oscillatoria*, *Oedogonium*, *Marchantia*, and *Funaria*.

CO5: Evaluate the ecological roles and economic applications of algae and bryophytes, particularly in biofertilizer production and environmental sustainability

Unit-I	**Algae**	00 Hrs.

General characters of algae - Classification of algae (Fritsch 1945) – Distribution, structure, reproduction and life cycle of the following: Cyanophyceae (*Nostoc*), Chlorophyceae (*Oedogonium*, *Chara*) and Phaeophyceae (*Sargassum*), Bacillariophyceae (*Pinnularia*), Rhodophyceae (*Polysiphonia*) and Economic importance of algae.

Unit-II	**Fungi**	00 Hrs.

General characters of Fungi - Mode of nutrition - Classification of Fungi (Alexopoulos, 1972) - Structure, reproduction and life cycle of Zygomycetes- *Mucor*, Ascomycetes – *Penicillium*, Yeasts and Economic Importance of Fungi.

Unit-III	**Lichens**	00 Hrs.

Structure, reproduction and life cycle of Basidiomycetes - *Puccinia*. Lichens: Occurrence, Types, Morphology, structure, Reproduction and Economic importance

Unit-IV	**Bacteria**	00 Hrs.

Bacteria: General characteristics-and cell structure- Nutritional types of bacteria (based on carbon nitrogen and energy sources)-Reproduction: vegetative – asexual- sterilization techniques- Economic importance.

Unit-V	**Bryophytes**	00 Hrs.

General characters and classification of Bryophytes (Reimers 1954), Distribution, structure, development and reproduction of *Riccia, Anthoceros* and *Polytrichum*

Text Book(s):

1. Pandey, B.P. (2022). *College Botany, Volume I* (22nd ed.). New Delhi: S. Chand and Company.
2. Pandey, B.P. (2021). *A Textbook of Botany: A Simplified Course*. New Delhi: S. Chand and Company.
3. Sharma, O.P. (2017). *Textbook of Algae* (2nd rev. ed.). New Delhi: McGraw Hill Education
4. Vashishta, P.C., Sinha, A.K. & Kumar, A. (2022). *Botany for Degree Students: Algae, Fungi, Bryophyta, Pteridophyta*. New Delhi: S. Chand and Company
5. Rastogi, V.B. (2023). *Fundamentals of Botany*. New Delhi: MedTech Publishers

Reference Book(s):

1. Vashishta, P.C., Sinha, A.K. & Kumar, A. (2022). *Botany for Degree Students: Bryophyta* (Revised edition). New Delhi: S. Chand and Company.
2. Kumar, H.D. & Singh, H.N. (2020). *Cryptogams: Algae, Bryophyta and Pteridophyta* (3rd ed.). New Delhi: CBS Publishers & Distributors.
3. Pandey, S.N., Trivedi, P.S. & Chauhan, A. (2019). *A Textbook of Botany: Volume II – Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany*. Meerut: Vikas Publishing House.
4. Sharma, O.P. (2021). *Plant Diversity – Volume 1: Cryptogams (Algae, Fungi, Bryophytes, Pteridophytes)*. New Delhi: Tata McGraw-Hill Education
5. Srivastava, N. (2020). *Bryophytes and Pteridophytes: Morphology, Anatomy, Reproduction, and Classification*. New Delhi: Dominant Publishers.

Web Resources:

1. https://ncert.nic.in/
2. https://www1.biologie.uni-hamburg.de/b-online/e00/contents.htm
3. https://www.khanacademy.org/science/biology

4. http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx
5. http://www.efloras.org/

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)	ProgrammeOutcomes(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

Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/ VE / VAC	Category			Exam.	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.	Exam	CIA	ESE	Total.
I	**25UBO1CP1**	4	**Core-I: Plant Diversity I (Algae, Fungi and Bryophytes) - Practical-I**					**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. 1. To study the morphology, structure, and reproductive features of selected genera of algae (*Oscillatoria, Oedogonium, Caulerpa, Cyclotella, Sargassum,* and *Gracilaria*).
2. 2. To observe the anatomical and reproductive characteristics of representative bryophytes such as *Marchantia, Anthoceros,* and *Funaria* through preserved specimens and slides.
3. 3. To identify and describe the life cycles and structural diversity of important fungi including *Plasmodiophora, Albugo, Peziza, Puccinia,* and *Cercospora*.
4. 4. To explore natural freshwater and marine habitats through field visits and identify commonly occurring algal flora in situ.
5. To understand the industrial applications of algae by visiting nearby industries involved in algal mass culture, biofertilizer production, or biotechnology applications

