KANNUR UNIVERSITY
കണ്ണൂർ സർവകലാശാല
Re-accredited by NAAC with 'B++' Grade

KANNUR UNIVERSITYFYUGP SYLLABUS

B.Sc. PLANT SCIENCE

Effective from 2024 admissions

2024

CONTENTS

Foreword

The Four-Year Undergraduate Programme (FYUGP) in BSc Plant Science is undergoing rigorous transformations to better align with the evolving needs of students, industries, and society at large. Recognizing education as a cornerstone of progress, it's imperative that the curriculum reflects contemporary demands. This necessitates frequent and strategic updates to keep pace with societal and economic shifts.

In the current era, it is paramount that higher education equips students with robust, practical skills that are directly applicable to their chosen fields. Despite a surge in college enrollment, doubts persist regarding the adequacy of educational preparation for the workforce, particularly in terms of the competencies sought by employers.

As globalization intensifies and the world accelerates, educational institutions must adapt,instilling in students not only technical expertise but also critical thinking, communication prowess, and adaptability. These competencies are essential for thriving in the 21st century.

Moreover, there is an escalating expectation for colleges and universities to champion social responsibility and contribute to sustainable development through innovation. The government of Kerala is taking decisive actions to enhance higher education by establishing commissions to recommend comprehensive policy reforms, regulatory updates, and evaluation system overhauls.

Integral to these initiatives is the restructuring of the undergraduate curriculum, including the FYUGP in BSc Plant Science. This restructuring aims to forge a knowledge-driven society capable of spearheading sustainable development. These changes are designed to ensure that higher education remains relevant, effective, and advantageous for both students and society as a whole.

Chairperson, Board of Studies in UG Botany

Dr. K.P. Prasanth,

Associate Professor, Department of

Botany,Sree Narayana College, Kannur

Preamble

Welcome to the Four-Year Undergraduate Programme (FYUGP) in BSc Plant Science at Kannur University. This curriculum has been meticulously engineered to impart a profound understanding of plant science, arming students with the critical skills necessary to excel in today's demanding and ever-changing environment.

Plant science, the rigorous study of plants, is a field of immense and multifaceted significance, intersecting essential domains such as agriculture, medicine, ecology, and conservation. With the relentless pace of scientific and technological advancements, plant science continually evolves, offering both unprecedented opportunities and formidable challenges. Recent breakthroughs in genome editing, sustainable agriculture, and plant-microbe interactions are revolutionizing our understanding and capabilities in plant science.

Our syllabus is designed to merge deep theoretical knowledge with practical application, providing a robust education that readies students for both advanced academic research and professional careers. Through an intensive mix of classroom lectures, laboratory experiments, fieldwork, and research projects, students will delve into the intricate realms of plant biology.

At Kannur University, we are unwavering in our commitment to fostering an intellectually stimulating environment that promotes curiosity, critical thinking, and a fervor for discovery. We champion active participation, independent thought, and collaborative learning, ensuring our graduates emerge as confident and competent leaders ready to make significant contributions to society.

This syllabus embodies our relentless pursuit of academic excellence, innovation, and continuous improvement. We are dedicated to cultivating a profound appreciation for the natural world and instilling a deep sense of environmental stewardship in our students. Our goal is to shape future leaders who can tackle the pressing challenges facing our planet.

We extend our best wishes to all students embarking on this rigorous educational journey, confident that their time studying plant science at Kannur University will be enriching, rewarding, and transformative.

Academic Competency

In the dynamic field of BSc Plant Science at Kannur University, our graduate attributes bridge academic learning with practical botanical expertise. These attributes encompass a wide range of essential skills and qualities that students develop throughout their studies, ensuring they are well-prepared for real-world applications. Key attributes include critical thinking, enabling students to analyze and evaluate information effectively; problem-solving, fostering creative and practical solutions to botanical challenges; and professionalism, maintaining high standards in work and conduct. Leadership skills guide and inspire others, while teamwork emphasizes the importance of collaboration. Clear and effective communication is crucial for sharing ideas, and a deep understanding of botanical principles underpins all scientific endeavors. Kannur University is dedicated to nurturing these attributes in BSc Plant Science students, seamlessly integrating them into the curriculum. This commitment ensures that graduates are not only knowledgeable in plant science but also resilient, compassionate, and socially conscious leaders ready to excel in their careers and make meaningful contributions to society.

KANNUR UNIVERSITY VISION AND MISSION STATEMENTS

Vision

To establish a teaching, residential and affiliating University and to provide equitable and just access to quality higher education involving the generation, dissemination and a critical application of knowledge with special focus on the development of higher education in Kasargode and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission

➢ To produce and disseminate new knowledge and to find novel avenues forapplication of such knowledge.

➢ To adopt critical pedagogic practices which uphold scientific temper, theuncompromised spirit of enquiry and the right to dissent.

➢ To uphold democratic, multicultural, secular, environmental and gender sensitivevalues as the foundational principles of higher education and to cater to the modernnotions of equity, social justice and merit in all educational endeavors.

➢ To affiliate colleges and other institutions of higher learning and to monitor academic, ethical, administrative and infrastructural standards in such institutions.

➢ To build stronger community networks based on the values and principles of higher education and to ensure the region's intellectual integration with nationalvision and international standards.

➢ To associate with the local self-governing bodies and other statutory as well asnon-governmental organizations for continuing education and also for building public awareness on important social, cultural and other policy issues.

FYUGP BSc BOTANY AD HOC COMMITTE

1. Prof. S Sudheesh Dean, Faculty of Science, Kannur University

2. Dr. Harikrishnan E, (**Convener**) Assistant Professor of Botany Payyanur College, Edat 3.

Falilullahim Aslam K V., Assistant Professor, Department of Botany, Government Brennen College, Thalassery

4. Muhammed Haneef K A, Assistant Professor, Department of Botany. GovernmentBrennen College, Thalassery

5. Suvarnika V., Assistant Professor, Department of Botany, Government Brennen College, Thalassery

6. Dr. Biju P., Associate Professor, Department of Botany. Government College Kasaragod

7. Dr Josekutty EJ, Associate Professor, Department of Botany, Government College, Kasaragod

8. Dr Tomson Mani, Assistant Professor, Department of Botany, Government Brennen College, Thalassery

9. Dr. P.S Prakash, Associate Professor, Department of Botany. Government Brennen College,Thalassery

10. Dr. Gayatri. R. Nambiar, Asst. Professor, Dept. of Botany, Sir Syed Collage, Taliparamba

11. Dr Prajith PK, Assistant Professor, Department of Botany Nehru Arts and Science College Kanhangad

12. Dr. P Aparna, Assistant Professor, Department of Botany, Sree Narayana College Kannur

13. Sruthi C.C, Assistant Professor of Plant Science PRNSS College, Mattannur

14. Resmi P Thomas, Assistant Professor, Department of Botany Nirmalagiri College, Kuthuparamba

15. Dr. Ratheesh Narayanan M.K., Assistant Professor, Department of Botany, Payyanur College,Edat

16. Dr.Tajo Abraham, Assistant Professor, Department of Botany, Sir Syed College, Taliparamba

BOARD OF STUDIES IN UG BOTANY

Chairperson

Dr. K.P. Prasanth, Associate Professor, Department of Botany, Sree Narayana College, Kannur

Members

1. Mr. Falilullahim Aslam K V, Assistant Professor, Department of Botany, Government Brennen College, Thalassery
2. Mr.Muhammed Haneef K.A, Assistant Professor, Department of Botany, GovernmentBrennen College, Thalassery,
3. Ms.Suvarnika V, Assistant Professor, Department of Botany, Government Brennen College, Thalassery
4. Ms. Deepa A V, Assistant Professor, Department of Botany, Government Brennen College, Thalassery
5. Dr. Biju P, Associate Professor, Department of Botany, Government College, Kasaragod
6. Dr. R.D. Anpin Raja, Assistant Professor, Department of Botany, Nirmalagiri College, Kuthuparamba
7. Dr. Jeeshna MV, Assistant Professor, Department of Botany, Sree Narayana College, Kannur
8. Dr. Prajith PK, Assistant Professor, Department of Botany, NAS College, Kanhangad
9. Dr. Abdussalam A.K. Assistant Professor, Department of Botany, Sir Syed College, Taliparamba
10. Dr C. Pramod, Assistant Professor, Department of Botany, University of Calicut (Chairperson, PG Board)

PROGRAMME OUTCOMES

PO 1. CRITICAL THINKING

1. Evaluate information objectively to form well-founded judgments.

2. Draw logical conclusions from data, identifying essential details and discarding irrelevant ones for effective problem-solving or decision-making.

3. Detect logical inconsistencies in others' arguments.

4. Analyze data, facts, observable events, and research findings to generate relevant andvalid conclusions specific to the field.

PO 2. COMPLEX PROBLEM SOLVING

1. Tackle various challenges in both known and new environments, applying knowledgeto practical situations.

2. Analyze problems, develop and implement solutions, and assess their effectiveness.

3. Evaluate the impact of solutions on people and the

environment.

PO 3. CREATIVITY

1. Develop innovative content, theories, and methodologies.

2. Use diverse approaches to connect different concepts or events.

3. Provide new insights or improve existing ideas and solutions.

4. Generate, refine, and express new ideas with practical value or inherent

significance.

PO 4. COMMUNICATION SKILLS

1. Clearly and effectively communicate ideas or emotions.

2. Use language precisely to convey messages.

3. Engage and captivate the audience skillfully.

4. Listen attentively, understand, and show empathy towards speakers.

5. Express opinions and thoughts with confidence and assertiveness.

PO 5. LEADERSHIP QUALITIES

1. Lead diverse teams effectively and respectfully.

2. Build team unity toward common goals.

3. Motivate and mentor individuals to achieve collective solutions.

4. Offer support and motivation during tough times, promoting resilience and bravery.

PO 6. MASTERING THE ART OF SKILL ACQUISITION

1. Acquire new knowledge and skills, like mastering the ability to learn continuously, through self-directed learning.

2. Independently find and access appropriate resources essential for ongoing learningpursuits.

3. Cultivate organizational skills and time management strategies to set personal goalsand deadlines.

4. Cultivate a positive outlook to welcome lifelong learning.

PO 7. EMERGING TECHNOLOGICAL ABILITIES

1. Apply Information and Communication Technology in diverse learning and professional settings, accessing, evaluating, and utilizing various relevant information sources.

2. Utilize appropriate software for data analysis purposes.

3. Understand the risks associated with the digital world and take precautions to ensure security.

4. Uphold constitutional, humanistic, ethical, and moral principles in life, embracing universal values such as truth, integrity, peace, compassion, nonviolence, scientific reasoning, and citizenship responsibilities.

5. Formulate a position or argument on an ethical issue by considering multiple perspectives.

6. Identify ethical dilemmas in professional contexts, adhering to ethical standards by

avoiding unethical practices like data fabrication, falsification, plagiarism, and respecting intellectual property rights.

7. Employ impartial, objective, and truthful approaches in all professional endeavors.

PROGRAMME SPECIFIC OUTCOMES

Upon completing the program, graduates will discover a multitude of opportunities, armed with the expertise to excel in their selected field.

PSO 1

The curriculum provides students with a thorough grasp of plant diversity, encompassing topics such as structure, genetics, reproduction, ecology, and economic importance across diverse plant categories. (Programme Outcome Numbers1,6)

PSO 2

Students acquire a broad understanding of plant diversity, exploring the complexities of structure, function, reproduction, and life cycles within specific plant groups, igniting a profound curiosity to delve deeper into the world of plants. (Programme Outcome Numbers 1,2)

PSO 3

In the field of Plant Science, students delve into fundamental principles of Morphology, Taxonomy, Anatomy, Ecology, Physiology, Genetics, and Molecular Biology, while also exploring advanced subjects such as Plant Biotechnology, Molecular Plant Pathogen interactions, and Developmental Botany. (Programme Outcome Numbers 2,6)

PSO 4

Students encounter a wide array of professional pathways, ranging from Landscaping, Gardening, and Floriculture to Organic farming, Herbal technology, Mushroom cultivation, Ecotourism, and Forensic Botany, empowering them to emerge as future entrepreneurs in the field of Plant Science. (Programme Outcome Numbers 3,6,7)

PSO 5

Students develop proficiency in employing diverse analytical techniques and tools for both fundamental and practical research in plant biology, while also addressing intellectual and ethical aspects inherent in biological discoveries. (Programme Outcome Numbers 6,7)

PSO 6

Students acknowledge the essential role of the plant kingdom in human survival and cultivate skills for documenting, conserving, and sustainably managing plant resources in the face of climate change challenges. (Programme Outcome Numbers 6,7,8)

PSO 7

Involvement in project work and research activities encourages students to utilize interdisciplinary concepts, nurturing critical thinking, problem-solving skills, and creativity to innovate and generate new knowledge. (Programme Outcome Numbers 3,6,7)

PSO 8

Practical training across different fields nurtures hands-on skills, mastery in equipment operation, laboratory techniques, and the collection, analysis, and interpretation of biological data. (Programme Outcome Numbers 4,5,6)

PSO 9

Participating in laboratory work and field studies nurtures teamwork and leadership skills among students. Additionally, hands-on field experience provides a practical opportunity for mastering new skills. (Programme Outcome Numbers 5,6,7)

PSO 10

Completing assignments and presentations improves students' communication and ICT skills. Furthermore, coursework in Biostatistics and Bioinformatics offers hands-on experience with software and tools relevant to these areas of biology. (Programme Outcome Number 7)

PSO 11

The flexible curriculum enables instructors to incorporate inquiry-based learning activities, prompting students to inquire, investigate, and draw conclusions independently. This method fosters curiosity, encourages self-directed learning, and enhances understanding of scientific principles. Additionally, teacher-led debates and discussions on controversial scientific topics equip students with argumentation skills, enabling them to support claims with evidence and consider various viewpoints. (Programme Outcome Numbers 5,6,8)

PSO 12

Inspire a lifelong love for learning and professional growth by motivating students to stay abreast of developments in the field of botany, engage in continuing education initiatives, and pursue further studies or certifications when necessary. (Programme Outcome Numbers 4,5,7)

PROGRAMME PATHWAYS WITH PLANT SCIENCE

Sl No	Name of the Pathway	Minimum Requirements
1.	BSc Degree with Single Major in Plant Science	For the THREE YEAR PROGRAMME A minimum of 68 credits from 17 courses and out of these 10 courses above should be above level 300. 2 credits of internship in Plant Science and 24 credits from any 6 disciplines other than the major discipline. For the FOUR YEAR PROGRAMME students should earn a further 32 credits in Plant Science from advance level courses and project and an additional 12 credits from any discipline.
2.	BSc. Degree Major in Plant Science with Minor	A minimum of 24 credits in the minor discipline by the end of Third year and 32 credits by the end of Fourth year in any discipline along with major in Plant Science
3.	BSc Degree Major in Plant Science with Multiple Disciplines	Along with the criteria 4 major discipline in Plant Science, 68 credits from 17 courses along with 12 credits from 3 courses belonging to a maximum of two other disciplines with a total of 24 credits. In the Fourth-year students need to earn an additional 12 credits from any 3 disciplines with a total of 36 credits.
4.	BSc Degree with Plant Science and any other discipline as Major	There is a minimum requirement of 50 percentage credits in Plant Science and a minimum 40 percentage credits from any other disciplines. Students should earn a minimum of 68 credits in Plant Science and 53 credits from another discipline. The double major pathway is not extended to the Fourth year. In the fourth year the required credits from Plant Science or any other major discipline.
5	BSc Degree Major in Plant Science with Vocational Minor	68 credits from 17 courses in Plant Science and in the fourth year they should earn 32 credits in Vocational Minor discipline to get a UG Honours degree with a Vocational Minor
6.	Multidisciplinary UG Programme	The overall fraction of credits should be 70 percentage in the major and minor disciplines. A minimum of 94 credits is required for the Third year programme and a minimum of 124 credits including the project for the Four Year Programme
7.	Inter disciplinary UG Programme	For a Third Year Programme 94 credits from the constituent discipline and for a Four Year Programme124 credits including Project are required.

CONSOLIDATED LIST OF COURSES AND CREDITS REQUIRED FOR BSc BOTANY AND PLANT SCIENCE

Sl. No.	Course Category	3 year UG		4 Year UG	
		Minimum no. of Courses required	Minimum No. of Credits required	Minimum no. of Courses required	Minimum No. of Credits required
1	Major	17	68	22	88
2	Minor (for those with minor pathway)	6	24	8	32
3	MDC	3	9	3	9
4	SEC	3	9	3	9
5	VAC	3	9	3	9
6	AEC	4	12	4	12
7	Internship		2		2
8* (only one type of course from these 4 divisions)	Research project of 12 credits- Mandatory for Honours with research				12
	Project of 12 credits - optional for Honours				12
	Project of 8 credits + one major course (honours)				8 + 4
	Three major Courses instead of optional project				12
9	An additional Course in major/minor/any other discipline			1	4
	TOTAL	36	133	47	177

SEMESTER WISE CREDIT DISTRIBUTION OF GENERAL FOUNDATION COURSES FOR BSc PLANT SCIENCE

SL.. No.	Name of the GFC	No. of Courses	Required credits	Distribution among Semesters and Disciplines (*Should select from the list given in the GFC courses of Plant Science)	
1	AEC	4	12	Sem 1	**AEC 1**(English) and **AEC 2** (Hindi/ Malayalam/ Sanskrit/ Kannada/ Urdu/ Arabic, etc.)
				Sem 2	**AEC 3** (English) and **AEC 4** (Hindi/ Malayalam/ Sanskrit/ Kannada/ Urdu/ Arabic, etc.)
2	MDC	3	9	Sem 1	MDC 1
				Sem 2	MDC 2
				Sem 3	MDC 3*
3	VAC	3	9	Sem 3	VAC 1 *
				Sem 4	VAC 2* and VAC 3
4	AEC	3	9	Sem 4	SEC 1*
				Sem 5	SEC 2
				Sem 6	SEC 3
Total		13	39		

*MDC, VAC and SEC should be related to Horticulture, Plantation Management, Tissue culture and Plant propogation

DETAILS OF MAJOR PATH WAY COURSES IN B.Sc. PLANT SCIENCE									
Sl. No.	Course Code	Sem	Name of the course	credit	THEORY		PRACTICAL		TOTAL
					ESE	CCA	ESE	CCA	
FIRST YEAR									
Semester 1									
1	KU1DSCPLS101	1	Cell: Structure and Reproduction	3 +1	50	25	15	10	100
Semester 2									
2	KU2DSCPLS102	2	Angiosperm Anatomy, Embryology and Palynology	3+ 1	50	25	15	10	100
SECOND YEAR									
Semester 3									
3	KU3DSCPLS201	3	Diversity of Algae and Bryophytes	3 + 1	50	25	15	10	100
4	KU3DSCPLS202	3	Angiosperm Systematics I	4	70	30	0	0	100
Semester 4									
5	KU4DSCPLS203	4	Diversity of Pteridophytes and Gymnosperms	3 + 1	50	25	15	10	100
6	KU4DSCPLS204	4	Angiosperm Systematics II	3 + 1	50	25	15	10	100
7	KU4DSCPLS205	4	Genetics	3+ 1	50	25	15	10	100

DETAILS OF MAJOR PATH WAY COURSES IN B.Sc. PLANT SCIENCE

Sl. No.	Course Code	Sem	Name of the course	Credit	THEORY		PRACTICAL		TOTAL
					ESE	CCA	ESE	CCA	
THIRD YEAR									
Semester 5									
8	KU5DSCPLS301	5	Mycology and Plant Pathology	3+ 1	50	25	15	10	100
9	KU5DSCPLS302	5	Bio-instrumentation and Computers	4	70	30	0	0	100
10	KU5DSCPLS303	5	Basics in Molecular biology and Genetics	4	70	30	0	0	100
11	KU5DSCPLS304	5	Phytochemistry	3+ 1	50	25	15	10	100
12	KU5DSEPLS305	5	*Plantation Management*	4	70	30	0	0	100
13	KU5DSEPLS306	5	*Stress Physiology*	4	70	30	0	0	100
14	KU5DSEPLS307	5	*Weed Ecology*	4	70	30	0	0	100
15	KU5DSEPLS308	5	*Seed Technology*	4	70	30	0	0	100
Semester 6									
16	KU6DSCPLS309	6	Biotechnology and Basic Bioinformatics	3 + 1	50	25	15	10	100
17	KU6DSCPLS310	6	Research Methodology and Biostatistics	4	70	30	0	0	100
18	KU6DSCPLS311	6	Phytophysiology	3+ 1	50	25	15	10	100
19	KU6DSCPLS312	6	Evolution and Plant Breeding	4	70	30	0	0	100
20	KU6DSCPLS313	6	Plant Ecology and Phytogeography	3+ 1	50	25	15	10	100
21	KU5DSEPLS314	6	*Floriculture and Olericulture*	4	70	30	0	0	100
22	KU5DSEPLS315	6	*Agroecology*	4	70	30	0	0	100
23	KU5DSEPLS316	6	*Ethnobotany*	4	70	30	0	0	100
24	KU5DSEPLS317	6	*Pharmacognosy and Phytochemistry*	4	70	30	0	0	100
25	KU6INTPLS318	6	Internship/apprenticeship/ Field trip/ Nature Camp	2	35	15	0	0	50

DETAILS OF MAJOR PATH WAY COURSES IN B.Sc. PLANT SCIENCE

Sl. No.	Course Code	Sem	Name of the course	Credit	THEORY		PRACTICAL		
					ESE	CCA	ESE	CCA	TOTAL
FOURTH YEAR									
Semester 7									
26	KU7DSCPLS401	7	Advanced course in Plant Developmental Biology	4	70	30	0	0	100
27	KU7DSCPLS402	7	Advanced course in Cryptogamic Diversity	3+ 1	50	25	15	10	100
28	KU7DSCPLS403	7	Advanced course in Diversity of Phanerogams	3+ 1	50	25	15	10	100
29	KU7DSCPLS404	7	Advanced course in Mycology, Microbiology and Plant pathology	4	70	10	0	20	100
30	KU7DSCPLS405	7	Modern tools and Techniques for Ecological Studies	4	70	10	0	20	100
Semester 8									
31	KU8DSCPLS406	8	Advanced Bioinformatics	3+ 1	50	25	15	10	100
32	KU8DSCPLS407	8	Phytogeography of North Kerala	4	70	30	0	0	100
33	KU8DSCPLS408	8	Applications of Botany in Industries - North Kerala	3+ 1	50	25	15	10	100
34	KU8DSEPLS409	8	*Advanced course in Angiosperm Systematics*	4	70	30	0	0	100
35	KU8DSEPLS410	8	*Plant Microtechnique*	4	70	30	0	0	100
36	KU8DSEPLS411	8	*Nanobiotechnology*	4	70	30	0	0	100
37	KU8DSEPLS412	8	*Climate change and Disaster Management*	4	70	30	0	0	100
38	KU8DSEPLS413	8	*Environmental Impact Assessment and Conservation Management*	4	70	30	0	0	100
39	KU8DSEPLS414	8	*Structural biology*	4	70	30	0	0	100
40	KU8PRJPLS415	8	Project (A project of 8 credits +1 Major course or 3 Major courses instead of optional project. The scheme of evaluation of the project of 8 credits will 140 +60 = 200)	12	210	90		0	300

DETAILS OF MAJOR PATH WAY COURSES IN B.Sc. PLANT SCIENCE

DETAILS OF MINOR PATHWAY COURSES IN BOTANY / PLANT SCIENCE

Sl. No.	Course Code	Sem	Name of the course	credit	THEORY		PRACTICAL		
					ESE	CCA	ESE	CCA	TOTAL
Semester 1									
41	KU1DSCBOT103	1	Diversity of Plants I	3 + 1	50	25	15	10	100
42	KU1DSCBOT104	1	Plant Ecology and Phytogeography	3+ 1	50	25	15	10	100
Semester 2									
43	KU2DSCBOT105	2	Reproduction and Life Cycle of Plants	3+ 1	50	25	15	10	100
44	KU2DSCBOT106	2	Angiosperm Taxonomy and Morphology	3 + 1	50	25	15	10	100
Semester 3									
45	KU3DSCBOT206	3	Diversity of plants II	3+ 1	50	25	15	10	100
46	KU3DSCBOT207	3	Angiosperm Anatomy and Embryology	3+ 1	50	25	15	10	100
47	KU3DSCBOT208	3	Forest Botany	3+1	50	25	15	10	100
Semester 6									
46	KU6DSCBOT321	6	Mycology, Phytopathology and Applied Botany	3+ 1	50	25	15	10	100
47	KU6DSCBOT322	6	Evolution of Plants and Animals	4	70	30	0	0	100
48	KU6DSCBOT413	6	Plantation Management	3+ 1	50	25	15	10	100
49	KU6DSCBOT414	6	Forest Botany	3+ 1	50	25	15	10	100
50	KU6DSCBOT415	6	Ethnobotany	3+ 1	50	25	15	10	100
51	KU6DSCBOT416	6	Herbal Science	3+ 1	50	25	15	10	100
52	KU6DSCBOT417	6	Modern Plant Pathology	3+ 1	50	25	15	10	100
53	KU6DSCBOT418	6	Horticulture	3+ 1	50	25	15	10	100
54	KU6DSCBOT419	6	Agronomy and Agroforestry	3+ 1	50	25	15	10	100

DETAILS OF FOUNDATION COURSES IN BOTANY / PLANT SCIENCE

Sl. No.	Course Code	Sem	Name of the course		THEORY		PRACTICAL		
				credit	ESE	CCA	ESE	CCA	TOTAL
1	KU1MDCBOT101	1	Plant diversity	3	50	25	0	0	75
2	KU1MDCBOT102	1	Botany for the Beginners	3	50	25	0	0	75
3	KU2MDCBOT103	2	Beginner's exploration to the world of leaves and flowers	3	50	25	0	0	75
4	KU2MDCBOT104	2	Agrobiodiversity	3	50	25	0	0	75
5	KU3MDCBOT105	3	Botanical Art	3	50	25	0	0	75
6	KU3MDCBOT106	3	Introductory course on Applications of Botany	3	50	25	0	0	75
7	KU3MDCBOT107	3	Microscopy and visualisation tools in Biology	3	50	25	0	0	75
8	KU4SECBOT108	4	Biodiversity of Kerala and Ecotourism	3	50	25	0	0	75
9	KU4SECBOT109	4	Floral art Business	3	50	25	0	0	75
10	KU4SECBOT110	4	Entrepreneurship in Botany	3	50	25	0	0	75
11	KU4SECBOT111	4	Gardening Indoor and Outdoor	3	50	25	0	0	75
12	KU4SECBOT112	4	Medicinal Plants of Kerala	3	50	25	0	0	75
13	KU4SECBOT113	4	Mushroom Cultivation and Marketing	3	50	25	0	0	75
14	KU4SECBOT114	4	Plant Tissue culture Lab set up for commercial Production	3	50	25	0	0	75
15	KU5SECBOT115	5	Basics of Anthurium and Orchid Cultivation	3	50	25	0	0	75
16	KU5SECBOT116	5	Mangrove and Laterite Hill Ecology for Tourism	3	50	25	0	0	75
17	KU5SECBOT117	5	Plantation Crop Nursery Setup Management	3	50	25	0	0	75
18	KU5SECBOT118	5	Hydroponics and Aquaponics	3	50	25	0	0	75
19	KU5SECBOT119	5	Plant Propagation Methods	3	50	25	0	0	75
20	KU3VACBOT120	3	Gender: A Biological perspective	3	50	25	0	0	75
21	KU3VACBOT121	3	Sustainable Life style	3	50	25	0	0	75
22	KU3VACBOT122	3	Conservation Biology	3	50	25	0	0	75
23	KU4VACBOT123	4	Basics of Environmental Science	3	50	25	0	0	75
24	KU4VACBOT124	4	Climate Change and Disaster Management	3	50	25	0	0	75
25	KU4VACBOT125	4	Entrepreneurship in Compost Making	3	50	25	0	0	75
26	KU4VACBOT126	4	Biofertiliser and marketing	3	50	25	0	0	75
27	KU6VACBOT127	6	Agribased Microenterprises	3	50	25	0	0	75
28	KU6VACBOT128	6	Indigenous plants: their Identification and utility	3	50	25	0	0	75
29	KU6VACBOT129	6	Wetland and Laterite Hill Ecology	3	50	25	0	0	75
30	KU6VACBOT130	6	Apiculture	3	50	25	0	0	75

GENERAL RULES

ELIGIBILITY FOR ADMISSION AND SELECTION OF COURSES

Admission, enrollment, registration, options for changing major programs, selection of academic pathways, readmission and scheme migration, assessment and evaluation, and final grading and awarding of degrees are based on the Kannur University FYUGP Regulations and Curriculum Framework 2024, as well as the norms and rules established by the Government and the University from time to time.

Students must have completed the examination conducted by a recognized Board or University at the +2 level of schooling or its equivalent.

Departments will provide information on the courses they offer, including the eligibility criteria.

At the end of the second semester, students may be permitted to change their major program of study. Based on the availability of seats and infrastructure facilities, students may opt for any discipline they studied during the first two semesters as discipline-specific foundation courses or multidisciplinary foundation courses. If a student switches their major to a discipline in which an MDC has been completed, they will have to undertake additional DSC courses in the new discipline to acquire the required minimum credits.

One course should be offered by a faculty member whenever possible. The faculty member shall inform the students about the outcomes, course plan, and assessment methods at the beginning of the course.

Module 5 of each course is designated as 'Teach Space'—a personal, flexible, and dynamic area for teaching activities tailored to the needs of the instructor, infrastructure, course outcome, and the requirements of the students.

Students are advised to select a variety of courses from the available options instead of choosing courses with similar content. Some professional courses and jobs require a Botany/Plant Science major along with minors in Chemistry and Zoology. Therefore, students should carefully consider their selection of major and minor courses.

SWAYAM, MOOC, or other online courses can be selected from the course offerings of Indian universities and institutes. These courses must be related to the student's major and can be used to earn credits. Students can opt for SWAYAM and other online courses to earn credits, provided they complete an internal viva, give a presentation, and submit a report on the course.

SUGGESTED PEDAGOGY AND EVALUATION

Teaching-Learning

The FYUGP program is based on Outcome-Based Education (OBE). To achieve the desired outcomes in each course, various methods of teaching, learning, and evaluation are employed. Credit earning and transfer follow the guidelines of the Kannur University FYUGP regulations and curriculum framework of 2024.