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

1. CO1: Identify and describe the morphological and reproductive features of key algal genera such as *Oscillatoria, Oedogonium, Caulerpa, Cyclotella, Sargassum,* and *Gracilaria*.
2. CO2: Examine the structure and reproduction of representative bryophytes (*Marchantia, Anthoceros,* and *Funaria*) through laboratory and slide preparation techniques.
3. CO3: Analyze and differentiate the life cycles and structural features of common fungi including *Plasmodiophora, Albugo, Peziza, Puccinia,* and *Cercospora*.
4. CO4: Demonstrate the ability to conduct fieldwork by documenting algal diversity from freshwater and marine ecosystems during field visits.
5. CO5: Assess the industrial and biotechnological relevance of algae through observation and reporting from industrial field visits.

1. I. Algae

1. **Microscopic and Morphological Observation**

1. *Nostoc* (Cyanophyceae): Heterocysts, mucilage
2. *Oedogonium* and *Chara* (Chlorophyceae): Vegetative structures, reproductive organs.

3. *Sargassum* (Phaeophyceae): Conceptacles, air bladders, holdfasts.

Observation and slide study

1. *Polysiphonia* (Rhodophyceae): Tetrasporangia, trichoblasts, cystocarps.
2. Diatoms (*Pinnularia*, *Cyclotella*): Frustule symmetry and silica patterns.

Demonstration of economic importance of algae

Samples/products: Agar, alginates, spirulina, chlorella, biofertilizers.

2. **Microscopic study of fungi**

1. *Mucor*: Sporangium, sporangiophores, zygospores.
2. *Penicillium*: Conidiophores and conidia.
3. *Yeasts* (*Saccharomyces*): Budding in wet mount.

Observation of rust fungi:

Puccinia on infected leaves (uredospores, teliospores, basidia using prepared slides).

Study of lichens

1. Identification of crustose, foliose, fruticose forms.
2. Slide/section showing algal and fungal layers.
3. Discussion on ecological and economic significance.

Bacteria

1. Tools and equipments used in microbiology: Spirit lamp- Inoculation loop- Hotair oven- Autoclave- Pressure cooker- Laminar air flow chamber- Incubator.
2. Types of Bacteria from temporary/permanent slides/photographs; EM bacterium- Binary Fission- Conjugation- Structure of root nodule.

Microscopic and dissection studies of bryophytes:

1. *Riccia*, *Anthoceros*, and *Polytrichum*: Gametophyte and sporophyte structures.
2. Reproductive organs: Antheridia, archegonia, capsules.

Spotters and identification:

Recognition of microscopic structures, reproductive stages, and economic products from algae, fungi, lichens, and bryophytes.

- Field visit to study fresh water/marine water algal habitats.*
- Visit to nearby industry actively engaged in algal technology.*

Text Book(s):

1. Sharma, O.P. (2021). *Plant Diversity – Volume 1: Cryptogams (Algae, Fungi, Bryophytes, Pteridophytes)*. New Delhi: McGraw Hill Education

2. Vashishta, B.R., Sinha, A.K. & Kumar, A. (2022). *Botany for Degree Students – Algae, Bryophyta, and Mycology*. New Delhi: S. Chand Publishing

3. Pandey, B.P. (2022). *College Botany Volume I* (22nd ed.). New Delhi: S. Chand & Company

4. Rastogi, V.B. (2023). *Fundamentals of Botany*. New Delhi: MedTech Publishers.

5. Dubey, H.C. (2020). *A Textbook of Fungi, Bacteria and Viruses* (Revised ed.). New Delhi: S. Chand Publishing

Reference Book(s):

1. Kumar, H.D. & Singh, H.N. (2020). *Cryptogams: Algae, Bryophyta and Pteridophyta* (3rd ed.). New Delhi: CBS Publishers & Distributors

2. Alexopoulos, C.J., Mims, C.W. & Blackwell, M. (2020 Reprint). *Introductory Mycology* (4th ed.). New Delhi: Wiley India.

3. Raven, P.H., Evert, R.F. & Eichhorn, S.E. (2021). *Biology of Plants* (8th ed.). New York: W.H. Freeman and Company

4. Sharma, O.P. (2015). *Textbook of Thallophytes (Algae, Fungi, Lichens and Plant Pathology)*. New Delhi: McGraw Hill Education

5. Sundara Rajan, S. (2019). *Bryophytes and Pteridophytes: Structure, Classification and Reproduction*. Chennai: Himalaya Publishing House

Web Resources:

1. https://www1.biologie.uni-hamburg.de/b-online/e00/contents.htm
2. https://ncert.nic.in
3. https://www.khanacademy.org/science/biology
4. http://www.missouribotanicalgarden.org/plantfinder/plantfindersearch.aspx

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)	ProgrammeOutcomes(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

Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/ VE / VAC	Category			Exam	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.		CIA	ESE	Total.
II	**23UBO2CC2**	5	**CORE-III PLANT DIVERSITY II (Pteridophytes, Gymnosperms and Paleobotany)**					**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To understand the general characteristics and classification of Pteridophytes and Gymnosperms, including major taxonomic systems (Reimer, 1954; Sporne, 1965).
2. To study the morphological, anatomical, and reproductive features of representative genera of Pteridophytes (*Lycopodium, Selaginella, Equisetum, Adiantum,* and *Marsilea*) and Gymnosperms (*Cycas, Pinus,* and *Gnetum*).
3. To explore evolutionary concepts such as telome theory, stelar evolution, homospory, heterospory, and the origin of the seed habit.
4. To examine the origin, features, and classification of extinct and extant gymnosperm groups such as Pteridospermales, Bennettitales, and Coniferales and assess their economic significance
5. To gain insight into the fundamentals of paleobotany, including fossil types, the Indian fossil record (e.g., Rajmahal flora), geological time scale, and the contributions of Birbal Sahni to Indian paleobotany

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

1. CO1: Explain the general characteristics and classification of Pteridophytes and Gymnosperms using standard systems (Reimer, 1954; Sporne, 1965).
2. CO2: Describe the morphology, anatomy, and reproductive structures of key genera such as *Lycopodium, Selaginella, Equisetum, Adiantum, Marsilea, Cycas, Pinus,* and *Gnetum*.
3. CO3: Interpret key evolutionary concepts including telome theory, stelar evolution, homospory, heterospory, and seed habit in vascular cryptogams and gymnosperms.

CO4: Classify and distinguish major fossil and living gymnosperm groups such as Pteridospermales, Bennettitales, Coniferales, and Gnetales, and explain their ecological and economic relevance

CO5: Demonstrate an understanding of paleobotanical principles, fossil types, geological time scale, and the contributions of Indian paleobotanists, especially Birbal Sahni

Unit-I	**Pteridophytes**	00 Hrs.

General characteristics, Distribution, Classification (Reimer's System, 1954). Telome Theory, Stellar Evaluation. homospory, heterospory, seed habit and economic importance

Unit-II		00 Hrs.

Detailed study of morphology, anatomy and reproduction of *Lycopodium, Selaginella, Equisetum, Adiantum* and *Marsilea*.

Unit-III	**Gymnosperms**	00 Hrs.
General characteristics, distribution and classification (Sporne, 1965). Salient features of Cycadales, Coniferales and Gnetales. Economic importance.		
Unit-IV		00 Hrs.
Detailed study of morphology, anatomy, reproduction of the following genera: Cycas, Pinus and Gnetum.		
Unit-V	**Paleobotany**	00 Hrs.
Fossils, types (compression, impression, petrifaction, coal balls). Indian fossil flora – Rajmahal hill flora. Contribution of Birbal Sahni to Indian Paleobotany. Geological time scale. Morphology, anatomy and reproduction in Rhynia, Lepidodendron, Calamites and Williamsonia.		

Text Book(s):

1. Vashishta, B.R., Sinha, A.K. & Kumar, A**.** (2022). *Botany for Degree Students: Pteridophyta, Gymnosperms and Paleobotany*. New Delhi: S. Chand Publishing
2. Sharma, O.P. **(**2021). *Plant Diversity – Volume 2: Pteridophytes, Gymnosperms and Paleobotany*. New Delhi: McGraw Hill Education
3. Pandey, B.P**.** (2020). *College Botany Volume II* (Latest Edition). New Delhi: S. Chand & Company
4. Rashid, A. (2023 Reprint). *An Introduction to Pteridophyta & Gymnosperms*. New Delhi: Vikas Publishing House
5. Raven, P.H., Evert, R.F. & Eichhorn, S.E**.** (2021). *Biology of Plants* (8th ed.). New York: W.H. Freeman and Company

Reference Book(s):

1. Beck, C.B**.** (2022). *An Introduction to Plant Structure and Development: Plant Anatomy for the Twenty-First Century* (3rd ed.). Cambridge University Press
2. Taylor, T.N., Taylor, E.L., & Krings, M. (2020). *Paleobotany: The Biology and Evolution of Fossil Plants* (2nd ed.). Academic Press
3. Stewart, W.N. & Rothwell, G.W**.** (2021 Reprint). *Paleobotany and the Evolution of Plants* (2nd ed.). Cambridge University Press.
4. Sporne, K.R. (2022 Reprint). *The Morphology of Pteridophytes*. New Delhi: B.I. Publications.
5. Bhatnagar, S.P. & Moitra, A. (2020). *Gymnosperms* (Revised Edition). New Delhi: New Age International Publishers