Types of Teaching and Learning Activities

Types of Course	Teacher Activity	Student Activity
Theory	Lectures, demonstrations, presentations, discussions, and debates	Review of literature, assignments, presentations, e-learning, discussions, and debates with peers, teachers, and experts.
Practical	Demonstrations, experimentation, field visits, and certification	Identification, comparison, differentiation, and categorization of different plants and their parts using permanent slides and hand sectioning. Additionally, demonstration, experimentation, field visits, report writing, and record keeping
Field Study/Study Tour	For plant diversity and technological studies, experiential learning should complement theoretical learning. Faculty members guide this flexible activity, determining the field for the trip.	Students should observe the features from the field and document peculiarities and diversity in a report.

Internship

Each student must complete an internship within the six semesters to engage with practical aspects of their learning and enhance employability. A report is required by the end of the sixth semester. The internship must last a minimum of 60 working hours and can be on-campus or off-campus, potentially consisting of 1-3 accumulated activities. Off-campus internships require prior approval, and an attendance certificate must be submitted to the HoD upon rejoining. HoDs ensure completion of the internship.

Suggested Internships: Summer internships at biology institutes or local industries related to botany/ecology/agriculture, field trips to various ecosystems or nature camps, apprenticeships in NGOs or relevant industries, and social responsibility activities such as river restoration, PBR preparation, landscaping, and green auditing.

Student Responsibilities: Selecting the internship topic/activity, discussing with a mentor, planning and execution, and preparing and presenting the report.

Teacher/Supervising Guide Responsibilities: Confirming the topic/activity, providing guidance, and correcting and certifying the prepared report.

Mandatory/Optional Project

In the eighth semester, a mandatory 12-credit project (minimum 360 working hours) is required for FYUGP research or honors, or an optional 8-credit project (minimum 240 working hours) alongside a major theory course. Project guidance can be provided by a faculty member of the department. If necessary, the expertise of an external guide may be utilized. Facilities and expertise for the project can be on-campus or off-campus, with required permissions for off-campus projects. Students must maintain and submit a project log book/register along with the final report.

Student Responsibilities: Suggesting the topic, discussing with the project guide and peers, reviewing literature, planning and designing the project, experimentation, data analysis, and preparing and presenting the project report.

Teacher/Supervising Guide Responsibilities: Confirming the topic, demonstrating, planning experimentation, providing guidance, and correcting and certifying the project.

Evaluation

Each student should go through the evaluation process in an indirect grading method, as per the Kannur University FYUGP- regulations and curriculum frame work.- 2024. The evaluation for the odd semesters and the practical components will be done by the college itself and that for even semesters will be conducted at the university level.

Regarding evaluation, one-credit courses will be assessed for 25 marks, two-credit courses for 50 marks, three-credit courses for 75 marks, and four-credit courses for 100 marks. A copy of all records of evaluation shall be maintained in the department/college and should be available for verification by the university/BoS / the student.

EVALUATION	WEIGHTAGE
END SEMESTER EVALUATION- ESE	70
CONTINUOUS COMPREHENSIVE ASSESSMENT - CCA	30

The CCA component has two parts Formative Assessment (FA) and Summative Assessment (SA) with an equal weightage. The components of Evaluation will be determined by the instructor/faculty and the same will be communicated to the student at the beginning of the course.

Suggestive Methods of Formative Assessment (FA)

Formative assessment methods may include assignments (both theory and practical), viva voce, quizzes, interviews, presentations, classroom discussions, observation of practical skills, and self and peer assessments. The course coordinator or faculty member will determine the combination of these

tools and their respective weightages and will communicate this information to the students at the beginning of the course.

Suggestive Methods of Summative Assessment (SA)

SA methods may include written tests, open-book tests, laboratory records or reports, project reports, and case study reports. The coordinator can decide on the combination and relative weightage of these tools, which should be communicated to the students at the beginning of each course.

Evaluation of Theory Courses

End Semester Examinations will be held in October for odd semesters and in March for even semesters. A 3-credit theory course will be evaluated with a 50-mark question paper, with a duration of 1.5 hours. A 4-credit theory course will be evaluated with a 70-mark question paper, with a duration of 2 hours.

A copy of all records of evaluation shall be maintained by course in charge or the faculty for verification by the HoD / the student.

Evaluation of Practical Courses

Students must attend the practical classes and go through the continuous evaluation process for the course. Only those who have completed the continuous evaluation will be permitted to appear for the end-semester (practical) viva-voce. A copy of all records of evaluation shall be maintained by course in charge or the faculty for verification by the HoD / the student.

The end-semester practical examination, viva-voce, and evaluation of practical records shall be conducted by the course in-charge and an internal examiner appointed by the Department Council. The Continuous Comprehensive Assessment (CCA) of practical courses shall be conducted by the course in-charge. For courses with both theory and practical components, the CCA components: The continuous evaluation of practical courses shall be completed at least 10 days before the start of the end-semester examination.

EVALUATION	WEIGHTAGE
END SEMESTER EVALUATION- ESE	60
CONTINUOUS COMPREHENSIVE ASSESSMENT - CCA	40

Internship

The components of internship evaluation include performance evaluation, attendance and participation, the quality of the internship report, and the effectiveness of the presentation. Additional components are the viva voce examination, feedback from the internship site, self-assessment, and, if applicable, peer assessment. Continuous Comprehensive Assessment (CCA) will be conducted by the

faculty in charge, while the End Semester Examination will be evaluated by the Department Council, excluding the faculty in charge.

Components of Evaluation of Internship	Weightage Marks	Marks for Internship 2 Credit/50
Continuous Comprehensive Assessment (CCA)	30%	15 (Report 5, Viva 5 , Presentation 5)
End Semester Evaluation (ESE)	70%	35

Evaluation of Project

A student pursuing UG Honours with research must complete a mandatory research project worth 12 credits by the end of the eighth semester. For other UG Honours students, the project is optional. Since each credit corresponds to 25 marks, the 12-credit project will be evaluated for a total of 300 marks. The evaluation scheme for the project is detailed below:

Project type	Maximum Marks	CCA (30%)	ESE (70%)
Research Project of 12 Credits	300	90 Pre synopsis presentation and viva Review of literature Regularity and Participation (1:1:1)	210 Report, Methodology, Social Relevance, Scientific accuracy, innovation, data analysis, presentation skill ,viva (components and their relative weightage can be decided by the department council)
Research Project of 8 Credits	200	60 Pre synopsis presentation and viva Review of literature Regularity and Participation (1:1:1)	140 Report, Methodology, Social Relevance, Scientific accuracy, innovation, data analysis, presentation skill ,viva (components and their relative weightage can be decided by the department council)

**The question paper design and model question papers will be added later*

Grading

Marks obtained in each component or question of a course are converted into a 10-point indirect grading system. The Semester Grade Point Average (SGPA) is calculated from these grades to evaluate student performance each semester. The Cumulative Grade Point Average (CGPA) and the corresponding grading scale are outlined below.

Sl. No	Percentage of Marks (ESE and CCA put together)	Description	Letter Grade	Grade Point (P)	Range of Grade Points
1	95% and above	Outstanding	O	10	9.50 – 10
2	Above 85% and below 95 %	Excellent	A+	9	8.50 – 9.49
3	Above 75% to below 85%	Very Good	A	8	7.50 – 8.49
4	Above 65% to below 75%	Good	B+	7	6.50 – 7.49
5	Above 55% to below 65%	Above Average	B	6	5.50 – 6.49
6	Above 45% to below 55%	Average	C	5	4.50 – 5.49
7	Above 35% to below 45% (CCA and ESE put together) with a minimum of 30% in ESE.	Pass	P	4	3.50 – 4.49
8	Below an aggregate of 35% or below 30% in ESE	Fail	F	0	0 – 3.49
9	Not attending the examination	Absent	Ab	0	0

1	CELL: STRUCTURE AND REPRODUCTION	KU1DSCPLS101
Semester : I **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Knowledge in the basic structural and functional unit of life, the cell.
CO2	Understanding of the cell biology related terms used in the description of diverse forms of life.
CO3	Understanding the basic differences in cell structure and cell reproduction that exist in various plant groups.
CO4	Ability to apply the concepts gathered in the field of evolution and diversity studies.
CO5	Firsthand experience in viewing cells under microscope and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√		√							
CO3					√				√			
CO4							√		√			
CO5											√	√

Course Description
This is an introductory biology course designed for UG students in general and BSc Botany and Plant Science in particular. The aim of the course is to give basic knowledge about the structure and function of cells and cellular components with historical and evolutionary perspectives.
• *First module gives the brief history of the development of cell biology and evolution of cells.* • *Second module gives an account on the cellular envelopes and nucleus.* • *Third module is packed with endo-membrane system and other cellular organelles.* • *Fourth module will give you in-depth knowledge on cell cycle and division, different phases of Mitosis and Meiosis.*

This course will also provide you opportunities to observe diverse cells and hands-on training to identify stages of mitosis and meiosis during laboratory sessions.

Course Objectives:

1. To gather knowledge on evolution of cell biology as a discipline.
2. To understand the diversity in structure and function of cells and cell components.
3. To understand the stages of cell reproduction- mitosis and meiosis as well as the significance of these processes in sustenance and evolution of species.
4. To get hands on training in observing various types of cells under microscope.

Credit			**Teaching Hours**		**Assessment**		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. INTRODUCTION TO CYTOLOGY (5 hrs)

1.1. History - History of the progress of cell biology and development of cell theory.
1.2. Cell as a unit of structure and function. Levels of organization of cells up to organism.
1.3. Origin and Evolution of cell. Characteristics of prokaryotic and eukaryotic cells.
1.4. Modern concept on cell components- Cellular envelopes, Protoplasm, Cell organelles, Cytoplasm, Non living inclusions.

Module 2. CELLULAR ENVOLOPE AND NUCLUEUS (10 hrs)

2.1. Cellular envelopes- Types and functions
2.2. Cell wall - Chemistry, Ultra structure and function of Plant cell wall. Thickening of cell wall, Pits and pit apertures, Plasmodesmata. Cytoplasm- Physical, chemical and biological properties.
2.3. Cell membrane - Overview of fluid mosaic model; Chemical composition of membranes; membrane function.
2.4. Nucleus - Ultra structure of the interphase nucleus, The nuclear envelope; Nuclear pore complex, Nucleolus - Structure and functions.

Module 3. CELL ORGANELLES (15 hrs)

3.1. Endomembrane system - Endoplasmic Reticulum; Golgi Apparatus; Lysosomes. Vacuole. Phagocytosis and Pinocytosis and Membrane transport
3.2. Plastids – Types of plastids. Structure and function of Chloroplast and Mitochondria. Significance of Mitochondria and Chloroplast in evolutionary biology and molecular taxonomy. Endosymbiotic Theory.
3.3. Microbodies- Structure and functions of Peroxisomes, Glyoxysomes and Ribosomes.
3.4. Cytoskeleton: Role and structure of microtubules, microfilaments and intermediary

filament. Major nonliving inclusions in the plant cell.

Module 4. CELL CYCLE AND CELL REPRODUCTION (15 hrs)

4.1. Concept of cell Cycle: Phases of eukaryotic cell cycle -Interphase and Mitotic Phase.

4.2. Mitosis: Karyokinesis and Cytokinesis. Different Stages in Karyokinesis – Prophase, Metaphase, Anaphase and Telophase. Significance of mitosis. Cytokinesis – Cytoplasmic division in Plant cell. Types of mitosis.

4.3. Meiosis: Stages of Meiosis I and II- both karyokinesis and cytokinesis.Variations among plants. Significance of Meiosis.

4.4. Comparative account of Mitosis and Meiosis among different organisms- Gametic meiosis and Zygotic meiosis.

Module 5. Teach Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Compound microscope and its parts.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Crinum*/*Rheo*.
3. Diversity of cells- prokaryotic (blue green alga), eukaryotic (*Chlorella*, *Spirogyra*, stomata of different leaves, Trichomes).
4. Demonstration of the phenomenon of protoplasmic streaming in *Hydrilla* leaf, *Vallisnaria*.
5. Mitosis using Onion root smear.
6. Demonstration of staining of organelles/ animal/ plant/ microbial cells for light microscopic observation
7. Demonstration of meiosis using flower buds or any other suitable specimen.
8. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics

1. Geological time scale
2. Theories and experiments on evolution of life- classical and modern
3. Types of models of plasma membrane
4. Significance and applications of membrane studies in immunology, medicine , drug designing etc.
5. Meiotic errors and syndromes in human beings and plants
6. Evolution of crop plants and significance of meiosis and mitosis.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. The World of	1, 2, 3,4

	the Cell. 7th edition. Pearson Benjamin Cummings Publishing, San Francisco, 2009	
2	Cooper, G.M. and Hausman, R.E. The Cell: A Molecular Approach. 5th edition. ASM Press &Sunderland, Washington, D.C.; Sinauer Associates, MA.,2009	1, 2, 3, 4
3	De Robertis E.D. and De Robertis E.M.F. Cell and Molecular Biology 8th Edition. Lee and Fab International edition, Philadelphia.2017.	1, 4
4	Pawar, Cell Biology, Himalaya Publishing House, Mumbai. 2019.	1, 2,3, 4
5	Rastogi, S.C. Cell and Molecular Biology. New Age International Publishers, New Delhi. 2016	1, 2, 3, 4
6	Verma P.S. and Agarwal V.K. Cell Biology (Cytology, Biomolecules, Molecular biology),Paper back, S.chand and Company .Ltd. 2016.	2, 4
Core Compulsory Readings		
1	Karp, G. (2010), Cell Biology, John Wiley & Sons, U.S.A. 6th edition.	
2	Lodish, H. Berk A, Zipursky SL, et al., 2000: Molecular Cell Biology, 4th edition., W.H. Freeman, New York.	
Core Suggested Readings		
1	http://ndl.iitkgp.ac.in/document/eXF1YzdhQ2RxM3hPUm8ra0k0NHZGUT09	
2	http://ndl.iitkgp.ac.in/document/SFBhRUg0cDg3MTJyRXE0OVB5RkpLZz09	

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- What are the two main types of cells, and what distinguishes them from each other?
- Explain the fluid mosaic model of the cell membrane and its significance in cell biology.
- What are the phases of the eukaryotic cell cycle, and what happens during each phase?
- How does protoplasmic streaming contribute to cellular functions in plants?

- Define cytokinesis and describe its role in cell division.

3 Marks Questions (Applying and Analyzing):

- Using a diagram, illustrate the structure of a plant cell wall and explain its functions.
- Compare and contrast the structure and function of mitochondria and chloroplasts.
- Design an experiment to demonstrate the process of phagocytosis in cells.
- Analyze the implications of the endosymbiotic theory for our understanding of cellular evolution.
- Propose a hypothesis to explain the possible evolutionary line of three cells- A- prokaryotic cell autotrophic, B- prokaryotic heterotrophic and C- eukaryotic autotrophic.
- Give an illustrated self- explanatory diagram of prokaryotic and eukaryotic cells, indicating their primary structural differences.

5 Marks Questions (Evaluating and Creating):

- Evaluate the significance of mitosis in the growth and development of multi-cellular organisms.
- Design an educational poster illustrating the stages of meiosis and explaining their importance in sexual reproduction.
- Critically evaluate the role of the endomembrane system in protein synthesis and trafficking within cells.
- Develop a model to demonstrate the role of the cytoskeleton in maintaining cell shape and facilitating cell movement.
- Evaluate the impact of advancements in cell biology on modern scientific research and technology.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in biology as well as in daily life

2	ANGIOSPERM ANATOMY, EMBRYOLOGY AND PALYNOLOGY	KU2DSCPLS102
Semester : II **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
C01	Knowledge in the internal structure of angiosperm.
C02	Understanding of the anatomical, palynological and embryological related terms used in the description of diverse forms of life.
C03	Understanding the variations in the internal structure and reproduction that exist in various plant groups.
C04	Interpret the adaptive and protective mechanisms exhibited by plants in response to various environmental conditions.
C05	Ability to apply the concepts in the field of evolution and diversity studies.
C06	Firsthand experience in viewing cells under microscope and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√		√									
CO2		√			√							
CO3							√	√				
CO4											√	√
CO5				√					√			
CO6											√	√

Course Description
The course offers a thorough exploration of plant biology- angiosperm anatomy, embryology, palynology. Students get theoretical and practical knowledge about various plant tissues, tissue systems present in various plant organs; along with secondary growth of root and stem. Additionally, the course gives insights into various terms and stages in embryology, fertilization mechanisms.
• *First module brings the knowledge of tissues and tissue systems in angiosperms* • *Second module gives an account on structure of primary plant body and its secondary growth.*

• *Third module is packed with pre fertilisationsal stages relevant in the embryology of angiosperms.* • *Fourth module gives in-depth knowledge on embryo formation, structure and variations.*
This course will also provide opportunities for intense laboratory sessions to observe diverse tissues and tissue systems present in plants.

Course Objectives:

1. Understand plant tissue classification, structure, and functions.
2. Explore plant anatomy, including primary structures and tissue systems.
3. Study plant reproduction mechanisms and embryology.
4. Develop practical skills in observing and analyzing plant structures and tissues.

Credit			**Teaching Hours**		**Assessment**		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Plant Tissues and Tissue Systems (12 hours)

1.1. Introduction to plant tissues and their classification. Meristems and Permanent Tissues. Classification, distribution, structure, and function of meristems.

1.2. Theories explaining the growth and development of plant structures from meristem. Histogen theory, Tunica Corpus Theory. Developmental processes of the plant body: root apex, vegetative shoot apex, floral apex.

etc.

1. 3. Occurrence, structure and functions of simple tissues: Parenchyma, Collenchyma, Sclerenchyma. Complex tissues: Xylem and Phloem. Special tissues- Types of secretory tissues: digestive glands, glandular hairs, nectaries,

1.4. General Account of Epidermal tissue system, Ground tissue system and Vascular System.

- Types of Stomata- monocot and Dicot; different types of vascular bundles-Radial, Conjoint, Collateral- open and closed, Bicollateral.

Module 2. Structure of Plant Body (15 hours)

2.1. Anatomy of primary structures: roots, stems, and leaves in dicots and monocots with a comparative account. Nodal Anatomy- Types of nodes and Evolutionary trend. Anatomy of Abscission zone. Floral anatomy and mechanisms of flower development.

2.2. Processes and structures involved in secondary growth: distribution, structure and

function of stelar cambium and extra-stelar cambium. Secondary growth in dicot stem root. Seasonal variation in cambial activity and its implications on wood formation. Heartwood and sap wood. Spring wood and Autumn Wood.

2.3. Anomalous Secondary growth- A general account on types of anomalies. Unusual patterns of secondary growth in *Dracaena*, *Bignonia* and *Boerhaavia*.

2.4. Anatomical adaptations in xerophytes, halophytes, epiphytes, hydrophytes.

Module 3. Sporogenesis, Gametophyte formation and Pollination (10 hours)

3.1. Introduction to Angiosperm Embryology and Palynology**:** Historical overview of embryology and its significance. Various techniques in Embryology and Palynology. General account on pollen structure and morphology. Applications of Embryology and Palynology.

3.2. Structure and functions of microsporangium and its wall layers. Pollinia. Microsporogenesis- process, types and male gametophyte development.

Megasporogenesis: process and significance in female gametophyte development.

3.3. Structure and functions of megasporangium- Types of ovules. Megasporogenesis- process, types and female gametophyte development. Monosporic, Bisporic and Ttrasporic; detailed structure of Polygonum type of Embryosac.

3.4. Pollination- Types of Pollination- Self Pollination and Cross Pollination. Significance of Cross Pollination. Different Mechanisms of pollination. Basic concept of self-incompatibility. Economic and Evolutionary significance of Pollination.

Module 4. Fertilization and Embryogenesis (8 Hrs)

4.1. Pollen tube formation and fertilization: Processes and significance. Types of pollen tube entry- Porogamy, Chalazogarmy and mesogamy.

4.2. Double Fertilization and triple fusion- processes and significance. Structure, development, and types of endosperms.

4.3. Development of Embryo in Dicots and Monocots with major substages. Structure of mature dicot and monocot embryos.

4.4. Apomixis and Amphomixis. Classification and significance of polyembryony. Brief account on Experimental Embryology.

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Module 5. Teach Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Observation of apical meristems in root and stem.
2. Microphotographs of different types of tissues- Parenchyma- Aerenchyma, Chlorenchyma (Spongy, Palisade), Collenchyma, Sclerenchyma, Xylem and Phloem
3. Microphotographs of different types of tissue systems- trichomes, stomata- Anomocytic,

Paracytic, Diacytic and Anisocytic.

4. Primary structures in dicot stem (*Centella*), root (*Tinospora*), and leaf (*Ixora*) and monocot stem (Grass), root (*Colocasia*), and leaf (Grass).
5. Secondary Structures in Dicot root (*Tinospora*, *Ricinus*) and Stem (*Eupatorium/Vernonia* and *Tinospora*)
6. Anomalous secondary thickening in *Boerhaavia* stem.
7. Acetolysis of Pollengrains - *Hibiscus*
8. TS of Mature anther- *Datura, Ixora*
9. Observation of Pollinia- *Calotropis*/ Orchids
10. Embryos of Monocots and Dicots

Suggested Assignments – Theory

1. Different theories on meristem
2. Different types of nodes with examples
3. Root stem transition with examples
4. Biochemical changes that happen during abscission
5. Anomalous secondary thickening in various climbers and herbs and shrubs
6. Types of anthers with examples
7. Variations in Pollen morphology
8. Anatomy and taxonomy
9. Anatomy and Evolution
10. Polyembryony and Apomixis with examples and relevance
11. Production of fruits without pollination/seeds

Suggested Assignments – Practical

1. Different types of nodes with examples
2. Root stem transition with examples
3. Anomalous secondary thickening in various climbers and herbs and shrubs
4. Types of anthers with examples
5. Variations in Pollen morphology
6. Pollen calendar preparation
7. Aeropalynology- survey

Suggested readings specific to the module.		
Sl. No	Title/Author/Publishers of the Book specific to the module	Module No.
1	Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, Vikas Pub. House. Delhi. 5th edition.	3, 4
2	Dutta, A. C. (2019). Botany for Degree Students. Oxford University Press.	1, 2, 3, 4
3	Esau, K. (1953). Plant Anatomy. John Wiley & Sons.	1, 2

4	Johri, B.M. l (1984). Embryology of Angiosperms, Springer-Verlag, Netherlands	3, 4
5	Pandey, B. P. (2009). Plant Anatomy and Embryology. S. Chand & Company Ltd.	1, 2, 3, 4
6	Shivanna, K.R. (2003). Pollen Biology and Biotechnology. Oxford and IBH Pub. Co. Pvt. Ltd. Delhi.	3
7	Tripathi, R. D. (2018). Introduction to Plant Anatomy. Rastogi Publications	1, 2
Core Compulsory Readings		
1	Fahn, A. (1990). Plant Anatomy. Pergamon Press.	
2	Kaur, R., & Singh, J. (2019). Practical Plant Embryology. S. Chand Publishing.	
3	Mauseth, J. D. (2012). Plant Anatomy and Development. Jones & Bartlett Learning	
4	Singh, S., & Singh, P. K. (2015). Textbook of Embryology. CBS Publishers &Distributors Pvt. Ltd	
Core Suggested Readings		
1	O'Brien, T. P., & McCully, M. E. (1981). Introduction to Plant Anatomy. Academic Press.	
2	Mauseth, J. D. (2012). Plant Anatomy: An Applied Approach. Jones & Bartlett Learning.	
3	Irish, V. F. (2009). Plant Development and Evolution. Wiley-Blackwell.	
4	Taiz, L., & Zeiger, E. (2010). Principles of Plant Physiology. Sinauer Associates, Inc.	

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Questions:

1. Explain the structural characteristics of Parenchyma tissue and its role in plant physiology.
2. Differentiate between conjoint and collateral vascular bundles, highlighting their significance in plant structure and function.
3. Define the term "hydathodes" and discuss their role in plant water management.
4. Describe the structure of the root apex in dicot plants and its importance in root development.
5. Compare and contrast the anatomy of monocot and dicot leaves, emphasizing their structural differences.

3 Marks Questions:

1. Discuss the functions of secretory tissues in plants and provide examples of plant organs where they are found.
2. Analyze the process of microsporogenesis and its significance in plant reproduction.
3. Explain the mechanism of self-incompatibility in plants and its implications for pollen-pistil interactions.
4. Compare the structures of dicot and monocot embryos, highlighting their developmental differences.
5. Evaluate the importance of endosperm in seed development, citing examples of different types of endosperm.

5 Marks Questions:

1. Describe the process of double fertilization in angiosperms, including the events occurring during each fertilization event.
2. Discuss the structure and functions of the vascular cambium in secondary growth of roots and stems.
3. Analyze the adaptive features of xerophytes and hydrophytes, illustrating how their anatomical structures enable them to thrive in their respective habitats.
4. Explain the significance of pollen allergy in human health and its ecological implications.
5. Compare and contrast the primary and secondary structures of dicot stems, highlighting their differences in tissue composition and organization.

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Employability for the Course / Programme

It is one of the basic courses with intense practical exercises involving the observation of plant structures and tissues; thereby provides a solid foundation in plant biology essential for careers in botany, agriculture, and pharmacognosy.

3	Diversity of Algae and Bryophytes	KU3DSCPLS201
Semester : 3 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English
3. Completed the basic foundation courses in the first two semesters

Course Outcomes	
CO1	Acquisition of basic knowledge in the diversity among plants, especially algae and bryophytes.
CO2	Understanding of the life cycles in algae and bryophytes.
CO3	Understanding the basic differences that exist among different selected genera of algae and bryophytes..
CO4	Ability to apply the concepts gathered in this course to the field of evolution and ecological studies.
CO5	Firsthand experience in viewing the diversity in algae and bryophytes using laboratory procedures. .

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2	√				√							
CO3						√	√					
CO4											√	√
CO5								√	√			

Course Description
This is a major intermediate course designed for BSc Botany students. The aim of the course is to give basic knowledge about the diversity of algae and bryophytes..
• *First module gives a general idea on Algal classification.* • *Second module gives details on the structure and life cycle of model organisms from selected algal taxa.* • *Third module gives a general account on classification of bryophytes* • *Fourth module is a detailed account on selected bryophytes.*

This course will also provide you opportunities to observe diverse cells, tissues and organs of algae and bryophytes, through the practical sessions on model organisms.

Course Objectives:

1. To expertise in collection, preservation and studies in algae and bryophytes.
2. A comparative knowledge of lower plants.
3. Skill development in for proper description, identification and classification through morphological, anatomical and life cycle studies
4. Consciousness on the origin and evolution of lower groups of plants.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Taxonomy of Algae (10 hrs)

1.1. Salient features of algae; Features used for the identification; Classification of algae F E Fritsch.

1.2. Origin and evolution of Algae, Relationships of Algae.

1.3. Thallus organization in algae. Pigments and stored food in algae. flagella types, life cycle and alternation of generations in algae. Evolutionary trends in Algae.

1.4. Brief Account on Indian Algology and major contributors

Module 2. Diversity of Algae (15 hrs)

2.1. Study of the habitat, distribution, habit, anatomy, reproduction and life cycle of Cyanophyceae- *Nostoc* and *Oscillatoria*, Chlorophyceae –*Volvox*, *Zygnema*, *Oedogonium*, *Chara*; Xanthophyceae – *Vaucheria*; Bacillariophyceae - *Pinnularia*; Phaeophyceae – *Sargassum*; Rhodophyceae - *Polysiphonia* (Developmental details are not required). .

2.2. General methods in collection, preservation and Algal culturing. Ecological and economic importance of Algae. Algal blooms.

Module 3. Taxonmy of Bryophytes (8 hrs)

a. General characters and classification of bryophytes. Diversity-habitat, thallus structure and Sprophyte structure. Salient features for the identification. Classification.
b. Evolutionary trends and affinities with Algae. Evolution of gameto phyte and sporophyte among Bryophytes.

Module 4. Diversity of Bryophytes (12 hrs)

4.1. Distribution, morphology, anatomy, reproduction and life cycle of the following types (developmental details are not required): Hepaticopsida - *Riccia*, *Marchantia*;

Anthocerotopsida - *Anthoceros*; Bryopsida - *Funaria.*

4.2. General methods in collection and preservation of Bryophytes Ecological and Economic importance of Bryophytes

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Micropreparations and microscopic observations of vegetative and reproductive structures of model genera of algae and bryophytes.
2. Documentation of algal and bryophyte diversity in various nearby places.
3. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Employability for the Course / Programme

It is one of the intermediate major course which is very essential for understanding the diversity of plants, especially of lower plants, for the completion of BSc Botany.

4	Angiosperm systematics I	KU3DSCPLS202
Semester: 3 **Hrs/week : 4 Theory + 0 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English
3. Completed the basic foundation courses in the first two semesters

Course Outcomes	
CO1	Knowledge on basic terms and methods in Angiosperms Taxonomy
CO2	Understanding the diversity in angiosperm morphology
CO3	Classification of angiosperms, especially belonging to Polypetalae, based on evaluation of taxonomic characters
CO4	Skill in conducting taxonomic field work, collection and identification of angiosperms.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2						√						
CO3			√		√				√			
CO4							√	√		√		

Course Description
This course is tailored for student majoring in Botany, focusing on foundational aspects of Angiosperm Systematics. The course blends theoretical knowledge and practical skills, including hands-on plant identification, field visits, and herbarium techniques.
• *First module deals with the classification of angiosperms and Indian contribution in taxonomy.* • *Second module draws attention to the vegetative morphology of angiosperms.* • *Third module gives an idea on reproductive morphology of angiosperms.* • *Fourth module is related to the taxonomic characters of selected families in Polypetalae.*
This course will also provide you opportunities to observe diverse angiosperms through the practical sessions on model organisms.

Course Objectives:

1. Develop a Fundamental Understanding of Systematics and Taxonomy
2. Acquire Proficiency in Angiosperm Classification and Nomenclature
3. Explore Polypetalous Plant Families with Economic Significance
4. Integrate theoretical understanding with practical skills through hands-on activities such as plant identification, field visits to botanical gardens or natural habitats, and herbarium techniques.
5. Prepare Students for Practical Applications in Botany

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CE	ESE	Total
3	1	4	4 +0 +0 (60 +0 +0)	4 (60)	30 (30 theory including module 5)	70	100

COURSE CONTENT

Module 1. Classical Taxonomy of Angiosperms: 10 hrs

1.1 Salient features of Angiosperms; Classification by Linnaeus, Bentham and Hooker .

1.2 Origin and evolution of angiosperms, Relationship, similarities and dissimilarities with Gymnosperms.

1.3. Major Indian contributors:

1.4. Basic Features used for classical systematic of angiosperms. Basic Herbarium technique.

Module 2. Vegetative Morphologic characters: 15 hrs

2.1. Root: types of roots and modifications in angiosperms

2.2. Stem types of stem and modifications in angiosperms

2.3. Leaf types of leaves and phyllotaxy and leaf modifications in angiosperms

Module 3. Reproductive Morphologic characters: 8 hrs

a. Flower the sex organ and general features – non essential and essential whoerls. Adhesion and cohesion. Aestivation. Placentation
b. Inflorescence- types
c. Fruits – types
d. Seeds and germination- types

Module 4. Diversity of Polypetalae: 12 hrs

4.1. Study of the distribution, habit, major vegetative and reproductive features Annonaceae, Nympheaceae, Malvaceae, Rutaceae, Anacardiaceae, Fabaceae with sub families.

Module 5. TEACH Space 15 hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Survey and documentation of vegetative modifications in angiosperms.
2. Survey and documentation of reproductive morphology of angiosperms
3. Study of Adhesion, Cohesion, Aestivation and Placentation in common plants.
4. Germination experiments.
5. Major vegetative and reproductive features Annonaceae, Nympheaceae, Malvaceae, Rutaceae, Anacardiaceae, Fabaceae with sub families.
6. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Employability for the Course / Programme

It is one of the intermediate major course which is very essential for understanding the diversity of plants, especially of Angiosperms and also for the completion of BSc Botany.

41	Diversity of Plants I	KU1DSCBOT103
Semester : 1 **Hrs/week: 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Acquisition of basic knowledge in the cell structure and diversity among life forms, especially on lower plants and fungi.
CO2	Understanding of the terms used cell biology and also in the description of diverse forms of life.
CO3	Understanding the basic differences that exist among different groups of plants.
CO4	Ability to apply the concepts gathered in this course to the field of evolution and advanced diversity and ecological studies.
CO5	Firsthand experience in viewing the diversity using laboratory procedures and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√		√	√						
CO3						√						
CO4									√	√		
CO5											√	√

Course Description
This is an introductory biology course designed for UG students in general and BSc Zoology BSc Microbiology and BSc Forestry in particular. The aim of the course is to give basic knowledge about the diversity of plant life forms.
• *First module gives details on plant cell structure* • *Second module focuses on the diversity of cell structure* • *Third module gives a detailed account on vegetative and reproductive structures of fungi, which enables the student to understand the classification of fungi.* • *Fourth module is a brief account on the diversity of algae, bryophytes and Pteridophytes and their economic importance and their classification.*
This course will also provide you opportunities to observe diverse forms of plant life of lower groups including fungi, during laboratory sessions.

Course Objectives:

1. Understanding of the fundamental structure of cells.
2. Concept development in structure and reproduction of lower plants- algae and bryophytes and fungi.
3. Enable the student to appreciate bio diversityfor sustainable development.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Cells and Structure of plants (10 hrs)

1.1. History - History of the progress of cell biology and development of cell theory. Origi n and Evolution of cell. Characteristics of prokaryotic and eukaryotic cells.

1.2. Brief history of classification of organism from Aristotle's days to modern days. Si x Kingdom Classification.

1.3. Levels of organization of cells up to organism. Macroscopic forms of plant life: Brief morphological and functional account on Root, Stem, Leaf, Flower, Fruit and Seed.

1.4. Morphological Comparison of Herbs, Shrubs, Trees, Creepers, Twiners, Lianas and Epiphytes.

Module 2. Diversity of cell structure (15 hrs)

1. Cell as a unit of structure and function. Modern concept on cell. A brief account on plant cell structure.
2. Cellular envelopes- Types and functions - Cell wall - Chemistry, Ultra structure and function of Plant cell wall. Thickening of cell wall, Pits and pit apertures. Plasmodesmata.
3. Protoplasm and Cytoplasm. A brief account of cell organelles and Non living inclusions plant cell. Chloroplast – structure and function.
4. Comparative account of cell structure and cell organelles among different lower plant groups- Algae, Bryophytes and Pteridohytes.

Module 3. Fungi (8 hrs)

3.1. General characters of Fungi and classification by Ainsworth (brief account).

3.2 General account on thallus structure and fruiting bodies among different fungal groups- Ascocarps, basidiocarps, ascogonium, perithecium, ascothecium, cleistothecium,

3.3. General account of Lichens- classification based on thallus morphology; major mycobionts and phycobionts.

3.4 Economic and ecological importance of fungi and lichens. Major Fungal diseases of plants, pets and human beings.

Module 4. Diversity of plants (12 hrs)

4.1. General characters of algae and their classification up to classes (F E Fritsch); Range of thallus variation in Algae.

4.2. Salient features of Bryophytes and brief account on their classification

4.3. General account on the characteristics of Pteridophytes and brief account on their classification

4. 4 Economic and ecological importance of Algae and Bryophytes and pteridophytes: food, industry, medicine, biofertilizers; algal bloom. Importance of Algae in Fisheries and livestock management. Role of Algae and Bryophytes in ecological succession and soil formation.

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Compound microscope and its parts.
2. Study of plant cell structure with the help of epidermal peel mount of Onion/*Crinum*/*Rheo.*
3. Diversity of cells- prokaryotic (*Nostoc*), eukaryotic (*Spirogyra*, *Oedogonium*, stomata of different leaves, Trichomes).
4. Study of non-living inclusions: cystolith (*Ficus*), raphides (*Pistia*), aleurone grains(Castor) and Starch grains (Rice, Wheat and Potato)
5. Photographs of Herbs, Shrubs, Trees, Creepers, Twiners, Lianas and Epiphytes from local sites.
6. Geotaggged Photographs of algae (2), bryophytes (5) and Pteridophytes(10).
7. Geotagged photographs of any 5 fungal fruiting bodies from the premises of.house and college
8. Collection, classification and documentation of different types of plants- algae, bryophytes and Pteridophytes.
9. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Geological time scale
2. Theories and experiments on evolution of life- classical and modern
3. Comparative account on different plant groups
4. Comparative account on prokaryotes and eukaryotes

Suggested Assignment Topics- Practical

1. Microphotographs of different stomata and trichomes
2. Collection of different mushrooms and their submission
3. Preparation of Album of fungal fruiting bodies.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	De Robertis E.D. and De Robertis E.M.F. (2017). Cell and Molecular Biology 8th Edition. Lee and Fab International edition, Philadelphia.	1, 2
2	Pawar, (2019).Cell Biology, Himalaya Publishing House, Mumbai.	1, 2
3	Rastogi, S.C. (2016).Cell and Molecular Biology. New Age International Publishers, New Delhi.	1, 2
4	Verma P.S. and Agarwal V.K. (2016).Cell Biology (Cytology, Biomolecules, Molecular biology),Paper back, S.chand and Company .Ltd.	1, 2,
5	Kumar H D and H N Sharma, (1979). A textbook on Algae,	4
6	Dube, H.C. (2008). Fungi, Bacteria and Viruses. Agrobios	3
7	Sambamurty A. V. S. S., (2006). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. I.K. International publication, New Delhi.	4
8	Arumugam N, Annie Ragland and V Kumaresan, A textbook of Botany, Saras Publication	4
9	Annie Ragland, V Kumaresan and Arumugam N, (2020). A text of Botany- algae, Fungi, Bryophytes, Microbiology and Plant Pathology,	3, 4

	Saras Publication.	
10	Pandey, S. N. & Misra, S. P. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.	4
Core Compulsory Readings		
1	Karp, G. (2010), Cell Biology, John Wiley & Sons, U.S.A. 6th edition.	
2	Misra, A., & Agrawal, P. R., (1978). Lichens. Oxford and IBH, NewDelhi	
3	Singh, G. (2010). Plant systematics - an integrated approach (3rd Edn) Science Publishers	
4	Bell, A.D (1991). Plant form- An illustrated guide to Flowering plant morphology. Oxford University Press, New York, Tokyo.	
5	Gangulee, S.C., Das, K.S., Dutta, C.D., & Kar, A.K., (1968). College Botany Vol. I, II and III. Central Education Enterprises.	
Core Suggested Readings		
1	Starr, C., (2007). Biology: concepts and applications. VI edn. Thomson Press.	
2	Raven, P.H., Evert, R.F., & Eichhorn, S.E., (2013). Biology of plants. VIIIth Ed. W.H. Freeman Publishers.	

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- What are the two main types of cells, and what distinguishes them from each other?
- List out any four features of fluid mosaic model of the cell membrane and its significance in cell biology.
- Differentiate pit from pit fields
- What are the functions of plant roots?
- Differentiate phycobiont from mycobiont with examples

3 Marks Questions (Applying and Analyzing):

- Using a diagram, illustrate the structure of a plant cell wall and explain its functions.
- The distribution and structure of chloroplast helps in the functioning of photosysntheis. Substantiate.
- Analyze the implications of the endosymbiotic theory for our understanding of cellular evolution.

- Explain the vegetative thallus of ascomycete fungi.

5 Marks Questions (Evaluating and Creating):

- Evaluate the impact of advancements in cell biology on modern scientific research and technology.
- Knowledge in biodiversity is highly essential for the economic growth and human welfare. Substantiate the statement.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in cell biology as well as in diversity of life

42	Plant Ecology and Phytogeography	KU1DSCBOT104
Semester : 1 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Acquisition of basic knowledge in ecology and phytogeography.
CO2	Understanding the dynamic nature of ecosystems in particular and biosphere in general.
CO3	Understanding the basic relationships that exist among different species.
CO4	Ability to apply the concepts gathered in this course to the field of evolution and modern ecology
CO5	First -hand experience in observing the major ethical and legal aspects in environmental sciences.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√							
CO3			√	√								
CO4								√	√	√		
CO5											√	√

Course Description
This is an intermediate minor course designed for BSc Zoology, Forestry and Microbiolgy students. It emphasizes on the basic principles and processes that are very relevant to the vast field of environmental sciences.
• *First module is an introduction to environmental sciences.* • *Second module emphasizes on the basic structure of Ecosystem* • *Third module is related to the function and dynamics of ecosystem.* • *Fourth module is mainly focused on the basic principles of phytogeography and relationship of plant with biodiversity.*
This course will also provide opportunities to do some laboratory work to find out the adaptations of plants as well as regional differences in physicochemical parameters of various ecosystems.

Course Objectives:

1. To enable the student to appreciate bio diversity and the importance of various conservation strategies, laws and regulatory authorities.
2. To recognise the need for more research to create a baseline data for sustainable exploitation- Think globally and Act locally
3. To observe and analyse the interrelationship between the geography and pattern of distribution of plants.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Introduction to Environmental Science (5 hrs)

1.1. History, scope and importance of ecology and environmental science.
1.2. Difference between ecology, environmental biology and environmental science and environmental studies.
1.3. Branches of ecology- autecology, synecology.
1.4. Motto and Achievements of Major Indian Institutes and Research Centres in Ecology and Environmental Science.

Module 2. Basic Structure of Ecosystem (8 hrs)

1. Structure and hierarchy of ecological units- species, population, community, ecosystem, biome and biosphere.
2. Basic structure of ecosystem- Factors affecting the structure of ecosystem-biotic- Producers, consumers and decomposers; and abiotic- climatic, edaphic, physiographic.
3. Concept of food chain and food web, Energy flow, 10% theory. Ecological Pyramids- Pyramid of numbers, biomass and energy. Erect and inverted.
4. General structure of pond and forest ecosystem.

Module 3. Function and Dynamics of Ecosystem (20 hrs)

3.1. Concept of Productivity. Primary productivity, Secondary Productivity, GPP and NPP. Comparative account on productivity major ecosystems in the biospehere. Concept of Biogeochemical Cycles. Carbon Cycle, Nitrogen Cycle, Sulphur and Phosphorus Cycle. Water Cycle.
3.2. Concept of habitat and ecological niche, Ecotone and Edge Effect. Concepts in ecospecies- Ecads and Ecotypes.
3.3. Concept of Succession: Types, characteristic features, structure of each substages in Xeracrh, Hydrarch and Mesarch.
3.4. Adaptations -morphological, anatomical and physiological in Hydrophytes, Xerophytes, Halophytes, Epiphytes and Parasites.

Module 4. Role of plants and Phytogeography (12 hrs)

4.1. Role of plants in structure, function and evolution of existing ecosystems. Deforestation and its ill effects on biodiversity and ecosystems.
4.2. Biodiversity. Definition and Types. India as a megadiversity centre. Endangered and endemic plants of India with special emphasis to Western Ghats.
4.3. Phytogeography- Definition, concepts --Descriptive and dynamic -Continental drift, age and area theory,
4.4. Plant migration and barriers. Topographic factors- Altitude and latitude. Vegetation types of India
.

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Study of ecological and anatomical modifications of xerophyte, hydrophyte, halophyte, parasite and epiphyte.
2. Estimation of DO and BOD and calculate the primary productivity of pond water.
3. Observation of ecads and ecotypes, if available in the college campus.
4. Estimation of biodiversity in the premises of house and college campus.
5. Collection of maps showing hotspots of biodiversity.
6. Visit to a local polluted site and/or reserve forest. for documentation of major pollutants/species
7. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Structure of Ecosystem
2. Food chain and Food Webs in Nearby locality
3. Vegetation types of India

Suggested Assignment Topics- Practical

1. Visit to pond ecosystem and estimation of physicochemical parameters
2. Estimation DO in different temperatures

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Kumaresan V and N Arumugam, 2020. *Plant Ecology & Phytogeography* – Saras Publication	1, 2, 3,4
2	Deka U and T Datta, 2023. *Plant Ecology and Phytogeography*, Asian Humanities Press	1, 2, 3, 4
3	Ambasht RS and N K Ambasht, 1988. Text book of Plant Ecology, Students Friends.	1,2, 3
4	Bhatnagar A, 2010. Ecology and Environment. Oxford	1, 2,3
5	Bharucha F R, 1983. A text book of the Plant Geography of India, Oxford University Press.	4
6	Mc Dougall, W B B, 2022. Plant Ecology, Legare Street Press.	2, 3
Core Compulsory Readings		
1	Kormondy, E. 1989. *Concepts of Ecology* (3rd Ed.). Printice Hall of India, New Delhi.	
2	Schulze E. D., Beck, E., & Klaus Mü ller-Hohenstein. (2005). Plant ecology. Springer.	
Core Suggested Readings		
1	Bock, J. H., Linhart Y B, Stebbins G L and C E Turner, 2020. The Evolutionary Ecology of plants. CRC Press.	
2	Pullaiah, T, 2024. Biodiversity Hotspot of the Western Ghats and Sri Lanka. Apple Academic Press.	

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- List out any two environmental science research institutes in India and their major achievements
- Define ecological niche with example.
- Differentiate GPP and NPP
- List out the similarities of Food Chain and Food web
- Enlist any four morphological adaptations of Xerophytes with example.

3 Marks Questions (Applying and Analyzing):

- Discuss the adaptive features of Halophytes and list out the similarities with xerophytes.
- How does altitude and latitude influences the plant vegetation?
- What are the similarities and dissimilarities between autecology and synecology.

5 Marks Questions (Evaluating and Creating):

- How do anthropogenic land conversion and natural succession influence ecosystem dynamics? Illustrate with specific impacts on biodiversity and ecosystem services.
- Mangrove ecosystems are found to be more productive and diverse. Substantiate and evaluate this statement based on Edge effect.

Employability for the Course / Programme

It is one of the basic minor courses which is very essential for understanding the diversity of plants and their ecosystems.

43	Reproduction and Life cycle of plants	KU2DSCBOT105
Semester : 2 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Acquisition of basic knowledge in diversity of reproduction and life cycle among life forms, especially plants.
CO2	Understanding of the terms used in the description of diverse forms of life.
CO3	Understanding the basic differences that exist among different reproductive methods of plants.
CO4	Ability to apply the concepts gathered in this course to the field of evolution and advanced diversity and ecological studies.
CO5	Firsthand experience in viewing the diversity using laboratory procedures and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√							
CO3			√				√					
CO4								√	√			
CO5											√	√

Course Description
This is an introductory biology course designed for UG students in general and BSc Zoology BSc Microbiology and BSc Forestry in particular. The aim of the course is to give basic knowledge about the diversity of plant life forms.
• *First module deals with the reproduction and life cycles of plants.* • *Second module focuses on the reproduction algae and bryophytes.* • *Third module gives an idea on the reproduction of pteridophytes and gymnosperms.* • *Fourth module delves into the reproduction in angiosperms.*
This course will also provide opportunities to observe and experience diverse forms of plant reproduction through various laboratory sessions.

Course Objectives:

1. Understanding of the fundamental concepts in reproduction and life cycle of plants.
2. Concept development in diversity of general growth and development plants.
3. Enable the student to appreciate bio diversity.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Reproduction and Life cycles of plants (20 hrs)

1. Definition and significance of Reproduction. Brief account on reproduction of prokaryotic and eukaryotic cells. A comparative account on reproduction among different Fungal groups.
2. Types of reproduction with examples- vegetative, asexual and sexual reproduction. Importance of reproductive methods in identification and classification of plants. General Account on Vegetative methods with examples: Buds, Bulbils, Fragmentation; Asexual reproduction with examples- Spores- Zoospores, Hypnospores, Chlamydospores.
3. Sexual reproduction- Characteristics and Substages- Gametogenesis and Fertilization. Comparative account on reproduction among different plant groups. Brief account on post fertilization changes. Types of sexual reproduction–Isogamy, Anisogamy and Oogamy with examples.
4. Different Life cycles -haplontic diplontic, haplodiplo biontic life cycles.

Module 2. Diversity of reproduction in Lower plants (8 hrs)

1. Vegetative methods of reproduction among different algal groups.
2. Sexual reproduction in Algae- General and comparative account.
3. Vegetative methods of reproduction among different groups of Bryophytes. .
4. Sexual reproduction in Bryophytes. General and comparative account

Module 3. Diversity of reproduction in Higher plants (7 hrs)

1. Vegetative methods of reproduction among different pteridophyte groups.
2. Sexual reproduction in Pteridophytes- General and comparative account.
3. Vegetative methods of reproduction among different groups of Gymnosperms.
4. Sexual reproduction in Gymnosperms. General and comparative account.

Module 4. Diversity of reproduction in Angiosperms (10 hrs)

1. Vegetative methods of propagation in angiosperms-natural- root stem and leaf as propagules and human intervention- budding, layering, grafting and micropropagation.
2. Sex organs of angiosperms- flower –parts and their function.
3. Brief account on gametogenesis in plants; Types of pollination; Pollen tube growth and fertilization. Brief account on embryo and seed development.
4. Life cycle of angiosperms. Seed- germination-sapling establishment- vegetative growth-flowering – pollination – pollen tube growth – fertilization embryo formation – fruits.

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Collection of different types of flowers, inflorescence, fruits and seeds.
2. Observation of conjugation in Spirogyra.

3. T.S of mature anther
4. Observation of Dicot embryo and Monocot embryo.
5. Dissection of Embryo from Flower buds
6. Digitalisation of any one -Flower/inflorescence/placentation/flower as a modified shoot/anthers/pollinia or any other
7. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Comparative analysis of different reproductive methods in different plant groups
2. Poster preparation on life cycles of different groups
3. Vegetative propagation methods in various crops

Suggested Assignment Topics- Practical

1. Observe diverse reproductive structure in major plant groups and classification of collected specimens
2. Finding out the mixed characters in the inflorescences of common plants.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Pandey, S. N. (2009). Plant Anatomy and Embryology. India: Vikas Publishing House Pvt Limited	4
2	Bhojwani, S. S, Bhatnagar, S. P., and Dantu, P. K. (2015). The embryology of angiosperms. Vikas Publishing House	4
3	Singh A K and Kumar A, (2023). Plant Propagation and Nursery management, AK Kataria and Sons.	1, 4
4	Kumar H D and H N Sharma, (1979). A textbook on Algae,	2
5	Vasishta, P. C. (1980). Gymnosperms, S Chand & Co., Ltd., New Delhi	3
6	Sambamurty A. V. S. S., (2006). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany. I.K. International publication, New Delhi.	2, 3
7	Arumugam N, Annie Ragland and V Kumaresan, A textbook of Botany, Saras Publication	1,2, 3, 4
8	Annie Ragland, V Kumaresan and Arumugam N, 2020. A text of Botany-algae, Fungi, Bryophytes, Microbiology and Plant Pathology, Saras Publication.	2, 3
9	Pandey, S. N. & Misra, S. P. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.	4
10	Vashista, B. R, (1993). Gymnosperms, S Chand & Co., New Delhi.	3
Core Compulsory Readings		
1	Maheshwari, P. (1971). An introduction to the embryology of angiosperms. Tata McGraw Hill Publishing Company Ltd., New Delhi.	
	Vashista, B. R, (1993). Bryophyta, S Chand & Co., New Delhi.	
	Vashista, B. R, (1993). Pteridophyta, S Chand & Co., New Delhi.	
2	Davis W, (2006). Plant Propagation. Read Books.	
Core Suggested Readings		
1	Kains M. G., 2010. Propagation of plants - A complete guide for professional and amateur growers of plants by Seeds, Layers, Grafting and Budding, With Chapters On Nursery And Greenhouse Management, Read Books.	

2	Raven, P.H., Evert, R.F., & Eichhorn, S.E., (2013). Biology of plants. VIIIth Ed. W.H. Freeman Publishers.
3	Starr, C., (2007). Biology : concepts and applications. VI edn. Thomson Press.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- Discuss the most important two stages in an amphimictic life cycle
- Define haplontic life cycle and cite an example
- Draw a neat labeled diagram of mature anther T S

3 Marks Questions (Applying and Analyzing):

- Comment on 'Flower is a modified shoot'.
- Compare and contrast Orthotrpus and Anatropus ovules with examples.
- Distinguish different types of endosperms.
- Distinguish the lomentum fruit from the legume type.

5 Marks Questions (Evaluating and Creating):

- Describe megasporogenesis and female gametophyte formation in *Polygonum* with the help of neat labeled diagram.
- Distinguish different types of Racemose inflorescence with the help of diagrammatic sketches and brief description of salient features of each type.
- Botanists classify inflorescences into three or four types. Nature doesn't obey our classification rules. Substantiate the two statements.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in cell biology as well as in diversity of lif

44	Angiosperm Taxonomy and Morphology	KU2DSCBOT106
Semester : 2 **Hrs/week: 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 200-299 level
2. Ability to write examination in Englis**h**

Course Outcomes	
CO1	Understanding of the fundamental concepts in morphological characters and classification of Angiosperms.
CO2	Concept development in diversity that exist in angiosperms through studies in vegetative and floral morphology.
CO3	Enable the student to classify different types flower, inflorescences, fruits and seeds.
CO4	Skill in comparison by observing the features, both vegetative and reproductive, and thereby classification of angiosperms.
CO5	Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√							
CO3			√				√					
CO4								√	√			
CO5											√	√

Course Description
This is an introductory biology course designed for UG students in general and BSc Zoology BSc Microbiology and BSc Forestry in particular. The aim of the course is to give basic knowledge about the diversity of plant life forms.
• *First module deals with the reproduction and life cycles of plants.* • *Second module focuses on the reproduction algae and bryophytes.* • *Third module gives an idea on the reproduction of pteridophytes and gymnosperms.* • *Fourth module delves into the reproduction in angiosperms.*
This course will also provide opportunities to observe and experience diverse forms of plant reproduction through various laboratory sessions.

Course Objectives:

1. Understanding of the fundamental concepts in reproduction and life cycle of plants.
2. Concept development in diversity of general growth and development plants.
3. Enable the student to appreciate bio diversity.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Vegetative morphology 5 Hrs

Root- Types of roots and brief account on modifications Stem- Types of stem and brief account on modifications

Leaf - simple, compound; venation and phyllotaxy and brief account on modifications

Module 2. Reproductive Morphology 8 hrs

Inflorescence: racemose, cymose and special types

Flower as a modified shoot, structure of flower - floral parts, their arrangement, relative position; cohesion and adhesion of floral parts, symmetry of flowers; types of aestivation and placentation; floral diagram and floral formula.

Module 3. Angiosperm Classification 7 Hrs

Systems of classification Artificial, Natural of Phylogenetic (Brief account only). Nomenclature-Binomial system of nomenclature, ICBN (Brief account only)

Bentham & Hooker's system of classification (Up to series) and its merits and demerits. Herbarium technique. Significance of herbaria and botanical gardens; important herbaria and botanical gardens in India.

Module 4. Representative Angiosperm Families 15 Hrs

Study the following families of Bentham and Hookers system of classification with special reference to major identifying characters and economic importance.

Annonaceae, Malvaceae, Fabaceae (with special emphasis to Subfamily Papilionoidiae, two others mention only), Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Euphorbiaceae, Orchidaceae. Evolutionary significance of the families studied

Primitive and advanced characters of the families mentioned above. Evolutionary significance of Angiosperms-relationship with gymnosperms

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Identify different types of inflorescences and fruits included in the syllabus by affixing photographs in the record
2. Learning family characteristics by demonstrations in the laboratory using one typical plant from each family Annonaceae, Malvaceae, Fabaceae (with special emphasis to Subfamily Papilionoidiae), Rubiaceae, Asteraceae, Apocynaceae, Solanaceae and Euphorbiaceae
3. Learning to describe plants in technical terms identifying the family to which the plant belongs.
4. Each student shall submit 10 herbarium specimens belonging to the families included in the syllabus & field book for evaluation
5. Documentation of the practical works – videos, microscopic photo, diagrams and photographs

into a record book.

Suggested Assignment Topics- Theory

1. Comparative analysis of different reproductive methods in different plant groups
2. Poster preparation on life cycles of different groups
3. Vegetative propagation methods in various crops

Suggested Assignment Topics- Practical

1. Observe diverse reproductive structure in major plant groups and classification of collected specimens
2. Finding out the mixed characters in the inflorescences of common plants.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Gangulee, S.C., Das, K.S., Dutta, C.D., & Kar, A.K., (1968). College Botany Vol. I, II and III. Central Education Enterprises	1,2, 3, 4
2	Baruah A, 2023. Angiosperm Taxonomy, Asian Humanities Press	3, 4
3	Gupta R.K. (1981). A Text Book of Systematic Botany, Atma Ram & Sons, Delhi	3, 4
4	Tewari L M and Jeewan S. Jalal (2011). Flowering Plants- Angiosperms, Jagdamba Publishing Company, New Delhi.	1, 2, 3,4
5	Harris JG and M W Harris, 2001. Plant Identification Terminology: An Illustrated Glossary, Spring Lake Publishers	1, 2, 3, 4
6	Ragland A and V Kumaresan, Angiosperms,Saras Publication	2, 3
7	Pandey, S. N. & Misra, S. P. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.	3, 4
8	Singh V, Pande P C and D K Jain, 2019. Taxonomy of Angiosperms, Rastogi Publications.	3
Core Compulsory Readings		
1	Gifford, E.M., & Foster, A.S., (1988). Morphology and Evolution of Vascular Plants. W.H. Freeman & Company, New York	
2	Simpson M G, (2019). Plant Systematics, Academic Press.	
3	Sharma ,O.P. (2010). Plant Taxonomy, The Mc Graw Hill Companies	
Core Suggested Readings		
1	Douglas, E. & Soltis *et al*. (2005). Phylogeny and Evolution of Angiosperms. Sinauer Associates Inc.	
2	Kitching, I.J. *et al*. (1998). Cladistics – the theory and practice of Parsimony Analysis. Oxford University Press.	

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	

• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- What are the major features of polypetalae?
- Define aestivation
- Name any two phyllotaxy with appropriate examples.
- Expand ICBN

3 Marks Questions (Applying and Analyzing)

- Flower is a modified shoot. Substantiate with the help of any four features.
- Position of gymnosperm in Bentham and Hookers' classification is found to be less significant. Apply the concepts of primitive and advanced characters in pheanerogams to substantiate the statement.
- How does herbaria preparation helps in plant taxonomy?

5 Marks Questions (Evaluating and Creating):

- Tubers are different in its morphology. Critically evaluate this statement.
- Asteraceae is having several advanced and primitive characters. Classify the characters of asteraceae to advanced and primitive; in a tabular form.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in cell biology as well as in diversity of life

45	Diversity of Plants II	KU3DSCBOT206
Semester : 3 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 100-199 level.
2. Completed the course Diversity of Plants I
3. Ability to write examination in English

Course Outcomes	
CO1	Acquisition of basic knowledge in the diversity among life forms, especially on plants.
CO2	Understanding of the terms used in the description of diverse forms of life.
CO3	Understanding the basic differences that exist among different groups of plants.
CO4	Ability to apply the concepts gathered in this course to the field of evolution and advanced diversity and ecological studies.
CO5	First-hand experience in viewing the diversity using laboratory procedures and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1V	√	√	√									
CO2			√	√	√							
CO3				√	√	√						
CO4								√	√			
CO5										√		√

Course Description
This is an intermediate biology course designed for UG students in general and BSc Zoology BSc Microbiology and BSc Forestry in particular. The aim of the course is to give basic knowledge about the diversity of plant life forms.
• *First module gives an idea on reproduction and lifecycle of algae through type organism studies.* • *Second module focuses on the features and life history of selected fungal taxa.* • *Third module is a discussion on bryophytes and pteridophytes, with an emphasis to reproduction and life cycle.* • *Fourth module is dealing with the reproductive structure and life cycle of gymnosperms.*
This course will also provide you opportunities to observe diverse cells and hands-on training to identify stages of mitosis and meiosis during laboratory sessions.

Course Objectives:

1. Understanding of the fundamental concepts in description of plants.
2. Concept development in structure and reproduction of lower groups of plants.
3. Enable the student to appreciate biodiversity.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Algae (15 hrs)

Reproduction and life history of the following groups with reference to the types mentioned (Excluding the developmental stages).

a) Cyanophyceae – *Nostoc*
b) Chlorophyceae –*Volvox*, *Spirogyra* and *Chara.*
c) Phaeophyceae – *Sargassum*
d) Rhodophyceae – *Polysiphonia*

Module 2. Fungi (10 hrs)

General characters, thallus structure, reproduction and life history of the following groups with reference to the types mentioned:

a) Zygomycotina – *Rhizopus*
b) Ascomycotina – *Penicillium*
c) Basidiomycotina – *Agaricus*

Module 3. Bryophytes and Pteridophytes (12 hrs)

General characters and classification -Morphology, anatomy, reproduction and life cycle of *Riccia* and *Funaria.*

General characters - Structure and reproduction of *Selaginella* and *Nephrolepis*

Module 4. Gymnosperms (8 hrs)

General characters - Structure and reproduction of *Cycas and Pinus*

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Identification of the vegetative & reproductive structures: Cyanophyceae – *Nostoc;* Chlorophyceae –*Spirogyra* and *Chara;* Rhodophyceae – *Polysiphonia*; *Selaginella; Cycas*
2. Study of vegetative structures – *Volvox* colony, *Sargassum* lateral, *Riccia* thallus, *Cycas* Leaflet TS
3. Study of reproductive structures – *Spirogyra* lateral and scalariform conjugation; *Rhizopus* zygospore and sporangiospore; *Agaricus* Basidiocarp entire and Gill TS, *Nephrolepis* sporophyll T S, *Cycas* sporophylls (entire), *Pinus* male and female cones (entire).
4. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Thallus structure in algae
2. Cell Structure and Pigments in mentioned algal genera

3. Lifecycle in algae with examples
4. Morphological variation in bryophytes
5. Variation in Reproduction among fungi
6. Leaf structure in Pteridophytes
7. Distribution of Gymanosperms
8. Fossil gymnosperms
9. Poster presentation in Life cycle of Algae, Archegoniates and Fungi.