Web Resources:

6. https://www1.biologie.uni-hamburg.de/b-online/e00/contents.htm
7. https://efloraofindia.com/
8. https://epathshala.nic.in/
9. https://ucmp.berkeley.edu/
10. https://www.fossilmuseum.net/

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)	ProgrammeOutcomes(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

Sem.	Course Code	Credits	Title of the Course	CC / AC/ DE / SE / GS / EVS/ VE / VAC	Category			Exam.	Max. Marks		
					Theo. Hrs.	Tutorial Hrs.	Lab. Hrs.	Exam	CIA	ESE	Total.
II	**23UBO2CP2**	3	CORE-IV PLANT DIVERSITY- II (Pteridophytes, Gymnosperm Andpaleobotany) - Practical-Ii					**3 Hrs.**	**25**	**75**	**100**

Pre-Requisite:

Course Objectives: The purpose of learning this course is:

1. To examine and identify vegetative and reproductive structures of selected Pteridophytes through slide preparation
2. To study the morphology and reproductive anatomy of Gymnosperms using preserved and fresh specimens
3. To observe and interpret the structure and significance of selected fossil plant genera using slides or models
4. To document ecological adaptations of living Pteridophytes and Gymnosperms through field observation in natural habitats
5. To understand fossilization processes and study fossil plant diversity through a visit to a paleobotanical institution

Course Outcomes:

CO1: Identify and describe vegetative and reproductive structures of selected Pteridophytes through microscopic slide analysis

CO2: Examine the morphology, anatomy, and reproductive parts of Gymnosperms using fresh or preserved specimens

CO3: Analyze the structure and significance of selected fossil plant genera using permanent slides or models

CO4: Observe and interpret ecological adaptations of Pteridophytes and Gymnosperms through botanical field visits

CO5: Understand fossilization processes and recognize key fossil plant types by visiting paleobotanical institutions or museums

1. A. Pteridophytes

Morphological and Anatomical Observation:

1. *Lycopodium*: Stem and strobilus
2. *Selaginella*: Ligule, rhizophore, strobilus (megaspores & microspores)
3. *Equisetum*: Internode anatomy, strobilus
4. *Adiantum*: Leaflet, sori types
5. *Marsilea*: Leaflet, sporocarp section

Slide preparation / Permanent slide observation

1. V.S. of stem and reproductive parts of above genera
2. Identification of sporangia types, vascular tissues

Demonstration

1. Homospory vs. Heterospory (using *Selaginella*)
2. Diagrammatic representation of Telome Theory and Stelar evolution

2. B. Gymnosperms

Morphology and Anatomy

1. *Cycas*: Coralloid roots, leaflet (rachis), male cone, ovule
2. *Pinus*: Needle, male/female cones, winged seeds
3. *Gnetum*: Leaf anatomy, reproductive structures

Permanent slide study / Dissection:

4. T.S. of leaflet, cone axis, ovule and seeds of *Cycas, Pinus, Gnetum*
5. Identification of vascular tissues and reproductive parts

Comparison Table:

6. Gnetales vs. Angiosperms (highlighting affinities)

3. C. Paleobotany

Fossil types identification

1. Compression, impression, petrifaction, coal balls (photographs/models)

Fossil plant studies:

2. *Rhynia, Lepidodendron, Calamites, Williamsonia*:
3. Morphological features (via charts/models)
4. Fossil records and reconstructions

5. **Charts/Models/Specimens**:

1. Geological Time Scale

Text Book(s):

1. **Vashishta, B.R., Sinha, A.K. & Kumar, A.** (2022). *Botany for Degree Students: Pteridophyta, Gymnosperms and Paleobotany*. S. Chand Publishing, New Delhi
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4. **Sporne, K.R.** (2022 Reprint). *The Morphology of Pteridophytes*. B.I. Publications Pvt. Ltd., New Delhi
5. **Bierhorst, D.W.** (2021 Reprint). *Morphology of Vascular Plants*. Dover Publications.

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1. https://ucmp.berkeley.edu/
2. https://www1.biologie.uni-hamburg.de/b-online/e00/contents.htm
3. https://efloraofindia.com/
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CO2		✔	✔	✔	✔	✔	✔	✔	✔	✔
CO3	✔		✔			✔				
CO4	✔	✔	✔	✔	✔	✔		✔	✔	✔
CO5	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
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