Suggested Assignment Topics- Practical

1. Fungal culture and collection
2. Bryophyte collection
3. Variation in Sporangium and sporophyll of ferns
4. Collection of algae from ponds

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Bilgrami K S and L C Saha, (2020). A Textbook of Algae,Athithi Books.	1
2	Sundararajan S, (2023). Introduction to Algae, V M Books	1
3	Singh, V, Pande P C and D K Jain, (2017). Archegoniate (bryophyta, pteridophyta & gymnosperms), Rastogi Publications.	2, 3, 4
4	Yadav, S.,2022. Archegoniate with practical, Mahaveer Publications.	2,3, 4
5	Singh, V, Pande P C and D K Jain, (2022). Botany Archegoniates And Plant Architecture, Rastogi Publications	2, 3, 4
6	Sirka, Y., (2021). An Introduction to Archegoniate Plants: Bryophytes, Pteridophytes and Gymnosperms, Academic Aspirations.	2, 3, 4
Core Compulsory Readings		
1	Pandey, A, Malhotra, S, Shukla, K, Husain, M, Saxena, S, (2023). Plant architecture: insights from Archegoniate, Book Saga Publications.	
2	Acharya, B C, (2020). Archegoniates, Kalyani Publishers.	
Core Suggested Readings		
1	Vanderpoorten, A and B Goffinet, (2009). Introduction to Bryophytes, Cambridge University Press.	
2	Price D and C Bealey, (2022). A field guide to Bryophytes, Species Recovery Trust.	

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5

• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- What is meant by stele? Give an example for polystele from Pteridophytes.
- Give a short note on heterospory with an example.
- Differentiate elaters from spores
- List out any four reserve food materials specific to algal groups.

3 Marks Questions (Applying and Analyzing):

- Amphibians are having the ability to live in two types of habitats. Comment on amphibious nature of bryophytes.
- Comment on the peculiarities of *Polysiphonia* life cycle.
- Write short note on different life cycles in algae.

5 Marks Questions (Evaluating and Creating):

- Critically analyze the characters of *Cycas* and comment on the xerophytic nature.
- Give a comparative account on reproductive structures in fungi.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in biology as well as in daily life

46	Angiosperm Anatomy and Embryology	KU3DSCBOT207
Semester : 3 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 200-299 level
2. Ability to write examination in English

Course Outcomes	
CO1	Knowledge in the internal structure of angiosperm.
CO2	Understanding of the anatomical, palynological and embryological related terms used in the description of diverse forms of life.
CO3	Understanding the variations in the internal structure and reproduction that exist in various plant groups.
CO4	Interpret the adaptive and protective mechanisms exhibited by plants in response to various environmental conditions.
CO5	Ability to apply the concepts in the field of evolution and diversity studies.
CO6	Firsthand experience in viewing cells under microscope and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1V	√	√	√									
CO2			√	√	√							
CO3				√	√	√						
CO4								√	√			
CO5										√		√

Course Objectives

1. Understand plant tissue classification, structure, and functions.
2. Explore plant anatomy, including primary structures and tissue systems.
3. Study plant reproduction mechanisms and embryology.
4. Develop practical skills in observing and analyzing plant structures and tissues.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Tissues 10 Hrs

Tissues – meristematic and permanent; classification of meristems based on position, origin; Organization of shoot apex and root apex- Histogen theory & Tunica corpus theory. Simple and complex tissues, secretory tissues (nectarines and hydathodes). Vascular bundles – types: conjoint collateral, bicollateral, concentric and radial.

Module 2. Anatomy of root, stem and Leaf 10 Hrs

Primary structure of monocots and dicots –root, stem and leaf. Secondary thickening in dicot

stem and dicot root. Anomalous secondary thickening in *Boerhaavia.* Heart wood and sap wood; tyloses; hard wood and soft wood; growth rings, dendrochronology.

Module 3. Embryology 15 Hrs

Introduction and Historical account of Embryology.

Structure and functions of Microsporangium and wall layers. Microsporogenesis and development of male gametophyte.

Megasporogenesis and development of female gametophyte (*Polygonum*, *Allium* and *Peperomia*). Types of ovules.

Pollination-mechanism. Fertilisation. Endosperm – structure, development and types (Nuclear, Cellular, Helobial, Special type – Ruminate). Embryo – Structure and development of Dicot embryo, Monocot embryo. Polyembryony- Classification and Significance, Apomixis, Agamospermy- Apospory and Parthenocarpy.

Module 4. Fruits, Seeds and Palynology 10 Hrs

Fruits-classification- simple, aggregate and multiple

Seeds – Definition, Types, Structure and germination.

Palynology - Pollen structure and Morphology, Acetolysis of pollen grain. Economic importance, Pollen allergy.

Plant animal Interaction in pollination and seed dispersal. Co-evolution of plants and insects, Role of Plant-Animal interactions in sustainability of ecosystem. Brief account of myrmecophily, chiropterophily.

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Observation of apical meristems in root and stem.
2. Microphotographs of different types of tissues- Parenchyma- Aerenchyma, Chlorenchyma (Spongy, Palisade), Collenchyma, Sclerenchyma, Xylem and Phloem
3. Microphotographs of different types of tissue systems- trichomes, stomata- Dicot and Monocot
4. Primary structures in dicot stem (*Centella*), root (*Tinospora*), and leaf (*Ixora*) and monocot stem (Grass), root (*Colocasia*), and leaf (Grass).
5. Secondary Structures in Dicot root (*Tinospora*) and Stem (*Vernonia*)
6. Anomalous secondary thickening in *Boerhaavia* stem.
7. TS of Mature anther- *Datura*, *Ixora*
8. Observation of Pollinia- *Calotropis*/ Orchids
9. Embryos of Monocots and Dicots
10. Documentation of the practical works – videos, microscopic photo

Suggested Assignment Topics- Theory

1. Comparative analysis of different reproductive methods in different plant groups
2. Poster preparation on life cycles of different groups
3. Vegetative propagation methods in various crops

Suggested Assignment Topics- Practical

1. Observe diverse reproductive structure in major plant groups and classification of collected specimens
2. Finding out the mixed characters in the inflorescences of common plants.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Pandey, S. N. (2009). Plant Anatomy and Embryology. India: Vikas Publishing House Pvt Limited	1, 2, 3
2	Bhojwani, S. S, Bhatnagar, S. P., and Dantu, P. K. (2015). The embryology of angiosperms. Vikas Publishing House	3
3	Pandey, B P, (2001). Plant Anatomy, S Chand Publications	1,2, 3
4	Siddiqui G A, (2012). Plant Anatomy, Pragun Publications.	2
5	Rudall, P A, (2020), Anatomy of Flowering Plants An Introduction to Plant Structure and Development, Cambridge University Press.	4
6	Spjut, R. W, (1994). A Systematic Treatment of Fruit Types, The Newyork Botanical Garden.	4
7	Dutta A C, 1964. A Class Book of Botany, Oxford University Press	1,2, 3, 4
8	Gangulee, H C and A K Kar, 2011. College Botany- Volume I, II, III New Central Book Agency (P) Ltd.	1,2, 3, 4
Core Compulsory Readings		
1	Maheshwari, P. (1971). An introduction to the embryology of angiosperms. Tata McGraw Hill Publishing Company Ltd., New Delhi.	
2	Crang, R, S L Sobaski and R, Wise, (2018). Plant Anatomy: A Concept-Based Approach to the Structure of Seed Plants, Springer.	
3	Davis W, (2006). Plant Propagation. Read Books.	
Core Suggested Readings		
1	Kains M. G., (2010). Propagation of plants - A complete guide for professional and amateur growers of plants by Seeds, Layers, Grafting and Budding, With Chapters On Nursery And Greenhouse Management, Read Books.	
2	Raven, P.H., Evert, R.F., & Eichhorn, S.E., (2013). Biology of plants. VIIIth Ed. W.H. Freeman Publishers.	
3	Starr, C., (2007). Biology: concepts and applications. VI edn. Thomson Press.	

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

Marks Question

- Discuss the most important two stages in an amphimictic life cycle
- Define haplontic life cycle and cite an example
- Draw a neat labeled diagram of mature anther T S

3 Marks Questions (Applying and Analyzing):

- Comment on 'Flower is a modified shoot'.
- Compare and contrast Orthotrpus and Anatropus ovules with examples.
- Distinguish different types of endosperms.
- Distinguish the lomentum fruit from the legume type.

5 Marks Questions (Evaluating and Creating):

- Describe megasporogenesis and female gametophyte formation in *Polygonum* with the help of neat labeled diagram.
- Distinguish different types of Racemose inflorescence with the help of diagrammatic sketches and brief description of salient features of each type.
- Botanists classify inflorescences into three or four types. Nature doesn't obey our classification rules. Substantiate the two statements.

ility for the Course / Programme

It is one of the basic courses which is very helpful in understanding the fundamental concepts in cell biology as well as in diversity of life

47	Forest Botany	KU3DSCBOT208
Semester : 3 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Completed the minor courses in the first two semesters
3. Ability to write examination in English

Course Outcomes

CO1	Knowledge in the basic concept and principles of forest botany.
CO2	Understanding the fields of application of botanical knowledge in the field of botan
CO3	Understanding the plant adaptations in forest ecosystem with an emphasis to Western Ghats.
CO4	Interpret the adaptive and protective mechanisms exhibited by plants in response to various environmental conditions.
CO5	Ability to apply the concepts in the field of evolution and diversity studies.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√							
CO3				√	√	√						
CO4								√	√			
CO5										√		√

Course Description
This is a comprehensive course designed for UG students in general and BSc Zoology and BSc Forestry in particular for understanding the applications of botany in understanding forest ecosystems. It covers taxonomy and morphology of forest plants that equips students for sustainable forest management. The aim of the course is to give basic knowledge about the diversity of plant life forms.
• *First module gives glimpses of forestry and its relation with botany.* • *Second module is an account on flora of Western Ghats and their adaptations.* • *Third module emphasizes on forest trees of Western Ghats.* • *Fourth module delves into the utilitarian aspect of forests.*
This course will also provide opportunities to observe diverse forms of plant life in forests and will help in future entrepreneurship.

Course Objectives:

1. Understanding of the fundamental concepts in forest botany.
2. Concept development in basic structure and reproduction of forest plants.
3. Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Introduction to forestry 10 Hrs

Definition, role direct and indirect benefits. General account on forest types in the World. Classification, Status and distribution of forests, with special reference to India. Comparative primary productivity of different types of forest ecosystems in the world. Basic concepts on Forest types of India and Kerala Champion & Seth Revised system of classification

Module 2. Diversity of plants in forests in Western Ghats 10 Hrs

Types of plant forms in tropical rain forests-Trees, Herbs, Shrubs, Creepers, Lianas, Twiners, Epiphytes. Annuals, Biennials, Perennials. Major plant groups- bryophytes, Pteridophytes, gymnosperms and angiosperms. Adaptation in forest environment- Structure of leaves, stem wood , bark and roots in trees, Adaptations with special reference to shade tolerance, leaf modifications, Root systems, seed dispersal mechanisms , epiphytic adaptations and mycorrhiza associations

Types of woody plants. Comparative wood anatomy of gymnosperms and angiosperms. Soft wood and hardwood. Dendrochronology and Dendroclimatology.

Module 3. Major forest trees of Western Ghats 10 Hrs

Concept of Endemic and RET plants. Significance, Threats and consequences of loss. Red data book, An overview of major RET and Endemic trees of Western Ghats. Role of vegetative characters in identification of forest trees- the bole, buttresses, flute, leaf characters, colour of younger and older leaves, characteristic of bark, blaze and exudations. Tree identification and classification based on morphology of stem and leaves and architecture. Tree forms, shapes and architecture. Importance scope of dendrology

Module 4. Useful Forest products and plants 10 Hrs

Major Timbers, Non timber forest products- bamboo and canes, resins, tannins, honey, Forest products and their utilization in industries and entrepreneurships

An overview of Gadgil Committee Report, Oommen V Ommen report.

Module 5. TEACH Space 15 Hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Collection of forest products.
2. Visit to forest area and document the diversity.
3. Collect news and photographs regarding the forest.
4. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Vegetation types of India
2. Types of products and their documentation

Suggested Assignment Topics- Practical

1. Microphotographs of all practical works
2. Collection documentation and classification of diverse forms of plant life in forestry.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Shanmughavel P, 2014. Forest Botany, Pointer Publishers	1, 2, 3,4
2	Negi S S, 2012. Forest Botany, Bishen Singh Mahendrapal Singh	1, 2, 3, 4
3	Sarmah D, 2024. Distribution of trees across the Western Ghats in Karnataka, Notion Press.	2, 3, 4
4	Pullaiah, T., 2024. Biodiversity Hot Spots of the Western Ghats and Srilanka, CRC Press.	2,3
5	Mukherjee, P, 2016. Flora of the Southern Western Ghats and Palnis, Niyogi books.	2, 3
6	Bor, N. L. (1953). Manual of Indian forest botany. Manual of Indian forest botany.	2, 4
7	Sivanna, H, 2012. Handbook on Forest Biology, Discovery Publishing House	1, 2, 3, 4
8	Raj, A J., 2013. Forestry Principles And Applications, Scientific Publishers	1,2, 3,4
Core Compulsory Readings		
1	Grebner D.L., 2024. Introduction To Forestry and Natural Resources, Elsevier.	
2	Burton, L D, 2019. Introduction To Forestry Science, Cengage India.	
Core Suggested Readings		
1	Sterck, F., & Turnbull, C. (2005). Woody tree architecture. Annual Plant Reviews, Plant Architecture and its Manipulation, 17, 210-237.	
2	FAO. (2015). *Global Forest Resources Assessment*. Rome: FAO of United Nations.	

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

➢ Define Forest Botany

- Give the botanical name and peculiarities of good timber
- Expand RET. Give an example from Western Ghats
- Differentiate Woods from forests

3 Marks Questions (Applying and Analyzing):

- Analyse the major reasons to consider Western Ghats as Biodiversity hot spot?
- List out the major reasons for the deterioration of Western Ghats and explain.

5 Marks Questions (Evaluating and Creating):

- Critically comment on Gadgil Committee Report and Add a note on the strategies that can be used to manage Western Ghat's biodiversity.
- Give a detailed account on different landscapes and forest types present in Western Ghats.

Employability for the Course / Programme

It is one of the advanced courses which is very helpful in understanding the diversity of plant life

1	Plant Diversity		KU1MDCBOT101
MDC	Semester : 1	Hrs/week: 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Acquisition of basic knowledge in botany.
CO2	Understanding of the major terms used in botany and the way of scientific description of diverse forms of life.
CO3	Understanding the basic differences that exist among diverse groups of plants.
CO4	Ability to apply the concepts gathered in this course to move forward in botanical studies.
CO5	First-hand experience in viewing the diversity using laboratory procedures and there by induction of enthusiasm in biological studies.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√		√	√						
CO3						√						
CO4									√	√		
CO5											√	√

Course Description
This is an introductory biology course designed for all UG students who are interested in botanical studies in future and presently are having a shallow knowledge in the field of biology. The aim of the course is to give basic knowledge about botany and the diversity of plant life forms.
• *First module gives details on branches of botany* • *Second module focuses on the classification of plants* • *Third module gives a detailed account on vegetative morphology of angiosperms.* • *Fourth module is a brief account on the reproductive morphology of angiosperms.*
This course will also provide opportunities to observe diverse forms of plant life of lower groups including fungi, during theory and laboratory sessions designed by the teacher.

Course Objectives:

1. Understanding of the fundamental nature of science, namely botany.
2. Concept development in identification, description and classification of plants.
3. Enable the student to appreciate bio diversity for sustainable development.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	45	25	50	75

COURSE CONTENT

Module 1. Botany as a science 8hrs

Botanical History: Contributions of eminent botanists: Theophrastus and Carl Linnaeus. Indian contributors- Itty Achudan and Van Rheed. E K Janaki Ammal, M S Swaminathan. Plants and their value- economic-food and fibre, timber- both natural and processed; medicinal- drugs and medicines; aesthetic - in gardening and landscaping; ecological - Producer and habitat for several organisms.

Module 2. Classification of Plants 6 hrs

Herbs, shrubs, trees, climbers, creepers, twiners, epiphytes and parasites. Annuals, biennials, and perennials.
Distinguishing features of major plant groups with an emphasis to vegetative morphology and prominent reproductive features- Algae, Bryophytes, Pteridophytes, Gymnosperms and Angiosperms.

Module 3. Vegetative morphology of Angiosperms 6hrs

Roots- Morphological Structure, function and Modifications-tubers (carrot), prop root (*Ficus*), stilt root (*Rhizophora*) and pneumatophores (*Avicennia*)
Stem- Morphological Structure –node- internode; Modifications- phylloclade (*Opuntia*), cladode (*Asparagus*), tuber (potato), rhizome (ginger).
Leaves- Basic morphology- Phyllotaxy- alternate, opposite, whorled. Venation- Parallel and reticulate. Modifications.

Module 4. Reproductive morphology Angiosperms 10 hrs

Flower- parts- calyx, corolla, androecium, gynoecium. Trimerous, tetramerous and pentamerous flowers with examples. Aestivation - Valvate (in calyx- *Hibiscus*) Twisted (in corolla- *Hibiscus*), Vexillary (*Clitoria*).
Inflorescence – Racemose, Cymose, Special and Mixed types. Raceme – in *Crotalaria, Caesalpinia*, Sunflower, *Anthurium*, Coconut. Cymose- Jasmine and *Hamelia*. Special- *Euphorbia, Ficus*. Mixed- *Ocimum, Clerodendrum panniculatum.*
Fruits- Simple- Berry- Tomato; Drupe- Coconut; Aggregate- *Polyalthia*; Multiple fruit- Jack fruit.
Seeds- General structure. Dicot and Monocot. Germination- Hypogeal and epigeal germination.

Module 5: TEACH Space 15 hrs (Only suggested list of topics and activities; that helps to achieve the aim, objectives and outcome of the course, which can be finalized by the concerned teacher. Assessment for this module is ***strictly internal***.)

Research potentials in Botany 2 hrs

Branches in Botany- Taxonomy, Morphology, Anatomy, Physiology. Pure and Applied Branches. Interdisciplinary and Multidisciplinary branches- with major applications of these branches.

Brief Account and Research potentials in: Plant systematics, Ecology, Plant anatomy, Plant physiology, Genetics, Ethnobotany, Crop improvement & Plant genetic engineering.

Practicals 13 hrs. This module is a list of suggested activities; which will be determined by the concerned teacher.

1. Reading on *Hortus Malabaricus*, Contributions of E K Janaki Ammal, Green revolution, and Life history and achievements of MS Swaminathan.
2. Observation of diversity in vegetative characters in the premises.
3. Documentation of diversity in flowers, inflorescences, fruits and seeds; in the premises.
4. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Gangulee, S.C., Das, K.S., Dutta, C.D., & Kar, A.K., (1968). College Botany Vol. I, II and III. Central Education Enterprises.	1, 2, 3, 4
2	Manilal, K.S. (2003). *Van Rheede's Hortus Malabaricus. English Edition*, with Annotations and Modern Botanical Nomenclature. (12 Vols.) University of Kerala, Trivandrum.	1
3	Iyer R D, 2021. M S Swaminathan	1
4	Dutta A C, (2000). A class book of botany, Oxford University Press.	1, 2, 3, 4
5	Suresh Narayana P and T. Pullaiah, 2021. Eminent Indian Botanists: Past and Present Biographies and Contributions, Regency Publications.	1
Core Compulsory Readings		
1	Baker. H.G. 1970. Plant and Civilization, Wadsworth Publishing Company	
2	Hait, G., 2023. Introductory Botany Vol – II, Asian Humanities Press, Global net Publication.	
3	Hait, G., 2024. INTRODUCTORY BOTANY - II : Morphology and Reproduction of Spermatophytes, Asian Humanities Press, Global net Publication.	
Core Suggested Readings		
1	Starr, C., (2007). Biology: concepts and applications. VI edn. Thomson Press.	
2	Raven, P.H., Evert, R.F., & Eichhorn, S.E., (2013). Biology of plants. VIIIth Ed. W.H. Freeman Publishers.	

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5

• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

- What are the two main types of cells, and what distinguishes them from each other?
- List out any four features of fluid mosaic model of the cell membrane and its significance in cell biology.
- Differentiate pit from pit fields
- What are the functions of plant roots?
- Differentiate phycobiont from mycobiont with examples

3 Marks Questions (Applying and Analyzing):

- Using a diagram, illustrate the structure of a plant cell wall and explain its functions.
- The distribution and structure of chloroplast helps in the functioning of photosysntheis. Substantiate.
- Analyze the implications of the endosymbiotic theory for our understanding of cellular evolution.
- Explain the vegetative thallus of ascomycete fungi.

5 Marks Questions (Evaluating and Creating):

- Evaluate the impact of advancements in cell biology on modern scientific research and technology.
- Knowledge in biodiversity is highly essential for the economic growth and human welfare. Substantiate the statement.

Employability for the Course / Programme

It is one of the basic courses in botany that is very helpful in understanding the fundamental concepts in botany, diverse forms of plant life and their description as well as classification. It is one of the course designed for a better start of a botanical journey in academics.

2	Botany for the Beginners		KU1MDCBOT102
MDC	Semester : 1	Hrs/week: 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Basic knowledge in botany
CO2	Understanding of the terms, concepts and basic nature of botany and its applications in human welfare.
CO3	Understanding the Ecological relations of plants.
CO4	Application of the concepts of botany and knowledge in plant diversity in future activities and also for the profession.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√		√	√						
CO3						√						
CO4									√	√		

Course Description
This is a foundation course in botany designed for all UG students in general with an aim to give basic knowledge about plants, their diversity and diverse applications in human welfare.
• *First module is emphasizing on the general classification of living forms.* • *Second module is dealing with the description and classification of higher plants.* • *Third module delves into the ecological roles of plants.* • *Fourth module is giving an idea on the application of plant into various aspects of human life.*
This course will also provide opportunities to observe diverse forms of plant life within the premises and will help to widen the knowledge in botany.

Course Objectives:

1. Understanding of the fundamental concepts in Botany.
2. Concept development in description and classification of plants.
3. Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany.
4. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/enterpreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	45	25	50	75

CONTENT

Module 1. Living world 6 hrs

Concept of Living and Non Living: Origin of Life. Viruses, Bacteria, Fungi, Plants and Animals; Five kingdom Classification. General characters of major plant groups- Algae, Bryophytes, Pteridophytes, gymnosperms and angiospersm. Life cycle of angiosperms plants.

Module 2. Major features of Angiosperms 6 hrs

Typical angiosperm plant: Functions of each organ viz. Root, Stem, leaves, inflorescence, flowers, fruit and seed.

Flower: Basic structure - essential and non essential whorls. Trimerous, tetramerous and pentamerous flowers with examples. Aestivation - Valvate (in calyx- *Hibiscus*) Twisted (in corolla- *Hibiscus*), Vexillary (*Clitoria*).

Inflorescence – Racemose, Cymose, Special and Mixed types. Raceme – in *Crotalaria*, Sunflower, Cymose- Jasmine. Special- *Ficus.* Mixed- *Ocimum.*

Fruits- Simple- Berry- Tomato; Drupe- Coconut; Aggregate- Polyalthia; Multiple fruit- Jack fruit.Seeds- General structure. Dicot and Monocot.

Module 3. Ecological role of plants 8hrs

Ecological Significance of Plants – Solar energy fixing Producers and Nitrogen fixation, Symbiotic relationships of plants – Lichens, Azolla and Blue green alga, Parasitism.

Plants and Animals for pollination and seed/fruit dispersal- Pollination- Entomophily, Chiropterophily, Myrmecophily. Seed Dispersal: Zoochory,

Specific case studies on examples for co evolution- Dodo and Calvaria, Butterflies and plants; Wasps and Ficus, mimicking for pollinators.

Module 4. Applications of Plant biology 10Hrs

Agriculture-Crop improvement-weed control and management-Integrated pest management- plant propagation- intercropping- crop rotation- biofertilisers, biopesticides, Plant breeding- Medicine-Plant derived drugs in various systems of medicine- netraceuticals and pharmaceuticals.

Environmental management- Gardens and biodiversity conservation- Productivity and role in biogeochemical cycling. Green corridors and belts

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Collection, documentation and observation of plants in the premises.
2. Collection of information on role of plants in various aspects of human life.
3. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Group wise characters of plants
2. Life cycle of plants

Suggested Assignment Topics- Practical

1. Photographs of different plants in the premises

2. Microphotographs of all practical works
3. Collection documentation and classification of diverse forms of plant life

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Hait, G., 2023. Introductory Botany Vol – I, Asian Humanities Press, Global net Publication.	1, 2, 3,4
2	Sen K and P Giri, 2024. Fundamental Botany, Santra Publication Pvt Ltd	4
3	Dutta A C, (2000). A class book of botany, Oxford University Press.	1, 2, 3, 4
4	Gangulee, S.C., Das, K.S., Dutta, C.D., & Kar, A.K., (1968). College Botany Vol. I, II and III. Central Education Enterprises.	1, 2,3, 4
Core Compulsory Readings		
1	Hait, G., 2023. Introductory Botany Vol – II, Asian Humanities Press, Global net Publication.	
2	Hait, G., 2024. INTRODUCTORY BOTANY - II : Morphology and Reproduction of Spermatophytes, Asian Humanities Press, Global net Publication.	
Core Suggested Readings		
1	Starr, C., (2007). Biology: concepts and applications. VI edn. Thomson Press.	
2	Raven, P.H., Evert, R.F., & Eichhorn, S.E., (2013). Biology of plants. VIIIth Ed. W.H. Freeman Publishers.	

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question
- ➢ What are the major features Kingdom Protista
- ➢ Define Primary Productivity

3 Marks Questions (Applying and Analyzing):
- ➢ Alga is a synthetic term to denote organisms belonging to different plant groups. Analyse.
- ➢ Basic knowledge about plants helps in improving human welfare. Give a short note.

5 Marks Questions (Evaluating and Creating):
- ➢ Plants are the dominating component of any ecosystems, that plays a key role in shaping of ecosystems. Critically evaluate.

Employability for the Course / Programme

It is one of the foundation courses which is very helpful in understanding the diversity of plant life and its application in various aspects of human life.

3	Beginner's Exploration to the world of leaves and flowers	KU2MDCBOT103
MDC	Semester : 2	Hrs/week: 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Ability to identify and describe the external morphology of a leaf and its parts.
CO2	Appreciation of the significance of leaves in plant identification and classification.
CO3	A comprehensive understanding the structure and function of flower and floral parts.
CO4	Acquisition of basic knowledge in the stages of reproduction in flowering plants and their importance in plant life cycles.
CO5	Ability to integrate their knowledge on leaf morphology, flower structure, and reproductive biology for further understanding of biology and ecology.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2		√		√								
CO3					√	√						
CO4							√		√			
CO5											√	√

Course Description
This is a foundation course designed for UG students in general and for BSc Zoology, BSc Microbiology and BSc Forestry in particular. This course provides a foundational understanding of structure, function and diversity among leaves and flowers into various studies in botany, ecology, and related fields and also for the application in bouquet making and other interior decorations.
• *First module identifies and describes the external morphology of a leaf, including the blade (lamina), petiole, stipules, and veins.* • *The second module provides an overview of the significance of leaves in plant identification and classification.* • *The third module focuses on the structure and function of flowers.* • *The fourth module covers flower development and reproduction.*
In this course, participants have the opportunity to delve into a wide array of plant leaves and flowers.

Course Objectives:

1. To identify different types of plant leaves and flowers based on their unique characteristics.
2. To get a basic knowledge in classification of flowers and leaves based on their structures, functions, and other features.

3. To appreciate the vast diversity present in plant leaves and flowers, recognizing the range of shapes, sizes, colors, and adaptations that exist in the plant kingdom.
4. to apply their knowledge of plant leaves and flowers in real-world contexts, such as gardening, landscaping, bouquet making, interior decorations and plant conservation efforts.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	45	25	50	75

COURSE CONTENT

Module 1: Basics of Leaf Structure, Function, and Diversity 8 hrs

External Structure: Blade (Lamina), Petiole, Stipules and Veins.

Leaf Arrangements: Alternate, Opposite, Whorled: Leaf Diversity: Leaf Types: Simple Leaves: Compound Leaves: Leaf Shapes: Elliptical, Lanceolate, Ovate. Leaf Margins: Entire, Serrated, Lobed. An overview of leaf apices.

Internal Structure: Epidermis, Mesophyll, Palisade Mesophyll, Spongy Mesophyll and Stomata.

Module 2: Leaf Diversity for various uses 8 Hrs

Role of Leaf in plant Life: Photosynthesis, Gas Exchange, Transpiration, Guttation, Storage, Protection. Leaf Senescence and Colour changes during development with examples. A brief account on leaf pigments. Dye yielding leaves. Modifications of leaves. Reproduction from leaves. Modern methods of propagation using leaves. Leaf spray in agriculture and horticulture. Significance of Phylloplane and Phyllosphere..

Significance of Leaf study in various fields. Adaptations and leaves. Evolution and leaves. Taxonomy and Leaves. Role in Ecosystem Dynamics- Allelopathy, Humus formation and Soil biodiversity. Medicinal and cultural uses of leaves.

Module 3. Sex organ of angiosperms – the flower: Structure and Function 6 hrs

Parts of a flower. Various types of flowers- based on symmetry, position of ovary, number of floral units, complete or incomplete, cohesion and adhesion.

Inflorescences- Racemose, Cymose and Special and Mixed. Special structures – Bracts, Bracteoles.

Fruits and seeds the end products of sexual reproduction.

Module 4. Flower Development and Reproduction- 8 Hrs

Flower/ inflorescence development stages: From bud to Anthesis, Pigments in flowers. Colour changing flowers. Adaptations for attraction of pollinators.

Fruit/Seed development and Fruit ripening and colour change. Diversity in dispersal of fruits and seeds.

Pollinators and Pollination mechanisms. Floral mimicry and deception. Fruit and seed dispersal and germination mechanisms with an emphasis to zoochory and germination with the help of animals. Case study- Rafflesia and elephant, Loranthus and Birds, Calvaria and Doddo.

Economic significance of flowers: Agriculture, horticulture, and floriculture. Medicinal and cultural uses of flowers.

Module 5. TEACH Space (15 hrs):

Theory: 5 hrs

Importance of leaves and flowers/inflorescence in various decorations- vase, wreath, garlands, stage arrangements, arch makings. Making methods. An overview of major flowers and leaves used in decorations- live and dead/preserved. Methods to increase the longevity and prevention of senescence. Wet and dry methods of preservations. Local case studies – during religious customs and ritual practices.

PRACTICALS 10 hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Microscopic observation of internal structure of leaf.
2. Observation and collection of different types of leaves.
3. Ecological variation in leaves.
4. Dissect out diverse flowers.
5. Students observe pollination in action by observing flowers in the college campus.
6. Organize symposium and workshops on floral decoration /bouquet making.
7. Visits to local farms or floral markets.

Suggested Assignment Topics- Theory/Practical

1. Leaf Morphology Comparative Analysis
2. Leaf Function Experiment Report
3. Leaf Diversity Field Guide
4. Taxonomic Classification Project
5. Ecosystem Dynamics Case Study
6. Leaf Identification Challenge
7. Flower Dissection Lab Report
8. Pollinator Observation Field Journal
9. Flowering Plant Life Cycle Diagram
10. Flowering Plant Classification Poster
11. Economic Importance of Flowers Presentation

Suggested readings specific to the module.		
Sl. No	**Title/Author/Publishers of the Book specific to the module**	**Module No.**
1	Ollerton J, 2020. Pollinators and Pollination: Nature and Society, Pelagic Publishing	4
2	Hait, G., 2023. Introductory Botany Vol – I, Asian Humanities Press, Global net Publication.	1, 2, 3,4
3	Sen K and P Giri, 2024. Fundamental Botany, Santra Publication Pvt Ltd	1, 2, 3, 4
4	Dutta A C, (2000). A class book of botany, Oxford University Press.	1, 2, 3, 4
5	Gangulee, S.C., Das, K.S., Dutta, C.D., & Kar, A.K., (1968). College Botany Vol. I, II and III. Central Education Enterprises.	1,2, 3, 4
Core Compulsory Readings		
1	"Botany for Gardeners: An Introduction and Guide" by Brian Capon	
2	"The Botany of Desire: A Plant's-Eye View of the World" by Michael Pollan	
3	"Plant Systematics: A Phylogenetic Approach" by Walter S. Judd, Christopher S. Campbell, Elizabeth A. Kellogg, and Peter F. Stevens	

4	"Botany in a Day: The Patterns Method of Plant Identification" by Thomas J. Elpel
5	"The Hidden Life of Trees: What They Feel, How They Communicate – Discoveries from a Secret World" by Peter Wohlleben
6	"Indian Herbalogy of North America: The Definitive Guide to Native Medicinal Plants and Their Uses" by Alma R. Hutchens
7	"Flowers of India" by Dinesh Valke
8	"The Book of Indian Trees" by K. C. Sahni
9	"Indian Medicinal Plants: An Illustrated Dictionary" by C.P. Khare
10	Natália O. Leiner, André R.T. Nascimento and Céline Melo Plant Strategies For Seed Dispersal In Tropical Habitats: Patterns And Implications - Tropical Biology And Conservation Management – Vol. I - Encyclopedia of Life Support Systems (EOLSS)
Core Suggested Readings	
1	Abrol D P, 2012. Pollination Biology: Biodiversity Conservation And Agricultural Production, Springer.
2	Roberto Caballero, Elizabeth V. Reyes and Luca Invernizzi Tettoni, 2012. Decorating with Flowers: A Stunning Ideas Book for all Occasions, Tuttle Publishing.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group Discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

1. How do the blade (lamina), petiole, stipules, and veins contribute to the external morphology of leaves?
2. What are the main components of leaf internal anatomy, and how do they facilitate leaf functions?
3. When might leaves exhibit different types of arrangements such as alternate, opposite, or whorled?
4. What are the primary functions of leaves, including photosynthesis, gas exchange, transpiration, storage, and protection?
5. How do simple and compound leaves differ, and what are some examples of each type
6. How do leaf shape and size serve as key identifying features in plant classification?
7. What are venation patterns in leaves, and when are they used for classification?
8. When are apex/base shapes of leaves important in identifying plant species

9. What is the significance of taxonomic classification in identifying plant families and genera?
10. Why are stamen, pistil, petals, and sepals essential reproductive structures in flowers?
11. When do flowers typically utilize wind, water, insects, and animals for pollination?
12. How do flowers adapt to different pollination mechanisms?
13. What are the stages of flower development from bud to fruit?
14. Why is it important to differentiate between pollination and fertilization in flower reproduction?
15. When does seed development and dispersal typically occur in the life cycle of a flowering plant?
16. How do adaptations in flowering plants contribute to their survival and reproduction

3Marks Questions (Applying and Analyzing):

1. Identify and describe the external morphology of a leaf, including the blade (lamina), petiole, stipules, and veins.
2. Explain the internal anatomy of a leaf, including the epidermis, mesophyll (palisade and spongy), and stomata.
3. Understand the functions of leaves, including photosynthesis, gas exchange, transpiration, storage, and protection.
4. Recognize different leaf types, such as simple and compound leaves.
5. Identify various leaf shapes, including elliptical, lanceolate, and ovate.
6. Describe different leaf arrangements, such as alternate, opposite, and whorled.
7. Differentiate between various leaf margins, including entire, serrated, and lobed.

5 Marks Questions (Evaluating and Creating)

1. Describe in detail the external morphology of a leaf, highlighting the significance of the blade (lamina), petiole, stipules, and veins. Explain how variations in these structures contribute to leaf diversity.
2. Discuss the internal anatomy of a leaf, including the epidermis, mesophyll (palisade and spongy), and stomata. Explain how each component facilitates leaf functions such as photosynthesis, gas exchange, and transpiration.
3. Compare and contrast simple and compound leaves, providing examples of each type and explaining their structural differences and potential advantages in various environments.
4. Analyze the diversity of leaf shapes, including elliptical, lanceolate, and ovate. Discuss the adaptive significance of different leaf shapes in relation to environmental factors and ecological niches.
5. Evaluate the importance of leaf arrangements, such as alternate, opposite, and whorled, in plant physiology and ecology. Discuss how different arrangements may reflect adaptations to specific environmental conditions.
6. Explain how leaf shape and size, leaf arrangement, and venation patterns serve as key identifying features in plant classification. Provide examples of how these features are used to classify different plant species.
7. Discuss the significance of taxonomic classification in plant biology, focusing on its role in identifying plant families and genera. Explain how taxonomic classification reflects evolutionary relationships among plants.

8. Analyze the functional adaptations of leaves to different environmental conditions, including structural modifications and physiological processes. Discuss how these adaptations enhance plant survival and reproduction.
9. Evaluate the ecological importance of leaves in ecosystem dynamics, including their role in primary productivity, nutrient cycling, and habitat provision. Provide examples of how leaves contribute to ecosystem services and biodiversity.
10. Discuss the potential impacts of environmental changes, such as climate change and habitat loss, on leaf diversity and plant communities. Evaluate strategies for conserving leaf diversity and promoting sustainable plant ecosystems.

Employability for the Course / Programme

"A Beginner's Exploration to the World of Leaves and Flowers" provides a gateway to various career paths within the realm of botany, horticulture, and environmental education. Graduates can find employment as botanical technicians, gardening assistants, floral designers, and nature educators, utilizing their knowledge of leaves and flowers to contribute to plant research, landscape design, and environmental advocacy.

4	Agrobiodiversity		KU2MDCBOT104
MDC	Semester : 2	Hrs/week: 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Basic knowledge in agro-biodiversity.
CO2	Understanding the historical context of plant and animal domestication.
CO3	Appreciation of the ecological benefits provided by agro-biodiversity.
CO4	Recognition of the critical role of agro-biodiversity in ensuring food security, nutrition, and its economic and cultural significance in agricultural systems.
CO5	Understanding of the importance of agro-biodiversity in sustainable agricultural practices, fostering resilience and environmental sustainability in farming systems.

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	POS8	POS9	POS10	POS11	POS12
CO1	√	√	√									
CO2			√		√							
CO3				√	√		√					
CO4								√	√			
CO5										√	√	√

Course Description
This course explores the variety and variability of plants, animals, and microorganisms used directly or indirectly for food and agriculture. It covers the concepts, importance, and conservation strategies of agro-biodiversity, focusing on sustainable agricultural practices and the impact of modern agricultural techniques.
• *First module covers the fundamentals of Agro-biodiversity Introduction.* • *The second module focuses on assessment and Threats to Agrobiodiversity.* • *Third module deals with Sustainable Agricultural Practices* • *Fourth module covers Modern Agricultural Technologies*
In addition, this course offers practical sessions on model organisms, providing you with opportunities to explore a wide range of angiosperms and their diversity. By combining theoretical learning with hands-on experiences, the course offers a structured approach to comprehending agro-biodiversity, ensuring a holistic understanding of the subject matter.

Course Objectives:

1. Understand the concept and components of agro-biodiversity.
2. Recognize the importance of agro-biodiversity in sustainable agriculture.
3. Identify the threats to agro-biodiversity and strategies for its conservation.
4. Explore traditional and modern agricultural practices and their impact on agro-biodiversity.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	45	25	50	75

COURSE CONTENT

Module 1: Introduction to Agro-biodiversity 8Hrs

Definition and scope of agro-biodiversity, Components of agro-biodiversity: Genetic, species, and ecosystem diversity, Historical perspective on the domestication of plants and animals, Importance of Agro-biodiversity- Role in food security and nutrition, Ecological benefits: Soil health, pollination, pest and disease control, Economic and cultural significance. Rice varieties of Kerala and contribution of Cheruvayal Raman.

Module 2: Assessment and Threats to Agrobiodiversity 12 Hrs

Methods and tools for measuring agro-biodiversity, Species Richness, Genetic Diversity, Ecosystem Diversity, Agro-Ecological Methods. On-farm conservation vs. ex-situ conservation- On-farm Conservation-definition, advantages, challenges. Ex-situ Conservation: Conservation-definition, advantages, challenges. Modern agricultural practices: Monocultures, use of pesticides and fertilizers, Climate change and its impact, Habitat loss and degradation

Module3: Sustainable Agricultural Practices- Organic farming 5 Hrs

Agroforestry and Crop rotation and polycultures. Traditional Knowledge and Agro-biodiversity- Indigenous farming practices, Role of traditional knowledge in conservation, Case studies from different regions. PPVFRA and Concept of Genomic Saviours- Shaji -the tuber saver. Praseed Kumar Thayyil and Sunil Kumar M. of Wayanad district. John Joseph of Kozhikode district and Vinod E.R of Thrissur district.

Module 4. Modern Agricultural Technologies for Agrobiodiversity Management 5 Hrs

GMOs and their impact on agro-biodiversity- Genetic erosion. Agricultural biodiversity management Strategies- Good agricultural practices to manage agricultural biodiversity- Species-based conservation- Area-based conservation- Ecosystem approaches- Creating a supportive environment- Improving the practice of conservation on the ground.

Module 5. TEACH Space (15 hrs):

Theory- 5 hrs

Successful agro-biodiversity conservation projects. Local initiatives- Kuttiattoor Geotagged Mango. Kannapuram and Kunhimangalam Mango movements. Shimjith Thillenkery and Curcuma varieties. Ezhome Rice Project.

Practical-10 hrs

Field Visits and Practical Work- Visits to local farms, botanical gardens, or research institutions. Hands-on activities: Seed saving, soil health assessment, biodiversity surveys

Sl. No	Title/Author/Publishers of the Book specific to the module
1	D. I. Jarvis, C. Padoch, and H. D. Cooper- "Agrobiodiversity: Managing Biodiversity in Agricultural Ecosystems"
2	Food and Agriculture Organization - "The Role of Biodiversity in Agriculture: Report of an FAO/UNEP Expert Consultation"
3	P. S. Teng - "Seeds of Sustainability: Lessons from the Birthplace of the Green Revolution in Agriculture"
4	S. K. Sharma, K. S. Varaprasad, P. S. S. Rao, S. A. Tarafdar, 2019. "Agrobiodiversity Hotspots: Concepts, Conservation and Management" Springer.
5	A.K.Kandya, 2015. "Agrobiodiversity and Sustainable Rural Livelihoods", Scientific Publishers.
6	P. R. Seshagiri Rao, 2004. Agrobiodiversity in India", Concept Publishing Company.
7	T. C. James, 2008. "Agricultural Biodiversity, Biotechnology and Traditional Knowledge: Biological and Legal Correlations", Academic Foundation.
8	B. S. Dhillon, B. S. Rana, R. K. Tyagi, 2002. "Managing Agrobiodiversity: Farmers' Changing Perspectives and Institutional Responses in the Hindu Kush-Himalayan Region", International Centre for Integrated Mountain Development (ICIMOD).
9	R. S. Rana, R. K. Tyagi, T. J. H. Renault, 1997. "Conserving Agricultural Biodiversity: The IPGRI Programme in Asia, the Pacific and Oceania", International Plant Genetic Resources Institute (IPGRI).
10	M.S. Swaminathan, 1996."Agrobiodiversity and Farmers' Rights", Konark Publishers Pvt. Ltd.
11	M.S. Swaminathan,2004. "Agrobiodiversity and Sustainable Agriculture", Academic Foundation.
12	M.S. Swaminathan and S. L. Kochhar, 2000. "Biodiversity and Sustainable Food Security: Exploring the Links", Macmillan India.
13	Nayar, N M (2011), "Agrobiodiversity in a biodiversity hotspot: Kerala State, India. Its origin and status", Genetic Resources and Crop Evolution, 58(1):55-82
14	Sunil Mani, S M Mohanakumar, V Santhakumar and T Abhilash, Conservation of Agrobiodiversity: Lessons from Kerala. *https://practiceconnect.azimpremjiuniversity.edu.in/conservation-of-agrobiodiversity-lessons-from-kerala*

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Sample Questions to test Outcomes.

2 Marks Question

1. What is agro-biodiversity?
2. What are landraces?
3. When is the International Day for Biological Diversity celebrated?
4. When did the Convention on Biological Diversity come into force?
5. Why is agro-biodiversity important for food security?
6. Why should traditional farming practices be preserved?
7. How can farmers contribute to the conservation of agro-biodiversity?
8. How does climate change impact agro-biodiversity?

3 Marks Questions (Applying and Analyzing):

1. Explain the role of agro-biodiversity in enhancing ecosystem services in agricultural landscapes.
2. Analyze the impact of monoculture practices on agro-biodiversity and suggest alternative practices that could mitigate these impacts.
3. Discuss how traditional agricultural knowledge contributes to the conservation of agro-biodiversity and provide an example.
4. Evaluate the effectiveness of in-situ conservation methods for agro-biodiversity compared to ex-situ conservation. Provide examples to support your evaluation.
5. How does agro-biodiversity contribute to climate change mitigation and adaptation in agricultural systems?

5 Marks Questions (Evaluating and Creating):

1. Evaluate the impact of global agricultural policies on agro-biodiversity and propose policy changes that could promote the conservation and sustainable use of agro- biodiversity.
2. Design a comprehensive community-based program to enhance agro-biodiversity in a rural agricultural setting. Outline key components, stakeholder roles, and expected outcomes.
3. Critically assess the role of modern biotechnology in agro-biodiversity conservation. Include potential benefits and risks, and suggest strategies for integrating biotechnology with traditional conservation methods.
4. Evaluate the role of agro-biodiversity in sustainable food systems and propose a model for integrating agro-biodiversity into urban agriculture.

Employability for the Course / Programme

This foundation course on agro-biodiversity offers students a comprehensive understanding of the intricate relationships between agriculture, biodiversity, and sustainability. By delving into topics such as genetic diversity, ecosystem services, and conservation strategies, students gain valuable insights into the importance of maintaining diverse agricultural systems for food security and environmental resilience. Armed with this knowledge, graduates are well- prepared to pursue diverse career paths, from agricultural research and conservation to policy development and sustainable farming practices, thereby contributing significantly to the global efforts towards a more sustainable and biodiverse agricultural future.

5	Botanical Art		KU3MDCBOT105
MDC	Semester: 3	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understanding of various types of documentations relevant to Botany.
CO2	Skill in Botanical illustrations, Handicraft making, Photography techniques and making of herbarium
CO3	Application of various skills and knowledge in life situations
CO4	Appreciation of the use of plant parts in various handicrafts
CO5	Designing of new handicrafts and illustrations using plants

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	
CO5									√	√	√	√

Course Description

This is an introductory biology course designed for all UG students who are interested in botanical studies in future and presently are having a shallow knowledge in the field of biology. The aim of the course is to give basic knowledge about botany and its applications as an art.

- *First module is dealing with various types scientific illustration including botanical illustrations*
- *Second module is giving the information on Herbarium making*
- *Third module is composed of knowledge and understanding of various plant related handicrafts*
- *Fourth module is giving a direction towards photography.*
- *Fifth module is an innovative space for teachers and students.*

This course will provide you opportunities to observe diverse forms of botanical arts along with practical sessions on various forms of botanical art and documentations,

Course Objectives:

1.Understanding of the fundamental concepts in classification of plants.

2.Concept development in structure and reproduction of lower plants.
3.Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany.
4.Explore traditional and modern documentation methods in botany.
5.Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3	25	50	75

COURSE CONTENT

Module 1: Botanical illustration 10 Hrs

1.1 Scientific illustration- the world of Visual Science. Introduction and history- cave paintings of Paleolithic era. Anatomical illustrations of Herophilus. Botanical illustrations in *Hortus Malabaricus.*

1.2. Brief account on various types of scientific illustrations- Natural History illustrations and mappings, Restoration and illustration of extinct species, Forensic reconstruction of facial structures, Botanical illustrations, Models and images for Museum Exhibits, Infographics. Digital 3D models, animations and Videos. AI tools for Scientific illustration. Canva, Inkscape and Vectr.

1.3. Types of botanical illustrations. Basic characters and differences between the types- Botanical illustration, Botanical art, Flower paintings and plant portraiture. Tools and techniques. Pencil/Charcoal technique, Lavy ink technology, Water color, Gouache technique, Ecoline and Mixed types

1.4. Relevance and Significance of Scientific Illustrations: Advantages of botanical illustration over modern digital documentations and photographs. Linnaean Society of London and Jill Smithies Award.

Module 2: Herbarium art 5 Hrs

2.1. Herbarium-Introduction, Types of Herbaria- International, National, Local and Special with examples.

2.2. Tools and techniques used in process of making herbaria- Field visits and specimen collection, preparation, pressing, drying, poisoning, mounting, identification, labelling, cataloguing and storage.

2. 3. Major herbariums in India & world: Role and Importance of Herbarium. -Scientific & Aesthetic.

2.4. Merits and Demerits of conventional Herbaria. Electronic / Digital herbarium- merits and demerits

Module 3: Plants and Handicrafts 5 Hrs

3.1 An introduction to relevance of plants in Handicraft making- Timber and non timber plants.

3.2. Conventional and modern innovative techniques and types of Handicrafts. Major plant parts

used in handicraft making case studies – root, stem, leaf, inflorescence, Flower, Fruit and Seeds. Vegetable printing and carving. Seed jewellery.

3.3., Interior decoration- various styles and their comparative account. Domestic, office, industry. Conventional occasions of interior decoration using plants. Modern life style and importance of plants in decoration.

3.4. Plant based handicraft industry in Kerala- conventional and modern. Major plants and their parts used in Handicraft making- Socio-economic relevance.

Module 4. Botanical Photography 10 Hrs

4.1History and Basics of photography, Basic principles of different camera with an emphasis to parts, basic function, aperture and shutter speed, auto and manual focus.

4.2. Digital photography-Introduction. Factors that influence the quality of photo. Resolution and Pixel, Lens quality, Capture medium and Capture format- A comparative account on various factors.

4.3, Types of cameras used in science and research. SLR and DSLR camera. Scientific photography-photomicrography. Digital photo editing-Photoshop. Understanding different file formats-TIFF, JPEG. Applications in research.

4.4 Aesthetics of photography. Important photographic journals.

Module 5. TEACH SPACE 15 Hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 5Hrs

Microscopic photography and videography; Microphotography and Photomicrography

Animation tools for cartoon making

Practical 10 Hrs

1. Preparation of 5 scientific illustrations of plants
2. Preparation of 5 herbarium sheets and making one wall framed herbarium
3. Preparation of different handicrafts from plant parts (minimum 5)
4. Vegetable carving and printing – hands on experience
5. Microscopic photo taking sessions and learn basic picture taking using a digital camera
6. Photo editing using Adobe photoshop, using animation tool for plant growth description and seed germination and development
7. Leaf area determination using any mobile application soft ware

Suggested Assignment Topics- Theory

1. Botanical illustrations
2. Various formats of image storage and their characteristics
3. Photography basic aesthetics
4. Digital photo editing
5. LASER leaf printing

Suggested Assignment Topics- Practical

1. Botanical illustrations
2. Photography- Scenic and Microscopic
3. Digital photo editing
4. Science Poster making
5. Seed jewelry making

Sl. No	**Title/Author/Publishers of the Book specific to the module**

1	Adams, B., (2022). Botanical illustrations: Valuable reference material for anyone interested in botany and nature.
2	Blunt, W., and Stearn W. T., (2015). The Art of Botanical Illustration: An Illustrated History.
3	Bridson Dm and L Forman. (2014). Herbarium Handbook
4	Datta S K, (2015). Dry flowers technology: Dehydration of flowers, foliages and floral craft
5	Gale L A, (2018). Botanical illustration: The complete guide. The Crowood Press Ltd;
6	Guner, I., 2019. Botanical Illustration from life, Editorial Parramon, Barcelona.
7	Gurdal Pamuklu, A., & Dursin, A., (2016). Botanical illustration techniques, Global Journal on Humanites & Social Sciences. [Online]. 03, pp 298-302. Available from: http://sproc.org/ojs/index.php/pntsbs
8	Hirsch, R.J (2017): Seizing the light: A social and Aesthetic history of photography. Routiedge.
9	http://www.ibiblio.org/unc-biology/herbarium/courses/chpt31.html
10	https://bsi.gov.in
11	https://magazines.feedspot.com/nature_photography_magaz
12	https://startupmission.kerala.gov.in/
13	https://www.kew.org/
14	https://www.pinterest.com/punkgirlabby/plant-crafts/
15	https://www.princeton.edu/~ota/disk3/1984/8430/843009.PD
16	https://www.researchgate.net/publication/355574340_Plant_image
17	https://www.startupindia.gov.in/
18	Jain, S K and RR Rao (2016). Handbook of field and herbarium methods
19	King, C., 2022. The Kew Book of Botanical illustration, Search Press.
20	Massey, J.R. (1974). Chapter 31: The Herbarium. In: Vascular Plant Systemics by A.E. Radford, W.D. Dickison, J.R. Massey & C.R. Bell). Harper & Row Publishers.
21	Pandya G., MP Ranjan and Nilam Iyer (1986). Bamboo and cane crafts of Northeast India. Development Commissioner of Handicrafts, Govt. of India, National Crafts Museum.
22	Peterson B (2009). Understanding close-up photography. Amphoto books.
23	Rix, M., 2018. The Golden Age of Botanical Art, Welbeck Publishing Group, ISBN: 9780233005423
24	Taylor D, Lowe P, Sanders P and Hallet T, (2015). Digital photography complete course, DK.
25	Thiers, B. M, (202). Herbarium: The quest to preserve and classify the worlds plants
26	Woodin C and Jess R, Botanical Art Techniques, Timber press.
27	Yadav, S.S. (2020). Herbarium: Historical account, significance, preparation techniques and management issues. *Plant archives,*20(1), page:2915–2926.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION

➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practical sessions with demonstrations and hands on experiences

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Reports/ presentations/ demonstrations by the students	10

Sample Questions to test Outcomes.

2 Marks Question

1. Define herbarium.
2. How do botanical illustrations differ from botanical art?
3. List any four factors influence digital photo quality.
4. Name any two major herbaria and their significance.
5. What are the key steps in herbarium specimen preparation?
6. What are the main types of herbaria?
7. What is the significance of Paleolithic cave paintings in scientific illustration?
8. What role did Herophilus play in the history of anatomical illustrations?

6 Marks Questions

1. Analyze the role of plants in interior decoration across various styles and settings.
2. Describe different types of herbaria, and cite examples.
3. Describe the primary types of scientific illustrations
4. Describe the types of cameras and digital file formats used in science and research.
5. Evaluate how does the digital herbaria enhance botanical research and education.
6. What is *Hortus Malabaricus*? Add a note on the influence of this work in modern botanical illustration?
7. Write an account on the socio-economic relevance of plant-based handicrafts in Kerala.

7 Marks Questions

1. Describe the primary types of scientific illustrations. Add a note on the differences between botanical art and botanical illustrations.
2. Describe the tools and techniques used in the process of making herbaria. Add a note on any two major herbaria in India and their significance.
3. Examine the plant-based handicraft industry in Kerala, focusing on its traditional and modern aspects.
4. Explain digital photography and factors influencing photo quality.
5. Write an account on the advantages and disadvantages of conventional herbaria over digital herbaria.
6. Describe various types of conventional and modern innovative techniques in Handicrafts.

14 Marks Questions

1. Analyze the various types of scientific illustrations and their significance in modern science.

2. Compare and contrast the different types of botanical illustrations, focusing on their characteristics and techniques.
3. Describe the conventional and modern techniques in handicraft making using plant parts.
4. Discuss the evolution of scientific illustration from Paleolithic cave paintings to the anatomical drawings of Herophilus and the botanical illustrations in the *Hortus Malabaricus.*
5. Write an account on the history and basic principles of photography.

Employability for the Course / Programme

It is one of the challenging, for both teachers and students, and innovative course which is very helpful in understanding the diverse forms of plant utilization, mixed with the aesthetics and skill of the students to achieve the heights of entrepreneurship and self-employment and thereby provides a gateway to various career paths within the realm of botany.

6	Introductory Course on Applications of Botany		KU3MDCBOT106
MDC	Semester: 3	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understanding of various terms related to applied fields of Botany.
CO2	Understanding various processes involved in applications of Botany
CO3	Application of various knowledge in applied botany in the enhancement of life skills.
CO4	Appreciation of the works of botanists and farmers in the sustenance of human population.
CO5	Development of various innovations in the studies processes.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	
CO5									√	√	√	√

Course Description

This is a general foundation course in botany course designed for all UG students. The aim of the course is to give basic knowledge regarding various applications of botany which is relevant in all aspects of human life.

- *First module is giving an introductory idea regarding the plant life and its common uses in human life.*
- *Second module is helping the stake holder to get a knowledge on various applications of botany in agriculture.*
- *Third module deals with the applications of botany in the field of forestry.*
- *Fourth module is a module for the applications in environmental science, especially on pollution management and biofuel production.*

This course will also provide you opportunities to observe diverse applications of plants in forestry agriculture and environmental science.

Course Objectives:

1. Understanding of the fundamental applications of botany various applied fields and human life.

2. Concept development in new fields of application.
3. Enable the student to appreciate bio diversity, sustainable development with the help of their core subject and subsidiary subject botany.
4. Explore traditional and modern applications of botany.
5. Induce to experiment on the subject in an intensive way to facilitate an interdisciplinary profession/enterprise/entrepreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3	25	50	75

COURSE CONTENT

Module1: Introduction 8Hrs

1.1 Introduction, objective and importance of applied botany. History and evolution of botany. Various disciplines of botany and their applications to human welfare

1.2 Relation of plants to man and relation with other services- Cereals, Millets, Legumes, oil seed crops, forage crops, commercial crops, plantation crops, beverages crops, spices and condiments

1.3. Basic knowledge on plant growth- Plant propagation methods. Various irrigation methods. Fertilizers and nutrients required for plant growth

1.4 Basic knowledge on plant reproduction. Flowers /inflorescences- Parts of the flower, Types of pollination and pollinators. Seed setting, collection and storage.

Module 2: Agriculture and Botany 12Hrs

2.1. Soil fertility and Plants: Biological Nitrogen Fixation Symbiotic Nitrogen Fixation in Legumes, Azolla. Green manuring and Biofertilizers. Crop rotation. Herbicides and insecticides from Plants and microbes. Microbial herbicides, bacterial insecticides, entomopathogenic fungi.

2.2. Modern agriculture practices: Scientific farming and Organic farming. Polyhouse and Precision farming, Various types of soil less cultures and hydroponics. Seed manipulation for enhancement of germination.

2.3. Branches of Horticulture: Horticulture: definition and role in human welfare. Various types and their significance. Olericulture. Pomology. Viticulture. Floriculture. Turf Management. Arboriculture.

2.4. Plant tissue culture: Definition, types- callus culture, anther culture and embryo culture. and importance. rDNA Technology for insect resistance- Bt Cotton: for quality enhancement- Golden Rice and Flavr Savr tomato.

Module 3: Forestry and Botany 5Hrs

3.1 Forestry and branches of forestry. Significance of forests. Forests and Human welfare/

3.2. Forest types in India. tropical forest, subtropical forest, temperate forest and northern coniferous forest India is a megadiversity centre. Hot spots in India.

3.3. Timber products

3.4. Non timber products from forests with plant origin- honey, resin, gums, latex,

Module 4. Environmental Science and Botany 5Hrs

4.1. Various types of pollution and their impact on plants. Plants as pollution reducers- Green belt and green corridors. Bioremediation. Phytoremediation- Phytoextraction,

phytostabilization, rhizofiltration.
4.2 Carbon foot print. Carbon Sequestration and Plants. Algae for the reduction of urban pollution- case study. Biodegradable plastics. Potent plant resources of bioplastics.
4.3. Plants as biofuels: significance, biodiesel, potent crops/algae for biofuel production, Agricultural waste management - Waste minimization, utilization of agricultural wastes- biocomposting and biogas production.
4.4. IUCN and Red Data book. Threatened and Endangered plants of India.

Module 5. TEACH SPACE 15Hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 5 Hrs

Various case studies on recent application of plants in environmental science, agriculture and forestry.

Practical 10 Hrs

1. Documentation of local plants with applications in human life
2. Data collection on red listed plants
3. Visit to various waste management systems
4. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

Suggested Assignment Topics- Theory

1. Agroforestry
2. Botany and Agriculture
3. Botany and forestry
4. Botany and Environmental Science

Suggested Assignment Topics- Practical

1. Practicing composting for domestic purposes
2. Collection and documentation of NTFP

Sl. No	Title/Author/Publishers of the Book specific to the module
1	Becca H, 2015. Plants Pollen and Pollinators, Collins. ISBN: 9780008163853.
2	Das K, 2025. Economic Botany. Mahaveer Publications
3	Dave R, 2022. Morphology of Flowering Plants. Lambert Academic Publishing
4	Khillar A K, 2024. History of Botany. Prashas Research Consulting Pvt Ltd.
5	Kumar N, 2021. Introduction to Horticulture. Medtech.
6	Malwa A S, 2025. Advanced Fundamentals of Agriculture (2 Vols), Narendra Publishing House
7	Manikandan K and Prabhu S, 2023. Indian Forestry. Jain Brothers.
8	Morton A G, 1981. History of Botanical Science: An Account of the Development of Botany from Ancient Times to the Present Day. Academic Press
9	Pandey B P, 1999. Economic Botany. S Chand Publications.
10	Prasad R L, 2012. Essentials of Economic Botany. Med Tech.
11	Reddy S R and Nagamani C, 2024. Introduction to Forestry. Kalyani Publishers
12	Sett R, 2012. Environmental Science a botanical and forestry perspective. Narendra Publishing House
13	Singh J, 2018. Fundamentals of Horticulture. Kalyani Publishers
14	Singh R and Singh B K, 2020.Text book on Horticulture. New India Publishing Agency,

	ISBN: 9789389571776.
15	Walker, T. 2020. Pollination the enduring relationship between plant and pollinator. Princeton University Press.
16	Weberling F, 1992. The Morphology of Flowers and Inflorescences, Cambridge University Press.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	**50**
• University Examination	50
Continuous Comprehensive Assessment CCA	**25**
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory /FIELD reports	5
• Viva Voce	5

Sample Questions to test Outcomes.

2 Marks Question

1. Define green corridor.
2. Differentiate flowers and inflorescences.
3. Enlist the botanical name of any two medicinal plants.
4. Explain the significance of anther culture.
5. Give an account on cereals and their significance.
6. Give any two examples for biodiesel yielding plants.
7. Name any two biodiversity hotspots in India.
8. Name any two methods of plant propagation using stem.
9. What are forage crops? Give an example.
10. What is Azolla's role in agriculture?

6 Marks Questions

1. India is a megadiversity centre. Explain with evidences.
2. Give an account on different types of non- timber forest products of Kerala.
3. Write down the basic principles of phytoremediation.
4. Give a detailed account on biodegradable plastics.
5. Write down the salient features of mangrove forests India.

7 Marks Questions

1. Explain about the types of forests in India.
2. Give an account on various strategies to manage agricultural waste.

3. What is red data book? Explain the significance.
4. Define Carbon sequestration and describe its role in modern environmental management.
5. What are the features of Flavr Savr tomato and describe its significance.

14 Marks Questions

1. Give an account on different types of forest products in India.
2. Explain in detail on the types of forests in India.
3. Use of plants in environmental pollution management is inevitable. Explain with examples.
4. Modern horticultural practices are changing spontaneously. Explain the salient features of any five modern agricultural practices.
5. Nitrogen fixation and related processes are very much significant in scientific agriculture. Explain in detail.

Employability for the Course / Programme

It is one of the basic courses which is very helpful in understanding the diverse applications of plant life. It may help students to initiate various startups and self-employment opportunities in the nera future itself.

7	Microscopy and Visualisation Tools in Botany		KU3MDCBOT107
MDC	Semester: 3	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Explain the principles and applications of light and electron microscopy in plant sciences.
CO2	Understand the fundamentals of sample preparation for light and electron microscopy.
CO3	Understand the basic parts of microscope, both light and electron microscopy.
CO4	Create a scientific enthusiasm about the morphological and anatomical variation that exist among plants.
CO5	Understand how to use visualisation tools in plant systematics, anatomy, and morphology
CO6	Be familiar with the principles of digital imaging and image analysis used in the field of Botany

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	
CO5									√	√	√	√
CO6										√	√	√

Course Description

This is a GFC course designed for all UG students for imparting the knowledge on microscopy, both theoretical and practical. The aim of the course is to give basic knowledge on this important tool of biology for the study of diverse life forms.

- *First module is a general introduction to the basic principles of microscopy.*
- *Second module delves into the world of light microscopy, giving an idea on basic principles and also on various types of light microscopy.*
- *Third module is dealing with the basic principles and procedures in electron microscopy.*
- *Fourth module is an advanced module on visualization tools and image formation principles.*

This course will also provide you opportunities to observe diverse imaging techniques in

biology,

Course Objectives:

1.Understanding of basic terms and principles of microscopy.
2.Skill in working of microscopes for different applications
3.Skill in enhancing the image contrast and clarity
4.Enthusiasm to work with electron microscope

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3	25	50	75

COURSE CONTENT

Module1: Introduction to microscopy and visualization techniques 8 Hrs

Basic parts, principles of image formation in microscopy. Importance of direct and diffracted light in image formation. Types of microscopes and their uses. Simple microscope. Compound microscope. Electron microscope. Stereomicroscope. Scanning probe microscope. Importance and applications of microscopy in biology, Fundamentals of digital imaging and image analysis- Conversion of analog to Digital image – merits and demerits.

Module 2: Light microscopy 10 Hrs

Principles and applications, Sample preparation, Slide preparation for plant anatomy, Microscopy for plant morphology. Protocol for Light Microscopy. Types of light microscopy: Bright field, Darkfield, Phase contrast, Differential interference. Sample preparation for various light microscopy. Visualization and documentation tools used in Light microscopy. Micrometry. Various types of errors in image formation in light microscopy- Chromic aberration and Spherical aberration. Deconvolution in light microscopy.

Module 3: Electron microscopy 7 Hrs

Principles and applications, preparing samples for electron microscopy, Imaging of ultrastructure of different plant cells, Types of electron microscopy- SEM and TEM and their comparison.Merits and Demerits of Electron microscopy.

Module 4. Image analysis and visualization 5 Hrs

Fundamentals of image analysis, Image analysis techniques for plant systematics and anatomy, Visualisation tools for plant morphology and development, Crowd sourcing-based visualisation and analysis methods

Module 5. TEACH SPACE 15Hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 5 Hrs

Various visualization applications available for biomedical studies

Basic principles and applications of X ray and various Scanning and imaging techniques

Practical 10 Hrs

1.Visit to labs with various imaging facilities
2.Demonstration of various microscopic techniques
3.Parts of Simple and Compound microscope

Suggested Assignment Topics- Theory

1.Light microscopy
2.Electron microscopy
3.History of microscopy
4.Principles of different microscopy
5.Applications of Microscopy

Suggested Assignment Topics- Practical

1.Demonstration of Parts of microscope
2.Documentation of different parts in various types of microscopy
3.Micrometry
4.Microscopic photography
5.Demonstration of microtomy
6.Camera lucida drawings

Sl. No	Title/Author/Publishers of the Book specific to the module
1	Chandler, D E and Roberson, R W, 2009. Bioimaging: current concepts in LM & EM 1st Edn. Jones & Bartlett Publishers, ISBN 978-0-7637-3874-7
2	Croft W J, 2006. Under the microscope, A brief history of microscopy. World Scientific Pub Co Inc
3	Fournier, M. 1996. The fabric of life: Microscopy in the seventeenth century. Johns Hopkins University Press.
4	Fulekar M H and Pandey B, 2013. Bioinstrumentation, Tech Sar Pvt Ltd
5	Rost, F and Oldfield, R, 2000. Photography with a Microscope. Cambridge: University Press.
6	Spector, D L and Goldman, R D, 2006, Basic Methods in Light Microscopy Cold Spring Harbor Lab Press, ISBN 978-0879-69751-8
7	Thomas, C. and Woolnough, L. 2014. Understanding and using the light microscope. Milton Contact Ltd.
8	Veerakumari L, Bioinstrumentation, MJP Publishers
9	Watkins, S C and Croix, C M, 2013. Imaging and Microscopy Wiley, ISBN 978-1-118-04431-5
10	Webster J G, 2003. Bioinstrumentation, Wiley.
11	White, G. W, 1966. Introduction to microscopy. Butterworth.
12	Woolnough, L. 2010. Understanding and using the Stereomicroscope. Q.M.C

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	

• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Viva Voce	5

Sample Questions to test Outcomes.

2 Marks Question

1. How does a compound microscope differ from a simple microscope?
2. List out the major differences between image magnification and resolution?
3. What are the advantages of using a scanning electron microscope (SEM)?
4. What is the purpose of the diaphragm in a microscope?

6 Marks Questions

1. Explain the principle and main components of a compound microscope.
2. Give an account on light controlling techniques used in light microscopy.
3. What are the major differences between SEM and TEM
4. Write an account on the principles and components of a scanning tunneling microscope (STM)?
5. Write down the salient features and significance of stereo microscope.
6. Describe the general steps involved in preparing plant tissue samples for microscopic examination.
7. Emphasize the importance of each step in preserving cellular structures.

7 Marks Questions

1. Compare and contrast the features and application of Light microscopy and Electron microscopy.
2. Discuss the challenges faced during sample preparation for light microscopy.
3. Define chromatic aberration and spherical aberration in the context of light microscopy. Discuss their causes and methods to correct or minimize these errors.
4. Compare and contrast the two types of light microscopy: bright-field and phase contrast.
5. Evaluate the impact of different mounting media on the clarity and longevity of plant tissue slides under light microscopy.

14 Marks Questions

1. Compare and contrast simple and compound microscopes.
2. Describe the working principle of an electron microscope and its applications in biological research.
3. Discuss the importance of microscopy in biological research, including its role in cell biology and microbiology.
4. Compare and contrast the various types of light microscopy and highlight their advantages and limitations in observing plant tissues.
5. Outline the procedure for preparing microscope slides of plant tissues.

Employability for the Course / Programme

It is one of the courses that gives a foundation for the microscopic techniques through which a student can move forward through several career paths and enterpreneurships.

20	Gender: A Biological Perspective		KU3VACBOT120
VAC	Semester : 3	Hrs/week : 3 Theory + 0 Practical	Credits : 3

Course Pre-requisite:

3. Knowledge in Biology at 10th Standard
4. Ability to write examination in English

Course Outcomes	
CO1	Understanding the biological basis of gender and various terms related to gender issues.
CO2	Appreciation of the existence of diverse human beings – LGBTQ+ instead of sexual binary.
CO3	Internalisation of political correctness on gender issues.
CO4	Modification of the individual character and behavior based on the knowledge and understanding of gender issues

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√	√	√							
CO2			√	√	√	√	√	√	√			
CO3							√	√	√	√	√	√
CO4								√	√	√	√	√

Course Description

This is a value addition course in botany, designed for UG students. The aim of the course is to give basic knowledge biological basis of sex determination and gender issues.

- *First module gives an idea about the concept of gender.*
- *Second module delves into the biological aspects of gender- the sex determination.*
- *Third module is an elaborate study on the major differences between the sexes in growth and development*
- *Fourth module is giving an opportunity to discuss various ethical aspects on gender.*

This course will provide go through various case studies of gender identity and its linkage with societal characteristics.

Course Objectives:

6. To know various gender issue related terms
7. To understand the biological basis of gender
8. To create enthusiasm to know more on diverse human behaviours and biological basis of such behaviours.
9. To develop communication skills with more political correctness

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Concept of Gender 7Hrs

1.1. Definition of Gender, Sex vs. Gender, Gender Identity and expression: Social construction of gender

1.2. History of concept of Gender- Myth of binary. History of feminism, Concept of Transgender and LGBTQ+, Concept of Intersectionality.

1.3. Basis of social construction of gender- Family and Gender, Religion and gender, Education and Gender, Ecology and Gender, Science and Gender

1.4. Need, scope and significance of Gender Studies. Nature vs. nurture debate

Module 2: Biology of Sex determination 8 Hrs

2.1. Basis of Heredity-General features of Chromosomes, Genes, and DNA

2.2. Role of Chromosomes in sex determination- XX -XY mechanism, Barr body, Genic Balance theory

2.3. Role of Molecules in sex determination: Role of hormones - Estrogen, Testosterone, Progesterone

2. 4. Effects of sex hormones on the body and brain; Hormonal cycles and mood/behaviour (e.g., menstrual cycle, menopause, andropause); Hormonal influences on aggression, nurturing, and cognition

Module 3: Sexual Differentiation and Development 10Hrs

3.1. Sexual reproduction and development- Evolution of sex and mating strategies. Major variations in morphology, anatomy, and biochemistry between male and females. Variations in transgender

3.2. Embryonic development of sex organs- major stages and differences in male and female sex organ development.

3.3. Differentiation of the brain and behaviour. Mental health and gender (e.g., depression, anxiety, autism)

3.4. Role of SRY gene and androgen exposure. Intersex conditions (e.g., AIS, CAH)

Module 4. Ethical aspects of Gender 5Hrs

4.1. Misuse of biology to justify sexism or transphobia: Sex and gender based on biological essentialism. Misinterpretation of biological determinism over intersex.

4. 2. Ethical considerations in sex testing in sports: cases of Caster Semenya and Santhi Soundarajan.

4. 3. Gender verification and biomedical ethics: case of Maria José Martínez-Patiño.

4.4. Politics of biological research: Matilda effect, Neurosexism.

Module 5. TEACH SPACE (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory: **5 hrs**

Case studies on gender issues – in visual media, newspapers, television, cinema and social media. Human rights and Gender rights. Various laws and organizations and/or agencies in India on gender issue.

Practicals 10Hrs

1. Collection of data /reports on various aspects of gender
2. Discussions and debates on gender issues
3. Readings on religious texts and gender issues

Suggested Assignment Topics- Theory

6. Sex and intersex
7. History of the concept of gender
8. Concept of LGBTQ+
9. Gender Vs. Science
10. Gender Vs religion
11. Local gender issues
12. Global issues of gender
13. Nature Vs Nurture

Suggested Assignment Topics- Practical

1. Discussions and debates on LGBTQ+
2. Discussions and debates on religious thoughts and gender issues

Sl. No	**Title/Author/Publishers of the Book specific to the module**
1	Butler J, 2004. Undoing gender. Routledge.
2	Dick F. Swaab,2007. Sexual differentiation of the brain and behavior, Best Practice & Research Clinical Endocrinology & Metabolism, Volume 21, Issue 3,Pages 431-444, ISSN 1521-690X, https://doi.org/10.1016/j.beem.2007.04.003.
3	Furlich S, 2021. Sex Talk: How Biological Sex Influences Gender Communication Differences Throughout Life's Stages.
4	Hooks B, 1984. Feminist theory- from margin to centre. South End Press.
5	https://nios.ac.in/media/documents/340-Gender_Studies/Ch-1.pdf
6	https://ocw.mit.edu/courses/21a-231j-gender-sexuality-and-society-spring-2006/pages/lecture-notes/
7	https://transreads.org/wp-content/uploads/2022/01/2022-01-13_61e080ae9cdfc_TheSpectrumofSexTheScienceofMaleFemaleandIntersexbyHidaViloriMariaNietoz-lib.org_.pdf
8	https://web.stanford.edu/~eckert/PDF/Chap1.pdf
9	https://www.bba u.ac.in/docs/FoundationCourse/MPDC/understanding%20gender%20concepts.pdf
10	https://www.egyankosh.ac.in/bitstream/123456789/84912/1/Unit-1.pdf
11	https://www.ekvilib.org/wp-

	content/uploads/2017/06/01_Gender_Concepts.pdf
12	https://www.ncbi.nlm.nih.gov/books/NBK279001/
13	https://youtu.be/HLEgiR1Fsds?si=g91NljbBWO7gILsw
14	https://youtu.be/nU-rYQB_OjE
15	https://youtu.be/UD9lOllUR4k
16	Kumar N, 2022. Gender and Science -studies across Cultures, Aakar Books
17	Menon N, 2012. Seeing Like a Feminsit, Penguin Books
18	Michelle N. Arbeitman, Artyom Kopp, Mark L. Siegal, Mark Van Doren, The Genetics of Sex: Exploring Differences, *Genetics*, Volume 197, Issue 2, 1 June 2014, Pages 527–529, https://doi.org/10.1534/genetics.114.165456
19	Paulson P J, 2019. Not a Choice: What You Weren't Taught About The Biology of Sex and Gender, Handsel Pulishers Ltd.
20	Singh, L, Arya S, 2024. Feminist movements in India: Issues, Debates, Struggles, Aakar books.
21	Stryker S, 2004. Transgender History, Seal Press.
22	Watchtel S S, 1994. Molecular Genetics of Sex determination, Academic Press Inc.
23	Woolf, V. 1929. A room of one's own. Penguin books.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practical sessions with demonstrations and hands on experiences

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Participation in debates/discussions	5
• Writing assignment	5
• Reports/ presentations/ demonstrations by the students	5

Sample Questions to test Outcomes.

2 Marks Questions

1. Define gender.
2. Differentiate between sex and gender with examples.
3. In what ways does education shape gender perceptions?
4. Name any two sex hormones in human beings with its functions.
5. What are intersex conditions? Provide two examples.

6. What is a Barr body and its significance?
7. What is biological essentialism?
8. What is intersectionality, and why is it important in gender studies?
9. What is Matilda effect,
10. What is meant by transphobia?
11. What is the SRY gene and its role in sexual differentiation?

6 Marks Questions

1. Briefly describe the connection between hormonal cycles and cognition.
2. Briefly explain the term 'neurosexism'.
3. Describe morphological differences between male and female bodies.
4. Describe the role of science in constructing gender norms.
5. Discuss gender differences in the prevalence of depression and anxiety.
6. Discuss the role of testosterone in the human body.
7. Explain gender identity and expression in the context of social construction.
8. Explain the XX-XY mechanism of sex determination.
9. How do hormones influence behavior and mood?
10. How does the family contribute to the social construction of gender?
11. How has biology been misused to justify sexism or transphobia?
12. Outline the evolutionary purpose of sexual reproduction.
13. Summarize the case of Caster Semenya in relation to gender testing.
14. Summarize the Genic Balance theory of sex determination.
15. What are the functions of estrogen and progesterone?
16. What hormonal changes occur during menopause and andropause?
17. What is the significance of the myth of binary in understanding gender?
18. Why is gender studies important in contemporary education?

7 Marks Questions

1. Briefly outline the historical development of feminism.
2. Discuss how religion influences gender roles in society.
3. Discuss the ethical issues in sex testing in sports by citing examples.
4. Give a detailed account on how sex hormones affect aggression and nurturing behaviors.
5. Give a detailed account on the stages of embryonic sex organ development.
6. How do politics intersect with scientific research on gender differences? Explain the condition by citing examples.
7. How does the brain differentiate in male and female development?
8. Why is ethical scrutiny essential in biological research on gender? Give specific examples.
9. Discuss the structural and functional relationship between DNA, genes, and chromosomes.

14 Marks Questions

1. Analyze the evolutionary origins of sexual reproduction and its impact on mating strategies across species.
2. Analyze the mechanisms of sex determination in humans, focusing on the XX-XY system, the formation of Barr bodies, and the Genic Balance Theory.
3. Critically examine the myth of the gender binary. How does this binary framework limit the understanding of gender diversity?
4. Define transgender and LGBTQ+ identities. How have societal attitudes towards these identities changed, and what challenges remain?
5. Describe the embryonic development of sex organs, highlighting the major stages and differences between male and female development.
6. Discuss gender expression and its role in societal perceptions of gender. How does it differ from gender identity, and what challenges do individuals face when their expression does not conform to societal expectations?

7. Discuss the history of feminism and its impact on the understanding of gender. What key movements have shaped feminist thought?
8. Discuss the importance of gender studies in contemporary society. What insights does this field provide into human behavior and social structures?
9. Elaborate on the concept of gender identity. How does it relate to an individual's internal sense of self, and what factors influence its development?
10. Examine the roles of estrogen, testosterone, and progesterone in sexual differentiation and reproductive health.

Employability for the Course / Programme

It is one of the challenging, for both teachers and students, general foundation course which is very helpful in understanding various aspects of gender. It adds flavors to the character and behaviors of the stakeholder through the knowledge of biology behind the gender disparities.

21	Sustainable Life Style		KU3VACBOT121
VAC	Semester : 3	Hrs/week : 3 Theory + 0 Practical	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understanding of the Core Concepts of Sustainability and the SDGs
CO2	Analyze Personal and Collective Environmental Footprints
CO3	Adopt and Promote Sustainable Practices in Energy and Water Use
CO4	Demonstrate Mindful Consumption in Food and Product Choices
CO5	Evaluate the Multidimensional Benefits of a Sustainable Lifestyle

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√	√	√							
CO2			√	√	√	√						
CO3					√	√	√					
CO4								√	√	√	√	√
CO5					√	√	√			√	√	√

Course Description

This is a general foundation course in botany/plant science designed for UG students. The aim of the course is to give basic knowledge on sustainable life style and its various reflections in daily life.

First module is an introduction to the concept of sustainability.
Second module deals with various tools and techniques of environmental footprint analysis.
Third module and forth module gives a clarity in the core area- the sustainable life style.

This course will also provide an opportunity to learn the theoretical background of sustainable life style which can be applied into various aspects of daily life.

Course Objectives:

1. To introduce the fundamental concepts of sustainability.
2. To familiarize learners with global sustainability initiatives.
3. To equip learners with the knowledge and tools to measure and analyze environmental footprints.
4. To promote the adoption of sustainable lifestyle practices.

Credit	Teaching Hours	Assessment

L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to concept of sustainability: 8Hrs

1.1. Definition, features and significance of sustainability in contemporary society.

1.2. Understanding the interconnection between environmental health, social equity, and economic viability.

1.3. UNESCO and SDGs. Exploration of the SDGs and their relevance to personal and community practices.

1.4. Principles of 3R's. reducing, reusing, and recycling.

Module 2: Environmental Footprint Analysis 9Hrs

2.1. Major environmental footprints- carbon, water, energy, material and waste footprints.

2.2. Methods to assess personal footprints. Steps in Conducting an Environmental Footprint Analysis

2.3. Tools and calculators for evaluating the impact of daily activities on the environment.

2.4. GHG Protocol, Life Cycle Assessment (LCA), Water Footprint Network tools, Ecological Footprint Calculator.

Module 3: Sustainable life style – Energy, water and Renewable Resources 10Hrs

3.1. Techniques for reducing energy consumption in households and communities. Use energy-efficient appliances.

3.2. Introduction to renewable energy sources such as solar, wind, and hydroelectric power. Merits and Demerits on the transition from fossil fuels to sustainable energy solutions.

3.3. Importance of water conservation in sustaining ecosystems and human populations. Understanding water scarcity issues and global disparities in water access.

3.4. Practical methods for reducing water usage in daily activities. Fix leaks, install low-flow fixtures; Rainwater harvesting- principles and types; Use water-efficient practices in gardening.

Module 4: Sustainable life style – food and other consumables 9Hrs

4.1. Impact of food production and consumption on the environment. Significance of more plant-based foods and local and organic produce.

4.2. Reducing food waste through mindful purchasing and consumption practices. Go zero-waste or low-waste

4.3. Significance of fair trade, cruelty-free, and eco-certified products. Strategies for mindful consumption, emphasizing quality over quantity. Understanding the lifecycle of products and their environmental impacts.

4.4. Benefits of sustainable life style- Environmental, Economic, Health and Social

Module 5. TEACH SPACE 9Hrs:

This module is a list of suggested activities that helps to achieve the aim, objectives

and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 3Hrs

Role of community initiatives in promoting sustainable practices. Strategies for effective advocacy and policy influence on sustainability issues. Building networks for collective action towards sustainability goals.

Practicals 6Hrs

Sustainability Reflection Journal: Maintain a weekly journal reflecting on how sustainability connects with daily life (e.g., transport choices, food habits, etc.).

SDG Mapping Activity: Choose 2–3 Sustainable Development Goals and map how individual or community actions can contribute to each goal.

3R Audit at Home or Campus: Conduct an audit of daily waste produced and categorize it into items that can be reduced, reused, or recycled. Present findings with a suggested action plan.

Food Waste Diary: Track food waste for one week. Analyze patterns and suggest changes to reduce waste (e.g., meal planning, composting).

Zero-Waste Shopping Challenge: Visit a local market or store and attempt to make a plastic-free or zero-waste purchase. Report the experience and barriers faced.

Product Lifecycle Analysis: Choose a common product (e.g., T-shirt, mobile phone) and analyze its lifecycle—from raw material extraction to disposal. Discuss environmental impacts and alternatives**.**

Sl. No	**Title/Author/Publishers of the Book specific to the module**
1	Bawa S K, 2011. Conservation Biology: A Primer for South Asia, Universities Press (India), ISBN: 978-8173717246
2	Belsare D K and Singh R K, 2019. Biology and Management of India's Wildlife, Himalaya Publishing House, ISBN: 978-93-5299-803-6
3	https://openknowledge.fao.org/server/api/core/bitstreams/ecb51a59-ac4d-407a-80de-c7d6c3e15fcc/content
4	https://unesdoc.unesco.org/ark:/48223/pf0000388948
5	*https://www.researchgate.net/publication/313712783_Water_for_Food_-_Water_for_Life_Comprehensive_Assessment_of_Water_Management_in_Agriculture*
6	Raman A, 2024. Wildlife Ecology and Conservation, Scientific Publishers, ISBN: 978-8172339746
7	Singh V, 2023. Biodiversity: Concepts, Crises, and Conservation. New India Publishing Agency, ISBN: 978-8119002351.
8	https://www.unesco.org/en/sdgs
9	Lee M B, 2022. The Carbon Footprint of Everything, Greystone Books.
10	Muthu S K, 2020. Carbon Footprints: Case Studies from the Building, Household, and Agricultural Sectors, Springer.
11	Chancel L, 2020. Unsustainable Inequalities: Social Justice and the Environment, Harvard University Press.
12	https://alison.com/course/principles-of-eco-friendly-living
13	https://www.futurelearn.com/courses/introduction-sustainability-development
14	https://www.edx.org/learn/sustainability

15	Sharma R K, Son, S and H J Ghunman, 2024. Green Consumption and Sustainable Lifestyle: Evidence from India, https://www.mdpi.com/2076-3387/14/10/262

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
Hands-on experiments Collaborative learning-Group discussion	Lecturing ICT Practical sessions with demonstrations and hands on experiences

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
University Examination	50
Continuous Comprehensive Assessment CCA	
Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
Participation in debates/discussions	5
Writing assignment	5
Reports/ presentations/ demonstrations by the students	5

Sample Questions to test Outcomes.

2 Marks Question (Understanding)

1. Define Life Cycle Assessment (LCA).
2. Define sustainability.
3. Define water footprint and discuss its significance.
4. How can households reduce energy consumption?
5. How do the 3Rs contribute to sustainability?
6. How does UNESCO contribute to the promotion of SDGs?
7. List two features of sustainable development.
8. What is the Ecological Footprint Calculator?
9. What is the GHG Protocol?
10. Why is sustainability significant in contemporary society?

6 Marks Questions (Applying and Analyzing):

1. Define the principles of the 3Rs and their role in sustainability.
2. Describe waste footprint and its implications for the environment.
3. Explain the global disparities in water access and their implications.
4. How do energy-efficient appliances contribute to sustainability?
5. How does UNESCO contribute to the promotion of SDGs?

6. Identify and explain the key features of sustainability.
7. Provide examples of how individuals can apply the 3Rs in their daily lives.
8. What is a carbon footprint, and how can it be reduced?
9. Why is sustainability crucial in today's global context?
10. Outline methods individuals can use to assess their environmental footprints.

7 Marks Questions (Evaluating and Creating):

1. Briefly describe the environmental, economic, health, and social benefits of adopting a sustainable lifestyle.
2. Discuss the interdependence of environmental health, social equity, and economic viability in sustainable development.
3. Discuss tools available for evaluating the environmental impact of daily activities.
4. Explain how the SDGs can be integrated into personal and community practices.
5. Explain the GHG Protocol and its role in measuring greenhouse gas emissions.
6. Outline methods individuals can use to assess their environmental footprints.
7. Provide an overview of renewable energy sources such as solar, wind, and hydroelectric power
8. What is material footprint, and why is it important in sustainability?
9. What is sustainability, and how does it differ from sustainable development?
10. Write an account on the advantages and disadvantages of transitioning from fossil fuels to renewable energy solutions.

14 Marks Questions (Evaluating and Creating):

1. Describe the principles and types of rainwater harvesting systems.
   Discuss the environmental, economic, health, and social benefits of adopting a sustainable lifestyle
2. Discuss tools available for evaluating the environmental impact of daily activities.
3. Evaluate the relevance of the SDGs to personal and community practices in achieving sustainability.
4. Explain techniques for reducing energy consumption in households and communities.
5. Explain the principles of the 3Rs and their importance in reducing environmental impact.
6. Give an account on practical methods for reducing water usage in daily activities.
7. Highlight a global initiative that has successfully promoted sustainability and its impact.
8. Provide examples of how individuals can apply the 3Rs in their daily lives to promote sustainability.

Employability for the Course / Programme

It is one of the foundation course that provide an environmental kinship for the stakeholders. It is very helpful in understanding the diverse actions that can be used for a sustainable lifestyle; giving an career opportunity as an environmentalist.

22	Conservation Biology		KU3VACBOT122
VAC	Semester: 3	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understand Core Principles of Conservation Biology
CO2	Identify Threats to Biodiversity
CO3	Evaluate Conservation Strategies and Policies
CO4	Apply Conservation Thinking to Real-world Scenarios
CO5	Develop Ethical and Sustainable Attitudes toward Nature

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2				√	√	√						
CO3						√	√					
CO4								√	√	√	√	√
CO5										√	√	√

Course Description

This is a value addition general foundation course in botany/plant science designed for all UG students in general. The basic aim of the course is to give an idea on conservation biology.

First module deals with the fundamental ideas and concepts on conservation biology.
Second module is giving an account on the basics of biodiversity concept.
Third module is related to the theoretical background of tools and techniques used in conservation biology.
Fourth module is giving a comprehensive account on policies, laws and actions on conservation biology.

This course will also provide you opportunities to observe diverse aspects of conservation biology.

Course Objectives:

1.To understand the scope and ethical foundations of conservation biology
2.To examine the importance and methods of biodiversity conservation

3.To apply tools and techniques for biodiversity monitoring

4. To analyze the merits and demerits of conservation laws, policies, and global agreements in the present conditions of man-wildlife conflict.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	3 (45)	50	25	75

COURSE CONTENT

Module1: Fundamentals of conservation biology: **7Hrs**

1.1.Definition and scope of conservation biology. Ethical and philosophical foundations of conservation efforts. Branches of conservation biology.

1.2.Types of conservation strategies: In situ conservation: protected areas, habitat restoration. Ex situ conservation: zoos, botanical gardens, seed banks.

1.3.Species-specific recovery plans and Community-based conservation and sustainable use.

1.4.Major conserved areas in India and Kerala.

Module 2: Fundamentals of Biodiversity 8Hrs

2.1.Levels of biodiversity: genetic, species, and ecosystem. India as megadiversity centre. and biodiversity hotspots in India

2.2.Benefits of biodiversity. Methods for measuring biodiversity- Species Richness, Species dominance and Species abundance: Diversity Indices: Shannon-Wiener and Simpson's indices

2.3.The value of biodiversity: ecological, economic, cultural, and intrinsic. Cultural perspectives on wildlife and conservation.

2.4.Threats to biodiversity – major reasons and control measures.

Module 3. Tools and techniques used in Conservation Biology 8Hrs

3.1. Ecological survey techniques: transects, quadrats, capture- mark-recapture.

3.2. Habitat assessment and monitoring: use of GIS and remote sensing, Drones (UAVs).

3.3. Genetic and Laboratory Tools: DNA Barcoding, Environmental DNA (eDNA)

3.4. Participatory Monitoring- PBR preparation and management.

Module 4: Laws and Policies for conservation 7Hrs

4.1.National and international conservation laws and agreements.

4.2.Role of organizations like IUCN, CITES, and WWF.

4.3.Policy tools: environmental impact assessments, conservation incentives.

4.4.Human-wildlife conflict and coexistence strategies.

Module 5. TEACH SPACE (15Hrs): This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Field Trips: Visits to local ecosystems, protected areas, and conservation projects.
2. Assignments: Species assessments, habitat evaluations, and policy analysis.
3. Seminars and Discussions: Debates on contemporary conservation issues and ethical considerations.
4. Documentation of the practical works – videos, microscopic photographs and other

drawings by the student for evaluation as soft copy and/or hard copy.

Sl. No	**Title/Author/Publishers of the Book specific to the module**
1	Bawa S K, 2011. Conservation Biology: A Primer for South Asia, Universities Press (India), ISBN: 978-8173717246
2	Belsare D K and Singh R K, 2019. Biology and Management of India's Wildlife, Himalaya Publishing House, ISBN: 978-93-5299-803-6
3	https://openknowledge.fao.org/server/api/core/bitstreams/ecb51a59-ac4d-407a-80de-c7d6c3e15fcc/content
4	Raman A, 2024. Wildlife Ecology and Conservation, Scientific Publishers, ISBN: 978-8172339746
5	Singh V, 2023. Biodiversity: Concepts, Crises, and Conservation. New India Publishing Agency, ISBN: 978-8119002351.
6	https://www.unesco.org/en/sdgs
7	Lee M B, 2022. The Carbon Footprint of Everything, Greystone Books.
8	Muthu S K, 2020. Carbon Footprints: Case Studies from the Building, Household, and Agricultural Sectors, Springer.
9	https://alison.com/course/principles-of-eco-friendly-living
10	https://www.futurelearn.com/courses/introduction-sustainability-development
11	https://www.edx.org/learn/sustainability
12	Sharma R K, Son, S and H J Ghunman, 2024. Green Consumption and Sustainable Lifestyle: Evidence from India, https://www.mdpi.com/2076-3387/14/10/262
13	Fisher M R, 2018. Environmental Biology. Open Oregon Educational Resources.

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
Hands-on experiments Collaborative learning-Group discussion	Lecturing ICT Practical sessions with demonstrations and hands on experiences

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
University Examination	50
Continuous Comprehensive Assessment CCA	
Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
Participation in debates/discussions	5
Writing assignment	5
Reports/ presentations/ demonstrations by the students	5

Sample Questions to test Outcomes.

2 Marks Question (Understanding)

1. Define in situ conservation, and why is it essential for biodiversity preservation?
2. Give and example for species-specific recovery plans in conservation efforts?
3. How do ethical considerations influence conservation priorities and strategies?
4. How does IUCN contribute to global conservation efforts?

5. List and briefly describe the main branches of conservation biology.
6. Name two major conserved areas in India and their significance.
7. Provide two examples for ex situ conservation.
8. What is CITES?
9. What is conservation biology, and why is it considered a multidisciplinary field?
10. What is eDNA, and how is it used in biodiversity monitoring?

6 Marks Questions (Applying and Analyzing):

1. Describe various strategies are employed to mitigate human-wildlife conflicts?
2. Explain the ecological benefits of maintaining biodiversity.
3. How does community-based conservation contribute to sustainable biodiversity management?
4. Give a brief account on the three levels of biodiversity, and why are they important?
5. What is DNA barcoding, and how does it contribute to species identification in conservation biology?

7 Marks Questions (Evaluating and Creating):

1. Describe the methods of transects and quadrats in ecological surveys. How do these techniques aid in assessing species distribution and abundance?
2. Discuss the concept of Participatory Biodiversity Registers (PBRs). How do they involve local communities in conservation efforts?
3. Explain how Geographic Information Systems (GIS) and remote sensing technologies are utilized in habitat assessment and monitoring.
4. What is the role of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in global conservation efforts?

14 Marks Questions (Evaluating and Creating):

1. Analyze the ecological, economic, cultural, and intrinsic values of biodiversity. How do cultural perspectives influence wildlife conservation?
2. Assess the effectiveness of current conservation laws and policies in India. What improvements can be made to enhance biodiversity protection?
3. Compare and contrast in situ and ex situ conservation strategies. Provide examples of each and discuss their advantages and limitations.
4. Define DNA barcoding and environmental DNA (eDNA). How do these genetic tools assist in species identification and biodiversity monitoring?
5. Describe various methods for measuring biodiversity. Discuss their applications and limitations.
6. Evaluate the advantages and challenges of using Geographic Information Systems (GIS) and remote sensing in habitat assessment and monitoring.
7. Explain methods for measuring biodiversity, focusing on species richness, dominance, and abundance. How do diversity indices like Shannon-Wiener and Simpson's indices aid in this assessment?
8. Explain the concept of species-specific recovery plans. How do community-based conservation and sustainable use contribute to biodiversity preservation?
9. Identify and describe major conserved areas in India and Kerala. Discuss their significance in the context of national and global conservation efforts.
10. What are biodiversity hotspots? Identify and explain the significance of biodiversity hotspots in India.
11.

Employability for the Course / Programme

This foundation course will provide an opportunity to delve into the field of conservation biologist.

5	Diversity of Pteridophytes and Gymnosperms	KU4DSCPLS203
Semester: 4 **Hrs/week: 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English
3. Completed the basic foundation courses in the first two semesters

Course Outcomes	
CO1	Acquisition of basic knowledge in the diversity among plants, especially Pteridophytes and gymnosperms.
CO2	Understanding of the life cycles in pteridophytes and gymnosperms.
CO3	Understanding the basic differences that exist among different selected genera of Pteridophytes and gymnosperms.
CO4	Ability to apply the concepts gathered in this course to the field of evolution and ecological studies.
CO5	Firsthand experience in viewing the diversity in tracheophytes using laboratory procedures. .

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√		√						
CO3					√	√	√					
CO4									√	√	√	
CO5									√	√		

Course Description
This is a major intermediate course designed for BSc Botany students. The aim of the course is to give basic knowledge about the diversity of pteridophytes and gymnosperms.
• *First module deals with the taxonomy of Pteridophytes.* • *Second module is giving and idea on diversity of Pteridophytes through selected taxa.* • *Third module is focused on the classification of Gymnosperms.* • *Fourth module is a giving a detailed account on diversity of Gymnosperms.*
This course will also provide you opportunities to observe diverse cells, tissues and organs of Pteridophytes and gymnosperms through the practical sessions on model organisms.

Course Objectives:

1. To expertise in collection, preservation and studies in Pteridophytes and Gymnosperms.
2. To achieve a comparative knowledge of lower vascular plants.
3. To develop skill in proper description, identification and classification through morphological, anatomical and life cycle of ferns and gymnosperms.
4. Consciousness on the origin and evolution of lower groups of plants.

Credit			**Teaching Hours**		**Assessment**		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Taxonomy of Pteridophytes 10 hrs

1.1 Salient features of Pteridophytes; Features used for the identification; Classification of pteridopytes- Reimer

1.2 Origin and evolution of Pteridophytes, Relationships of pteridophytes , similarities and dissimilarities with bryophytes.

1.3. Stelar variation and stelar evolution in Pteridophytes; heterospory and seed habit.

1.4. Brief Account on Indian Pteridology and major contributors

Module 2. Diversity of Pteridophytes 15 hrs

2.1. Study of the habitat, distribution, habit, anatomy, reproduction and life cycle of *Psilotum*, *Selaginella*, *Equisetum*, *Pteris* and *Marsilea*. (Developmental details are not required). .

2.2. General methods in collection, preservation, staining techniques for spores and reproductive parts. Ecological and economic importance of Pteridophytes

Module 3. Taxonomy of Gymnosperms 8 hrs

3.1. Salient features of gymnosperms. Classification -Sporne's

3.2. Origin and evolution of Gymnosperms. Relationship with Pteridophytes and Angiosperms

3.3. Distribution of Gymnosperms in India. Gymnosperm studies in India.

Module 4. Diversity of Gymnosperms 12 hrs

Study of the habitat, distribution, habit, anatomy, reproduction and life cycle of *Cycas*, *Pinus* and *Gnetum* (Developmental details not required).

General methods in collection, preservation and staining techniques for the vegetative and reproductive parts of Gymnosperms Ecological and Economic importance of Gymnosperms

Module 5. TEACH Space 15 hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Micropreparations and microscopic observations of vegetative and reproductive structures of model genera of Pteridophytes and gymnosperms.
2. Documentation of Pteridophyte and gymnosperm diversity in various nearby places.
3. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Employability for the Course / Programme

It is one of the intermediate major courses which is very essential for understanding the diversity of plants, especially of tracheophytes, for the completion of BSc Botany.

6	Angiosperm Systematics II	KU4DSCPLS204
Semester : 4 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English
3. Completed the basic foundation courses in the first two semesters

Course Outcomes	
CO1	Acquisition of basic knowledge in the diversity among Angiosperms, other than polypetalae.
CO2	Understanding of modern angiosperm classification.
CO3	Understanding the basic differences that exist among different selected families of angiosperms
CO4	Ability to apply the concepts gathered in this course to the field of evolution and ecological studies.
CO5	Firsthand experience in viewing the diversity of angiosperms using laboratory procedures. .

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2		√	√		√							
CO3				√				√				
CO4						√	√					
CO5									√	√		

Course Description

This course is meant for the student in Botany major, focusing on systematics and taxonomy of selected gamopetalae, monochlamydeae and monocot families. The course blends theoretical knowledge and practical skills, including hands-on training in plant description and identification, field visits, and herbarium techniques.

- *First module deals with modern systematic and typification.*
- *Second module focuses on families belonging to gamopetalae.*

- *Third module outlines the characteristics of selected angiosperm families belonging to monocotyledonae and monochlamydeae.*
- *Fourth module comapares the modern and classical systematics.*

This course will also provide you opportunities to observe diverse angiosperms through the practical sessions on model organisms.

Course Objectives:

1. Develop a fundamental understanding of modern systematics and taxonomy of angiosperms.
2. Acquire Proficiency in Angiosperm Classification and Nomenclature
3. Explore angiosperm families other than Polypetalae with Economic Significance
4. Integrate theoretical understanding with practical skills through hands-on activities such as plant identification, field visits to botanical gardens or natural habitats, and herbarium techniques.
5. Prepare Students for Practical Applications in Botany

Credit			**Teaching Hours**		**Assessment**		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1. Introduction to Modern systematics of Angiosperms (10 hrs)

1.1 Typification-. Holotype, Syntype, Lectotype, Paratype,
1.2 Rules of Botnaical Nomenclature. ICN. Rule of Priority.
1.3. Numerical Taxonomy, Chemotaxonomy. Molecular Taxonomy.
1.4. Brief account on Phylogentic System of Classification. Engler and Prantle, APG system of classification. Evolution of APG system.

Module 2. Diversity of Gamopetalae (15 hrs)

Study of the distribution, habit, major vegetative and reproductive features of gamopetalae.. Combretaceae, Cucurbitaceae, Apiaceae, Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Acanthaceae, Verbenaceae, Lamiaceae.

Module 3. Diversity of Monochlamydeae and Monocotyledonae (15 hrs)

3.1. Study of the distribution, habit, major vegetative and reproductive features of Monochlamydeae.. Euphorbiaceae, Amarantaceae,
3.2. Study of the distribution, habit, major vegetative and reproductive features of Monocotyledoneae. Orchidaceae, Zingiberaceae, Liliaceae, Arecaceae, Poaceae

Module 4. Comparative account of modern and classical systematics (12 hrs)

4.1. Comparative account on classification. Merits and demerits of Bentham and Hookers classification. Bentham and Hooker's Vs. APG system
4.2. Brief account on Phylogenetics and Cladistics in Angiosperms.

Module 5. TEACH Space (15 hrs):
This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Major vegetative and reproductive features of families given above.
2. Visit to a taxonomic research station to gather knowledge on the typification procedures.
3. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Employability for the Course / Programme

It is one of the intermediate major course which is very essential for understanding the diversity of plants, especially of angiosperms, for the completion of BSc Botany.

7	Genetics	KU4DSCPLS205
Semester : 4 **Hrs/week : 3 Theory + 1 Practical**		**Credits : 4**

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English
3. Completed the basic foundation courses in the first two semesters

Course Outcomes	
CO1	Acquisition of basic knowledge in classical genetics
CO2	Understanding the basic mechanism of phenotypic expressions.
CO3	Understanding the basis of differences that exist among different species.
CO4	Ability to apply the concepts gathered in this course to the field of evolution.
CO5	First -hand experience in solving genetic problems

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2					√	√	√					
CO3				√	√							
CO4										√	√	√
CO5							√		√			

Course Description

It is a comprehensive exploration of the fundamental principles and applications of genetics, beginning with an introduction to Mendelian genetics and Molecular Basis of genetics. The course also covers on social relevance of genetics and HGP.

- *First module is an introduction to the branch of genetics.*
- *Second module gives a detailed background and progress of Mendelian genetics.*
- *Third module gives an idea on different types of ratio in phenotypic expression.*
- *Fourth module is focused on the basic knowledge on genes, DNA and chromosomes.*

This course will also provide opportunities to practice the problems in genetics.

Course Objectives:

1. Identify the basic principles and current trends in classical genetics.
2. Recognise the historical process of the evolution of molecular genetics from classical genetics.
3. Review the relevance of the application of genetic principles in agriculture, medicine, research and industry.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	1	4	3 +0 + 2 (45 +0 +30)	5 (75)	35 (25T+10P)	65 (50T+ 15P)	100

COURSE CONTENT

Module 1.Introduction to Genetics (5 hrs)

1.1 Definition and scope of genetics. Brief history of genetics. Early concepts on reproduction and genetics. Phases of genetics.

1.2 Major terms used in genetics - factors, genes, chromosomes, alleles, homozygous and heterozygous, hemizygous, traits, phenotypes, genotypes, locus, linkage, mutation; population, offspring, clone, Test cross, back cross, reciprocal cross.

1.3 Genetics and Epigenetics. Genetics and Society – Euthenics, Eugenics, and Euphenics with examples.

1.4 Human genome project- Mile stones- Major output and their relevance in medicine and disease management.

Module 2. Mendelian Genetics (8 hrs)

a. Brief account of Mendel's life history
b. Mendelian experiments: Monohybrid cross and dihybrid cross, Mendelian ratios, Laws of inheritance.
c. Reasons for Mendel's success. Mendelian Genetics and sexual cycle in plant.
d. Rediscovery of Mendelism. Reasons for negligence of Mendelian discoveries.

Module 3. Mendelian and Non-Mendelian ratios. (17 hrs)

3.1. *Allelic interactions*: dominant – recessive, Incomplete dominance – flower color in Mirabilis; Co-dominance – Coat colour in cattle, Lethal genes – Sickle cell anemia in Human beings.

3.2. Interaction of genes: Non epistatic - Comb pattern inheritance in poultry 9:3:3:1. Epistasis: dominant - Fruit colour in summer squashes12:3:1; recessive - Coat color in mice 9:3:4; Complementary gene interaction- flower color in *Lathyrus* 9:7:1. Inhibitory genes – Leaf Colour in paddy 13:3; Duplicate gene interaction- Shepherd's Purse15:1, Duplicate

genes with cumulative effect-9:6:1.

3.3. Quantitative inheritance- Polygenes-General Characters-. Ear size in corn. Transgressive variation-Heritability Phenotypic expression- Penetrance and expressivity. Pleotropic genes. Examples from plants and human beings.

Module 4. DNA, Genes and Chromosomes (15 hrs)

4.2. Concept of Genes – from factors to the modern concept of gene. Role of chromosomes in inheritance and its significance.

4.3. Chromosome Morphology, Chromosomal nomenclature- Chromatid, Centromere, Telomere, Secondary constriction, Satellite and Nucleolar Organizing Regions.

4.4. Chromosomal classification based on position and number of Centormere. Heterochromatin and Euchromatin, Karyotype and Idiogram.Chromatin reticulum-Structure, Chemical organization of Chromosomes; DNA and Histones. Packaging the DNA into Chromosomes,

4.5. Special types of chromosomes: Polytene chromosomes, Lamp brush chromosomes and B chromosomes.

Module 5. TEACH Space (15 hrs):

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

1. Dihybrid inheritance
2. Allelic and Non allelic Gene interactions.
3. Poster preparation on HGP
4. Poster presentation competition on Chromosome structure.
5. Documentation of the practical works – videos, microscopic photographs and other drawings by the student for evaluation as soft copy and/or hard copy.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	70
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Laboratory reports	5
• Practical Examination	10

Employability for the Course / Programme
It is one of the intermediate major course which is very essential for understanding the classical genetics and its relevance; highly essential for the completion of any biological course.

8	Biodiversity of Kerala and Ecotourism		KU4SECBOT108
SEC	Semester: 4	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

5. Knowledge in Biology at 10th Standard
6. Ability to write examination in English

Course Outcomes	
CO1	Assess the geographic, climatic, and ecological factors contributing to Kerala's rich biodiversity
CO2	Evaluate Conservation Efforts
CO3	Identify endemic and threatened plant and animal species in Kerala
CO4	Design Sustainable Ecotourism Plans after the study of community based ecotourism projects in Kerala

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	

Course Description

This is a GFC SEC course designed for the fourth semester students of UG programmes.

- *First module is giving a basic knowledge on biodiversity of Kerala.*
- *Second module is a detailed account on flora and fauna of Kerala with case studies on endemic and invasive species*
- *Third module is giving theoretical knowledge of Ecotourism.*
- *Fourth module is directing the designing of ecotourism projects.*

This course will provide you opportunities to observe diverse forms of flora and fauna in major ecosystems of Kerala and also helps to plan ecotourism projects.

Course Objectives:

10. To explore the unique biodiversity of Kerala, emphasizing its flora, fauna, and ecosystems.
11. To understand the principles and practices of ecotourism and its role in sustainable development.
12. To analyze the interrelationship between biodiversity conservation and tourism.
13. To examine case studies of ecotourism initiatives in Kerala.

Credit	Teaching Hours	Assessment

L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3	25	50	75

COURSE CONTENT

Module 1: Introduction to Kerala's Biodiversity 9 hrs

1.1. Kerala's Geography and Climate- Major ecosystems: Western Ghats, wetlands, coastal areas, and backwaters.

1.2. Kerala's Tropical monsoon climate; Geographic and climatic factors influencing Kerala's biodiversity.

1.3. Major Biodiversity Areas- Silent Valley National Park, Agasthyamala Biosphere Reserve, Shendurney Wildlife Sanctuary, Ashtamudi Lake and Mangrove ecosystems.

1.4. Major threats to Kerala's biodiversity- Habitat loss and fragmentation (Case Study: Silent valley Movement) Invasive alien Species (Case study: plant-*Mikania micrantha* and animal- African snail)

Module 2: Flora and Fauna of Kerala 9 hrs

2.1. Flora- Endemic plant species, RET plants of Kerala. Medicinal plants of Kerala and their uses. Major Mangrove plants and their allies. (Case Study: *Strobilanthes kunthianus* (Neela Kurinji)

2.2. Fauna- Endemic fauna of Kerala - Nilgiri tahr, Indian elephant, lion-tailed macaque, Great hornbill (Case study: *Nasikabatrachus sahyadrensis*)

2.3. Conservation Status: red data book and IUCN. IUCN Red Listed species from Kerala.

2.4. Biodiversity Hotspots- Western Ghats as a global biodiversity hotspot; Endemic species and ecosystems. Western Ghat as World heritage site.

Module 3: Ecotourism: Concepts and Practices 9 hrs

3.1. Definition and Principles- Sustainable tourism, Community involvement and empowerment

3.2. Ecotourism Models- Community-based ecotourism; Nature reserves and wildlife sanctuaries.

3.3. Case Studies of Ecotourism: Thenmala Ecotourism and Periyar Wildlife Sanctuary, Community based – Adavi and Kadalundi

3.4. Impacts of Ecotourism- Positive impacts-Economic benefits: Employment, infrastructure development; Environmental awareness and conservation funding. Negative impacts-Environmental degradation: Pollution, habitat disturbance; Cultural impacts: Displacement, loss of traditions

Module 4: Designing Sustainable Ecotourism Models 9 hrs

4.1. Planning and Development- Site selection and feasibility studies, Infrastructure and facilities

4.2. Community Participation- Stakeholder engagement, Capacity building and training

4.3. Monitoring and Evaluation- Indicators of sustainability, Feedback mechanisms and adaptive management

4.4. Future Perspectives: Emerging trends in ecotourism; Role of technology and digital platforms in promoting sustainable tourism

Module 5. TEACH SPACE 9 Hrs

This module is a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 2Hrs

Aaralam Wild life sanctuary as a place of Ecotourism; Madayippara – a biodiversity centre.

Practical 7 Hrs

8. Preparation of field visit reports by visiting any two ecotourism initiatives
9. Conduct of Photoexhibition focusing on ecotourism
10. Reels and video documentary preparation on ecotourism

Suggested Assignment Topics- Theory

14. Botanical illustrations
15. Various formats

Suggested Assignment Topics- Practical

6. Poster making
7. Seed jewelry making

Suggested Readings

Sl. No	**Title/Author/Publishers of the Books and online resources**
1	Biodiversity Documentation For Kerala Part 1-11, KFRI
2	K P Laladhas , Preetha N & Oommen V Oommen, Biodiversity Richness of Kerala, KSBB.
3	K.V. Sankaran, T.A.Suresh, T.V.Sajeev, Invasive Plants of Kerala, KSBB.
4	Kerala Tourism Development Corporation, *Ecotourism In Kerala: A Gateway To Nature And Sustainability*
5	N. Sasidharan, Common Trees of Kerala, KSBB.
6	P Sujanapal & N Sasidharan, Handbook On Mangroves And Mangrove Associates Of Kerala, KSBB.
7	Rajani P, A Study on Ecotourism in Kerala, Lambert Academic Publishing, ISBN-13: 978-620-6-75176-2.
8	Sustainable Development of Tourism in India: A Case Study of Kerala ISBN-13: 978-3639511284.
9	T.M. Manoharan, S.D. Biju, T.S. Nayar, and P.S. Easa, 1999. Silent Valley: Whispers of Reason
10	Vishnu S and Gayathri M S, Eco-Tourism Projects in Kerala, Thrift Books. ISBN-13: 9780993885341.

TEACHING LEARNING STRATEGIES	**MODE OF TRANSACTION**
➢ Collaborative learning-Group discussion ➢ Field Visits ➢ Documentaries	➢ Lecturing ➢ ICT ➢ Demonstrations

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Field visit reports	5
• Presentations/ demonstrations	5

Sample Questions to test Outcomes.

2 Marks Questions

1. What are the major ecosystems found in Kerala?
2. Explain the significance of Kerala's tropical monsoon climate to its biodiversity.
3. Name two major biodiversity areas in Kerala and their importance.
4. What is the Silent Valley Movement, and why was it significant?
5. Identify two invasive species in Kerala and their impact on local ecosystems.
6. Define 'endemic species' and provide an example from Kerala.
7. What does 'RET' stand for in relation to plant species, and why is it important?
8. Mention one medicinal plant native to Kerala and its traditional use.
9. List two endemic animal species found in Kerala.
10. What is the IUCN Red List, and how does it relate to Kerala's fauna?

6 Marks Questions

1. Assess the threats posed by invasive species like Mikania micrantha and the African snail to Kerala's native ecosystems.
2. Define ecotourism and explain its core principles, emphasizing sustainable tourism and community involvement.
3. Describe the ecological importance of Kerala's backwaters and their role in supporting local biodiversity.
4. Describe the key steps involved in planning and developing a sustainable ecotourism site, including site selection and feasibility studies.
5. Describe the unique flowering cycle of Strobilanthes kunthiana (Neelakurinji) and its cultural significance in Kerala.
6. Evaluate the impact of habitat loss and fragmentation on Kerala's biodiversity, citing the Silent Valley Movement as a case study.
7. Examine the conservation status of the Nilgiri Tahr and the Lion-tailed Macaque in Kerala.
8. Examine the environmental and cultural impacts of ecotourism, highlighting both positive and negative aspects.
9. Explain how Kerala's tropical monsoon climate influences its diverse flora and fauna.
10. Explain the role of monitoring and evaluation in ensuring the sustainability of ecotourism projects, focusing on indicators and feedback mechanisms.

7 Marks Questions

1. Discuss the concept of community-based ecotourism and its significance in promoting environmental conservation.
2. Discuss the importance of community participation in ecotourism, outlining strategies for stakeholder engagement and capacity building.
3. Discuss the major ecosystems of Kerala and their significance in maintaining the state's biodiversity.
4. Discuss the significance of Kerala's mangrove ecosystems and their role in coastal biodiversity conservation.
5. Evaluate the economic benefits of ecotourism, focusing on employment generation and infrastructure development.
6. Give an account on the endemic plant species of Kerala and their ecological roles.
7. Identify emerging trends in ecotourism, particularly the use of technology and digital platforms in promoting sustainable tourism.
8. Outline the role of nature reserves and wildlife sanctuaries in ecotourism, with examples from Kerala.
9. Propose a model for a sustainable ecotourism initiative in Kerala, integrating the principles of conservation, community involvement, and economic viability.

10. Write an account on the importance of Kerala's wetlands in supporting migratory bird populations and their conservation status.

14 Marks Questions

1. Evaluate the ecological significance of Kerala's major ecosystems and discuss the factors influencing their biodiversity.
2. Discuss the role of community-based ecotourism in Kerala and assess their impact on local communities and conservation efforts.
3. Analyze the positive and negative impacts of ecotourism in Kerala. Use case studies to illustrate your points.
4. Propose a sustainable ecotourism model for a selected region in Kerala.
5. Examine the future perspectives of ecotourism in Kerala and their potential to promote sustainable tourism.

Employability for the Course / Programme

This course is a GFC SEC course that encourages the stakeholder to observe various places in Kerala on an ecological perspective and helps to develop an ecotourism plan.

9	FLORAL ART BUSINESS		KU4SECBOT109
SEC	Semester: 4	Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understand the scope of floral art business and to study different styles of floral arrangement
CO2	Application of different floral arts into daily life events
CO3	Basic idea on floriculture business
CO4	Enthusiasm to earn practical skills in floral and vegetable art.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	

Course Description

This is a general foundation course SEC in botany designed for UG all students. The aim of the course is to give basic knowledge about various floral art forms and its business aspects.

- *First module is dealing with various floral art forms in this era.*
- *Second module is unravelling the diverse forms of floral arts specific to various events and its significance in daily and corporate modes of human life.*
- *Third module is helping to study the floriculture as agriculture, business and industry.*
- *Fourth module delves into the cultural heritage of India in floral arts.*

This course will also provide opportunities to go through various first hand experiences on floral arts.

Course Objectives:

1. To acquire basic knowledge on different types of floral arts, processing and packaging
2. To acquire the basics of doing floriculture business
3. To equip the students for commercial propagation for getting self-employment and for giving employment to others
4. To understand the scope of floral art business and to study different styles of floral arrangement

5. To develop practical skills in floral and vegetable art.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Floral Arts 10hrs

1.1. Flowers and inflorescences: basic parts of flowers and inflorescences, variation in longevity among different flowers, Major flowers and inflorescences used in floral art.

1.2. Floral Materials and Tools: Introduction to various flowers, foliage, and essential tools used in floral design. Popular foliage species cultivated for floral arrangement.

1.3. **Principles of Floral Design**: Balance, proportion, harmony, unity, rhythm, focal point, and scale. Understanding color schemes, textures, and composition in floral arrangements. Drying and preservation of flowers, Longevity enhancement of cut flowers

1.4. Flower arrangement types (Classical, Contemporary, European, Ikebana). Essential tools and materials used in flower arrangement.

Module 2: Types of Floral designs and arts for specific events 9 hrs

2.1. Major events in common man's life where floral art is having importance: from birth to death. Indoor and Outdoor flower arrangements.

2.2. Funeral and Sympathy Floral Designs: Designing appropriate arrangements for funerals and sympathy occasions.

2.3. Wedding and Cultural events- major parts and types of designs essential for wedding. Cultural events/ occasions that require floral art.

2.4. Holiday and Seasonal Floral Designs: Creating designs for various holidays and seasons. Floral Arrangements for Corporate clients/ exhibitions**.** Creating large-scale floral installations for events and exhibitions.

Module 3: Floriculture as agriculture, business and industry, 9 Hrs

a. Floriculture in India: cut flowers, loose flowers, cut foliages, potted plants,
b. Steps in starting floriculture business (planning, developing innovative ideas, identifying demand, marketing strategies, taking permits etc). Online and offline floral business. Kerala Start UP mission.
c. Value Addition: Processing flowers into products like oils, perfumes, and dried arrangements.
d. Sustainability Practices: Eco-friendly cultivation and certification standards

Module 4. India's Cultural Significance of Flowers 8

4.1. Types of bouquets, garland, gajra, veni and rangoli used in India.

4.2. Major flowers used in floral offerings in various temples. Flower carpet (pookkalam) of Kerala. Phool Walon Ki Sair of Delhi.

4.3. Wild flowers in floral art. Dry flower industry and vegetable carving.

4.4. Floral embroidery and Paintings in India. Chikankari of Lucknow. Phool Patti of Rampur.

Module 5. TEACH SPACE (9 hrs):

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 hrs

Advanced Topics in Floriculture: Biotechnology Applications: Advanced Propagation Techniques: Climate Change Adaptation: Strategies for coping with environmental changes.

Practicals 5 hrs

1. Visit to floriculture industries
2. Exhibition of various types of floral decorations by the students: Dry flower preparation; Bouquets preparation; Wild flower arrangement; Vegetable carving; Preparation of garland, gajra, veni, rangoli etc.

Suggested Assignment Topics- Theory

1. Floral art
2. Features of a bouquet
3. Various floral arts
4. Flower carpet in Kerala

Suggested Assignment Topics- Practical

1. Bouquet of wild flowers
2. Flowervase arrangement
3. Exhibitions on flower arrangements

Suggested readings

Sl. No	Title/Author/Publishers of the Book specific to the module
1	Alexander C and Taylor S (2001). Flowers cut and dried: The essential guide to growing, drying and arranging
2	Aman A S, (2016). The online startup: How to start a business online leveraging the power of Amazon.
3	Baker J L (2023). Blossoming Brilliance: A guide for mastering the art, science and creating stunning arrangements for floral symphony for your business.
4	Beener S , (2012). How to open and Operate a Financially Successful Florist and Floral Business Online and Offline.
5	Chaudhary S, (2022). The complete guide to start up: How to start a startup in India.
6	Crary C (2020). Flower School: A practical guide to the art of flower arranging.
7	Datta S K (2015). Dry flowers technology and floral craft.
8	Fasust J E and Dole J M, (2021). Cut flowers and foliages (crop production science in horticulture).
9	https://khatabook.com/blog/floriculture-business-in-india/
10	https://startupmission.kerala.gov.in/
11	https://www.startupindia.gov.in/
12	Johnson E W, (2007).The art of floral arranging.
13	Kumar H G and Kumar U M S, (2022). Economic contribution of floriculture industry in India.
14	Palma D S, Break into the wedding flower business: start a floral design business from home
15	Sahoo S K and Goswami S S, (2023). How to start a successful start-up company in India.

16	Scace P D, (2001). The floral artists guide: A reference to cult flowers and foliages.
17	Start Your Own florist shop and other floral businesses: Enterpreneur Press
18	Willms, A (2024). How to turn your passion for flowers into profit: Harvesting Happiness and Income from your floral harvests, grow, and sell your passion into profitable blooms.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits ➢ Reels on floral arts and DIY	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Visit reports	5
• Presentations	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. What are the basic parts of a flower?
2. Define 'inflorescence' and give an example.
3. List two major flowers used in floral art.
4. Name one tool essential for floral design.
5. What is the principle of 'balance' in floral design?
6. Explain the term 'color scheme' in floral arrangements.
7. What is Ikebana?
8. Name a seasonal floral design for festivals.
9. List any two flowers used in temple offerings.
10. What is a 'gajra'?
11. What is floriculture?
12. Define 'value addition' in floriculture.
13. What is eco-friendly cultivation?
14. Name one certification standard in floriculture.
15. What is the Kerala Startup Mission?
16. List one online platform for floral business.
17. What is 'Chikankari'?
18. Define 'Phool Patti'.
19. What is vegetable carving and name a plant part used for the art.
20. Describe a flower carpet.

6 Marks Questions:

1. Explain the basic parts of a flower and their roles in floral arrangements.
2. Discuss the importance of balance and proportion in floral design.
3. Describe the significance of color schemes and textures in creating floral compositions.
4. Compare and contrast the different types of flower arrangements: Classical, Contemporary, European, and Ikebana.
5. Elaborate on the role of floral designs in major life events such as weddings and funerals.

7 Marks Questions:

1. Analyze the cultural significance of Pookkalam in Kerala's Onam festival.
2. Discuss the considerations involved in designing floral arrangements for corporate events and exhibitions.
3. Assess the economic impact of floriculture on Kerala's economy.
4. Outline the steps involved in starting a floriculture business, including planning and marketing strategies.
5. Explore the cultural practices involving flowers in Indian rituals and festivals, focusing on their symbolic meanings.

14 Marks Questions:

1. Discuss the principles of floral design—balance, proportion, harmony, unity, rhythm, focal point, and scale—and explain how they contribute to creating aesthetically pleasing floral arrangements.
2. Analyze the cultural significance and design elements of Pookkalam, the traditional floral arrangement created during the Onam festival in Kerala.
3. Evaluate the current state and future prospects of the floriculture industry in India, focusing on its economic impact, challenges, and opportunities.
4. Examine the role of flowers in Indian cultural practices, focusing on their use in rituals, festivals, and traditional arts.
5. Investigate the intersection of floral design principles and the floriculture business, emphasizing how artistic elements influence commercial success.

Employability for the Course / Programme

It is one of the general foundation courses which is very helpful in understanding the diversity of floral arts, so as to start as an entrepreneur in floral arts.

10	ENTERPRENURESHIP IN BOTANY	KU4SECBOT110
SEC	Semester : 4 Hrs/week : 3 Theory + 0 Practical	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Define entrepreneurship and analyze its significance in economic development
CO2	Evaluate various sources of business ideas and conduct feasibility analyses
CO3	Develop comprehensive business plans incorporating strategic objectives, financial projections, and legal considerations.
CO4	Explore opportunities in botanical entrepreneurship, including the cultivation of medicinal plants, organic farming, and sustainable agricultural practices.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4									√	√	√	√

Course Description

This is a GFC SEC course in botany designed for all UG students. The aim of the course is to give basic knowledge Botanical entrepreneurship.

- *First module is giving sparkles to the world of entrepreneurship.*
- *Second module is dealing about the business planning and strategies.*
- *Third module is delves into the vast areas of entrepreneurial botany.*
- *Fourth module deals with the future perspectives of the field. .*

This course will also provide initial induction for the botanical entrepreneurship through the field visits and other first-hand experiences.

Course Objectives:

1. To understand the foundational concepts of entrepreneurship and its role in fostering economic growth.
2. To identify and assess potential business opportunities through market analysis and feasibility studies.
3. To acquire skills to formulate effective business strategies and plans, considering financial and legal aspects.
4. To explore innovative practices in botanical entrepreneurship, focusing on sustainable and eco-friendly ventures.

5. To develop an entrepreneurial mindset that embraces creativity, risk-taking, and problem-solving.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Entrepreneurship 8hrs

1.1. Definition and Importance: Understanding entrepreneurship and its role in economic development.
1.2. Characteristics of an Entrepreneur: Key traits and skills of successful entrepreneurs.
1.3. Types of Entrepreneurs: Based on motivation, innovation, and business scale.
1.4. Entrepreneurial Mindset: Developing creativity, risk-taking, and problem-solving abilities.

Module 2: Business Planning and Strategy 12hrs

2.1. Sources of Business Ideas: Identifying opportunities through market gaps, trends, and personal experiences.
2.2. Feasibility Analysis: Assessing technical, financial, and market feasibility. SWOT Analysis Business Model Canvas
2.3. Business Plan Components: Executive summary, market analysis, organizational structure, product/service offerings, marketing plan, and financial projections. Financial Management: Budgeting, pricing, and cost analysis.
2.4. Strategic Planning: Setting objectives, identifying resources, and formulating strategies. Legal Considerations: Business structures, intellectual property rights, and regulatory requirements.

Module 3: Major areas of Botanical Entrepreneurship 7hrs

3.1. Cultivation of Medicinal and Aromatic Plants- significance, major resource plants and economics of medicinal plants in India.
3.2. Organic Farming, Mushroom Cultivation, Plant Tissue Culture: Biofertilizers
3.3. Floriculture and Landscape Gardening; Production Agroforestry and Sustainable Agriculture:
3.4. Single Cell Protein (SCP) Secondary Metabolites Production: Fermentation Technology: Plant-Based Bioeconomy Conservation Entrepreneurship

Module 4. Contemporary Issues and Future Trends 9hrs

4.1. Understanding IPR: Patents, trademarks, and copyrights in the context of botanical products. Bioethics: Ethical considerations in plant-based research and commercialization.
4.2. Marketing Strategies: Digital marketing, retail strategies, and customer engagement. Sales Channels: Exploring online platforms, local markets, and export opportunities.
4.3. Sustainable Practices: Eco-friendly and sustainable business models. Understanding global market demands and trends in botanical products. Building connections with industry experts, mentors, and potential collaborators.
4.4. Emerging Technologies: Role of AI and IoT in modern botanical enterprises.

Module 5. TEACH SPACE 9hrs

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 hrs

Case study: Success stories of industries on herbal medicines, mushroom cultivation, floriculture, horticulture and biofertilizer production.

Practicals 5 hrs

1. Field visits and interaction with botanical entrepreneurs.
2. Mushroom cultivation.
3. Tissue culture through callus.
4. Farm house /garden visits.
5. Vegetative propagation.

Suggested Assignment Topics- Theory

1. AI and IoT in Botanical entrepreneurships
2. Basic steps in mushroom cultivation
3. Organic farming
4. Composting
5. Biofertilisers
6. Biopesticides and insecticides
7. Tissue culture

Suggested Assignment Topics- Practical

1. Use of Mobile applications in Home gardens
2. Callus culture using coconut water
3. Budding, grafting and Layering in various crop plants.

Suggested readings

Sl. No	Title/Author/Publishers of the Book /online resources
1	https://apacwomen.ac.in/learning-resources/botany/BotanyForEntrepreneurship_Development.pdf
2	https://startupmission.kerala.gov.in/
3	https://www.brainkart.com/article/Entrepreneurial-Botany_38321/#google_vignette
4	https://www.learninsta.com/entrepreneurial-botany/
5	https://www.poddarinstitute.org/articles/entrepreneurial-potential-of-economically-useful-plants
6	https://www.researchgate.net/publication/383531157_Entrepreneurial_Botany
7	https://www.startupindia.gov.in/
8	Lokare, P D and Pandya J B (2024). Entrepreneurial Botany. Book Saga Publications ISBN 13: 978-8197603839
9	Pathak, S K and Kushwah J S, Entrepreneurial Botany and Skill Development, Nitya Publications, Bhopal.
10	Paul, B.(2011). *Entrepreneurship and small business*. 3rd ed. Basingstoke, Palgrave Macmillan.
11	Sen, S, (2024). Bio-entrepreneurship: Employment, Empowerment, Innovation. Career Guidance: Choices before You, pp. 189-197, 2024 ISBN 978-81-966693-8-6, Available at SSRN: https://ssrn.com/abstract=4813601 or http://dx.doi.org/10.2139/ssrn.4813601

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Documentaries and reels on agriculture, mushroom cultivation and other entrepreneurships ➢ Field visits	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations	5
• Field reports	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. Define entrepreneurship and explain its significance in economic development.
2. List and describe three key characteristics of a successful entrepreneur.
3. Differentiate between necessity and opportunity-based entrepreneurship.
4. What is an entrepreneurial mindset, and why is it crucial for success?
5. Identify two common sources of business ideas and explain their importance.
6. What is feasibility analysis, and why is it essential before starting a business?
7. Outline the primary components of a business plan.
8. Explain the role of strategic planning in business success.
9. Discuss the significance of legal considerations when starting a business.
10. What are medicinal and aromatic plants, and why are they economically significant in India?
11. Define organic farming and its advantages over conventional farming methods.
12. Explain the process and benefits of mushroom cultivation.
13. What is plant tissue culture, and how does it contribute to agriculture?
14. Describe the concept of floriculture and its economic impact.
15. What is agroforestry, and how does it promote sustainable agriculture?

6 Marks Questions:

1. Define entrepreneurship and discuss its significance in economic development.
2. Describe the process of strategic planning in business.
3. Differentiate between necessity and opportunity-based entrepreneurship.
4. Identify and explain three key characteristics of successful entrepreneurs.
5. Outline the key components of a business plan.

7 Marks Questions:

1. Discuss the significance of cultivating medicinal and aromatic plants in India.
2. Discuss various sources of business ideas and their significance.

3. Explain the components of a feasibility analysis.
4. Explain the concept of an entrepreneurial mindset and its importance.
5. Explain the role of biofertilizers in sustainable agriculture**.**

14 Marks Questions:

1. Discuss the role of entrepreneurship in economic development.
2. Explain the process of feasibility analysis in business planning, emphasizing its importance in assessing technical, financial, and market viability.
3. Analyze the economic significance of cultivating medicinal and aromatic plants in India.
4. Evaluate the impact of emerging technologies such as AI and IoT on the future of botanical entrepreneurship, considering both opportunities and challenges.
5. Assess the ethical considerations in botanical entrepreneurship, particularly concerning intellectual property rights, bioethics, and sustainable practices.

Employability for the Course / Programme

It is one of the entrepreneurship-oriented SEC courses in Botany which may benefit the stakeholder in the near future; to emerge as an entrepreneur.

11	GARDENING - INDOOR AND OUTDOOR	KU4SECBOT111
SEC	Semester : 4 Hrs/week : 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Demonstrate proficiency in selecting appropriate plants and gardening techniques for both indoor and outdoor environments
CO2	Apply sustainable gardening practices, including soil preparation, composting, mulching, and water conservation methods, to promote environmental sustainability
CO3	Identify and manage common pests and diseases in garden plants
CO4	Design and implement specialized gardening systems such as vertical gardens, hydroponics, and terrariums

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4									√	√	√	√

Course Description

This is GFC-SEC course in botany designed for all UG students to give basic knowledge in various types indoor and outdoor gardening. .

- *First module is giving an introduction to gardening.*
- *Second and third module is dealing with major indoor and outdoor gardening techniques respectively.*
- *Fourth module is adding some more special techniques in both out-door and in-door gardening.*

This course will provide opportunities to start gardening as a serious enterprise.

Course Objectives:

1. To understand the fundamental principles of gardening, including the importance of gardening for personal well-being and environmental sustainability.
2. To gain knowledge about various types of gardening.
3. To learn the use of essential gardening tools and equipment effectively for various gardening tasks.
4. To earn skills in plant parenting.
5. To explore advanced gardening techniques to promote sustainable practices.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total

3	0	3	3 +0 + 0 (45 +0 +0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Gardening 8 Hours

1.1. Definition and Importance: Understanding the role of gardening in personal well-being and environmental sustainability.

1.2. Types of Gardening: Differentiating between indoor and outdoor gardening.

1.3. Basic Terminologies: Soil, compost, mulch, irrigation, etc.

1.4. Gardening Tools and Equipment: Overview of essential tools and their uses.

Module 2: Module 2: Indoor Gardening Techniques 10 hours

2.1. Salient features of indoor plants, Major indoor plants and their uses for various types of indoor gardens.

2.2. Requirements for indoor gardening- Containers and Substrates: Types of pots, containers, and suitable growing media. Lighting Requirements: Natural vs. artificial lighting needs for indoor plants. Watering and Humidity: Best practices for watering and maintaining humidity levels.

2.3. Common Indoor Plants and their care and maintenance- succulents, ferns, and other in-house plants.

2.4. Indoor Plant Pests and Diseases: Identification and management of common indoor plant issues.

Module 3: Outdoor Gardening Practices 10 hours

3.1. Site Selection based on sunlight, wind, and space. Soil Preparation: Testing soil, amending soil, and composting.

3.2. Plant Selection: Choosing plants based on climate, soil, and aesthetic preferences. Planting Techniques: Proper planting depths, spacing, and timing.

3.3. Watering Systems: Drip irrigation, sprinklers, and manual watering methods. Mulching and Fertilization: Benefits and methods of mulching and fertilizing plants.

3.4. Weed and Pest Management: Organic and chemical methods for controlling weeds and pests.

Module 4. Specialized Gardening Techniques 8 hours

4.1. Vertical Gardening: Techniques for growing plants upwards using trellises, towers, and wall-mounted systems.

4.2. Hydroponics and Aquaponics: Soil-less growing methods and their applications.

4.3. Terrariums and Bottle Gardens: Creating and maintaining miniature ecosystems. Bonsai and Topiary: Art of miniature tree cultivation and shaping.

4.4. Organic Gardening: Principles and practices of organic gardening. Water Conservation: Methods to conserve water in gardening practices. Sustainable and Eco-Friendly Gardening

Module 5. TEACH SPACE 9 hrs

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 hrs

Seasonal Planting: Understanding planting schedules for different seasons.

Climate Considerations: Gardening in various climates and microclimates.

Regional Plant Varieties: Selecting plants suited to specific regions and their growing conditions.

Garden Maintenance: Routine tasks for maintaining a healthy garden.

Practicals 5 hrs

1. Building a compost bin, creating a rainwater harvesting system, and constructing a vertical garden.
2. Plant Propagation: Techniques for propagating plants from seeds, cuttings, and divisions.

Suggested Assignment Topics- Theory

1. Lawn preparation
2. Exhibition of indoor and outdoor gardening plants
3. Bonsai preparation

Suggested Assignment Topics- Practical

3. Terrarium
4. Bonsai
5. Topiaries
6. Vertical gardening

Suggested Readings

Sl. No	Title/Author/Publishers of the Book / online resources
1	Bora T, (2021). How Not To Kill Houseplants
2	Evans C, The Gardener's Handbook
3	Fish M, (1956). We made a Garden.
4	Hawes N H, (2017). Air-Purifying Houseplant and Healthy Housekeeping. Hammersmith Health Books, ISBN: 9781781610831
5	https://archive.org/details/GardeningInIndia
6	https://celkau.in/Agrienterprises/enerprise/30.Landscape%20Gardening/4.%20COMPONENTS%20OF%20LANDSCAPES%20AND%20GARDENS.pdf
7	https://celkau.in/Agrienterprises/landscape gardening
8	https://celkau.in/Agrienterprises/Vertical farming
9	https://www.nsdcindia.org/scmp/assets/image/996525282-Gardener-PHB-English-ASCI_KM_-V1.0.pdf
10	https://www.psscive.ac.in/storage/uploads/textbooks/pdf/english/gardener-english-class-11.pdf
11	Leendertz L (2016). My Tiny Indoor Garden. Mark Diacono, London, ISBN: 9781910904992

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits ➢ Documentaries	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	

• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Field reports	5
• Presentations	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. What is the role of compost in gardening?
2. Name two essential tools used for soil preparation.
3. What is the primary purpose of using containers in indoor gardening?
4. List two common pests that affect indoor plants.
5. What is the significance of mulching in outdoor gardening?
6. Define drip irrigation and its advantage over traditional watering methods.
7. What is hydroponics?
8. Name one benefit of vertical gardening.
9. What is the difference between organic and chemical fertilizers?
10. Explain the term 'sustainable gardening'.

6 Marks Questions:

1. Explain the significance of gardening in enhancing personal well-being and promoting environmental sustainability.
2. Differentiate between indoor and outdoor gardening, highlighting the unique challenges and benefits of each.
3. Define key gardening terms such as soil, compost, mulch, and irrigation, and discuss their roles in successful gardening practices.
4. Describe the process of site selection for outdoor gardening, considering factors like sunlight, wind, and space.
5. Discuss the importance of soil preparation, plant selection, and appropriate planting techniques in establishing a thriving outdoor garden.

7 Marks Questions:

1. Identify essential gardening tools and equipment, and describe their specific functions in maintaining a garden.
2. Discuss the characteristics of major indoor plants and their suitability for various types of indoor gardens.
3. Outline the requirements for indoor gardening, focusing on containers, substrates, lighting, watering, and humidity levels.
4. Provide care and maintenance guidelines for common indoor plants like succulents and ferns.
5. Identify common pests and diseases affecting indoor plants and propose effective management strategies.

14 Marks Questions:

1. Discuss the significance of indoor gardening in urban environments.
2. Explain the principles and practices involved in outdoor gardening.
3. Analyze the role of specialized gardening techniques in modern horticulture.
4. Evaluate the importance of sustainable gardening practices.
5. Assess the challenges and solutions in pest and disease management in gardening.

Employability for the Course / Programme

This SEC course is one of the self-employment oriented courses in Botany which is giving basic and advanced knowledge in outdoor and indoor gardening.

12	MEDICINAL PLANTS OF KERALA	KU4SECBOT112
SEC	Semester : 4 Hrs/week : 3 Theory	Credits : 3

Course Pre-requisite:

3. Knowledge in Biology at 10th Standard
4. Ability to write examination in English

Course Outcomes	
CO1	Understand the historical and cultural significance of medicinal plants in Kerala.
CO2	Identify and classify major medicinal plants of Kerala.
CO3	Analyze the pharmacological properties of medicinal plants.
CO4	Apply sustainable practices in the cultivation and conservation of medicinal plants.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2				√	√	√						
CO3							√	√	√	√		
CO4									√	√	√	

Course Description

This is a skill enhancement course in botany designed for all UG students. The aim of the course is to give basic knowledge about the diversity of medicinal plants in Kerala and its utility.

- *First module is laying the basics of plant based medicinal practices in Kerala.*
- *Second module is a pavement to the knowledge on the botanical diversity of our state.*
- *Third module delves into the pharmacological properties of chemicals present in some selected medicinal plants.*
- *Fourth module is giving an idea on the cultivation of these plants.*

This course will also provide you opportunities to emerge as an entrepreneur by knowing cultivation of medicinal plants of high commercial demand.

Course Objectives:

1. To explore the historical texts and traditional practices related to medicinal plants in Kerala.
2. To examine the botanical diversity of medicinal plants in Kerala.
3. To investigate the pharmacological properties of bioactive compounds in medicinal plants.
4. To understand the cultivation methods and sustainable practices for medicinal plants.
5. To discuss the role of institutions and government initiatives in promoting medicinal plant research and conservation.
6. To do more intensive experiments on the subject to facilitate an interdisciplinary profession/enterprise/entrepreneurship

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CE	ESE	Total
3	0	3	3 +0 + 0 (45 +0 + 0)	3 (45)			

COURSE CONTENT

Module 1: Introduction to Medicinal practices in Kerala (10 hours)

1.1. Definition and Significance of medicinal plants: Role in traditional and modern medicine.

1.2. Overview of the use of medicinal plants in ancient texts like *Hortus Malabaricus* and *Ashtanga Hridayam*. Ayurveda and Kalari Chikilsa.

1.3. Overview of Kerala's rich plant diversity, focusing on medicinal species. Significance of endemic medicinal plants. RET Plants and conserved medicinal plants.

1.4. Scope and Relevance: Importance of medicinal plants in Kerala's cultural heritage and contemporary healthcare. Kottakkal Arya Vaidya Sala and Adivasi medicines.

Module 2: Botanical Diversity of Kerala (9 hours)

4.1. Traditional Knowledge and Ethnobotany - Folk Medicine: Exploration of traditional healing practices in Kerala. Ethnobotanical Surveys: Methodologies for documenting traditional knowledge and plant usage.

4.2. Major plant parts used as medicine- whole plant, root, bark of root and stem, stem, leaf, flower, fruit and seed.

4.3. Plant and medicinal uses – Dasapushpam, Thriphala and Dasamoolam.

4.4. Examples for Major medicines of plant origin in Modern Medicine and Ayurveda.

Module 3: Pharmacological Properties (9 hours)

3.1. Active Compounds: Identification of bioactive compounds in medicinal plants. Examples of alkaloids, flavonoids, tannins, saponins, terpenoids, and essential oils used as therapeutic agents.

3.2. Pharmacological Activities: Antimicrobial, anti-inflammatory, antioxidant, and anticancer properties.

3.3. Major Institutes involved in Medicinal plant research and their success stories: CIMAP, Lucknow; CMPR , Kottakal, JNTBGRI, Palode.

3.4. Case Study: Arogyapacha plant (*Trichopus zeylanicus* ssp.*travancoricus*),

Module 4: Cultivation and Sustainable Practices 8hrs

4.1. Agro-techniques: Best practices for cultivating medicinal plants suited for Kerala's homesteads.

4.2. Sustainable Harvesting: Methods to ensure the sustainability of medicinal plant resources.

4.3. Conservation Efforts: Strategies for the conservation of medicinal plant species in Kerala

4.4. Government Initiatives: Overview of programs by the State Medicinal Plants Board Kerala to promote cultivation and conservation.

Module 5. TEACH SPACE (9 hrs):

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment

for this module is ***strictly internal***.

Theory 5 hrs

Integration with Modern Medicine: Exploring how traditional medicinal plants are being integrated into contemporary healthcare systems.

Phytochemical Studies: Research on the chemical constituents of medicinal plants and their therapeutic potentials.

Practicals 4 hrs

1. Field Visits: Organized trips to botanical gardens, research stations, and local farms.
2. Hands-on Experience: Practical sessions on identifying, harvesting, and preparing medicinal plant samples.
3. Documentation Skills: Training in botanical documentation and herbarium techniques
4. Research Projects: Students undertake projects on specific medicinal plants or related topics.
5. Presentation: Presentation of findings and discussions.

Suggested Assignment Topics- Theory

1. Chemical composition of thriphala
2. Chemical properties of dasamoolam plants
3. Daspushpam and their chemistry
4. Plant parts used as medicines with examples

Suggested Assignment Topics- Practical

1. Collection of medicinal plants
2. Collection of recipes of medicined
3. Cultivation of medicinal plants

Suggested readings

Sl. No	Title/Author/Publishers of the Book / online resources
1	https://agritech.celkau.in/agriculture/medicinal
2	https://bsi.gov.in/page/en/medicinal-plant-database
3	https://envis.frlht.org/implad
4	https://www.smpbkerala.in/herbal-data/
5	https://www.kfri.res.in/medicinal_plants.asp
6	Indian Council of Agricultural Research (ICAR), Textbook of Medicinal and Aromatic Plants
7	Joshi M C, Hand Book of Indian Medicinal Plants
8	Khare C P, Indian Medicinal Plants: An Illustrated Dictionary
9	Naik V N, Identification of Common Indian Medicinal Plants
10	Peter, K.V. Alice Kurian and M. Asha Sankar, Medicinal Plants
11	Warrier, P.K., V.P.K. Nambiar, P.M. Ganapathy, Some Important Medicinal Plants of the Western Ghats, India
12	https://agritech.celkau.in/agriculture/medicinal

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practical

ASSESSMENT RUBRICS	Marks

End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Field Visit Reports	5
• Presentations	5

Sample Questions.

2 Marks Questions:

1. Name any two ancient texts on medicinal plants.
2. Who authored *Hortus Malabaricus*?
3. Name any two RET plants.
4. What is the significance of endemic medicinal plants?
5. List out any two major contributions of Kottakkal Arya Vaidya Sala.
6. Write a short note on Adivasi medicines.
7. What is ethnobotany?
8. Name a plant with medically significant bark.
9. Give the names of two plants of Dasapushpam.
10. What is Triphala?
11. Give the common name and botanical name of a plant in Dasamoolam.
12. Name a major medicine of plant origin in modern medicine.
13. What are bioactive compounds?
14. What is the major contribution of JNTBGRI in the field of ethnobotany?
15. Expand CMPR?
16. What are agro-techniques?
17. What is sustainable harvesting?

6 Marks Questions:

1. Examine the contributions of research institutes like CIMAP and JNTBGRI in advancing medicinal plant research.
2. Explain the role of traditional texts like *Ashtanga Hridayam* in preserving Ayurvedic knowledge in Kerala.
3. Integrate knowledge from all modules to propose a sustainable model for cultivating and conserving medicinal plants in Kerala.
4. Describe the ethnobotanical importance of Dasapushpam in Kerala's cultural and medicinal practices.
5. Discuss sustainable harvesting methods for medicinal plants to ensure their conservation.

7 Marks Questions:

1. Analyze the therapeutic uses of common plant parts such as roots, stems, and leaves in traditional medicine.
2. Assess the impact of government initiatives by the State Medicinal Plants Board Kerala on promoting medicinal plant cultivation.
3. Critically analyze the challenges and opportunities in integrating traditional medicinal practices with modern pharmacological research.
4. Discuss the significance of *Hortus Malabaricus* in documenting the medicinal plants of Kerala.
5. Evaluate the pharmacological activities of bioactive compounds like alkaloids and flavonoids found in medicinal plants.

14 Marks Questions:

1. Discuss their contributions to traditional medicine and their relevance in contemporary healthcare practices.
2. Explain the role of Dasapushpam in cultural practices, traditional medicine and its medicinal uses.
3. Discuss the therapeutic potentials of medicinal plants of Kerala and give examples for scientific validation of their medicinal properties.
4. Discuss the role of agro-techniques, sustainable harvesting methods, and government initiatives in promoting medicinal plant resources.

Employability for the Course / Programme
This is a GFC SEC course in botany that helps to initiate a startup in medicinal plant cultivation or medicated product preparation.

13	MUSHROOM CULTIVATION AND MARKETING	KU4SECBOT113
SEC	Semester : 4 Hrs/week : 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understand the scope of mushroom cultivation in economic growth of rural people.
CO2	Gaining knowledge in theoretical and practical aspects of mushroom cultivation
CO3	Basic knowledge in mushroom production and marketing.
CO4	Practical skills in cultivation, spawn production and setting up of lab for mushroom business.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	

Course Description

This is an SEC course in botany designed for all UG students with an aim to give basic knowledge in Mushroom cultivation and marketing.

- *First module is a foundation to mushroom cultivation techniques.*
- *Second module delves into the mushroom cultivation steps and processes.*
- *Third module is dealing with post harvesting processes and value addition.*
- *Fourth module is giving a basic knowledge in mushroom marketing and entrepreneurship.*

This course will provide opportunities to visit successful entrepreneurs in mushrrom cultivations and can ignite the entrepreneur mind set in the student.

Course Objectives:

1. To study theoretical and practical ideas
2. To study the crop management practices
3. To study the post -harvest management
4. To equip the students for commercial propagation for getting self employment and for giving employment to others

Credit	Teaching Hours	Assessment

L/T	P/I	Total	L/T/P	Total	CCA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1 : Introduction to Mushroom Cultivation 6 hrs

1.1.History and scope of Mushroom cultivation.

1.2.Five kingdom classification and general features of fungi. Mushroom Biology: Life cycle, morphology, and taxonomy.

1.3. Mushroom- general characters, edible and poisonous mushrooms. Nutritional and medicinal importance.

1.4.Morphology of *Agaricus bisporus* (Button), *Pleurotus* spp. (Oyster), *Volvariella volvacea* (Paddy Straw), and *Ganoderma*.

Module 2: Cultivation practices: 10 hrs

2.1.Cultivation Systems: Indoor vs. outdoor, low-cost and high-tech setups.

2.2.Spawn Production: Methods of preparation and sterilization. Substrate Preparation: Composting techniques for different substrates like paddy straw, sugarcane trash, and banana leaves.

2.3. Inoculation and Incubation: Techniques and environmental conditions. Casing and Fruiting: Role of casing materials and inducing fruiting.

2.4. Conditions for cultivation: Environmental Control: Temperature, humidity, and light management. Pest and Disease Management: Identification and control measures.

Module 3: Harvesting and Post-Harvest Handling 10 hours

3.1. Harvesting and Packaging: Optimal timing and methods of harvesting. Sorting, grading, and packaging.

3.2. Storage Methods: Refrigeration, canning, drying, and preservation in salt solutions.

3.3. Value-Added Products: Preparation of mushroom-based products like pickles, papads, and powders.

3.4. Utilization of Spent Substrate: Vermicomposting and organic farming applications.

Module 4: Mushroom Marketing and Entrepreneurship (10 hours)

4.1. Government Schemes and Support: Subsidies, training programs, and certification for Mushroom cultivation and marketing: Start up preparation, project proposal, licensing procedure and registration.

4.2. Entrepreneurial Skills: Business planning, risk management, and scaling operations.

4.3. Market Dynamics: Demand and supply analysis in local and international markets. Marketing Strategies: Branding, packaging, and labeling.

4.4. Distribution Channels: Retail, wholesale, and online platforms. Cost-Benefit Analysis: Financial planning and profitability.

Module 5. TEACH SPACE (9 hrs) This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 3 hrs

Case study: Successful stories of Mushroom Cultivation and value addition

Practicals 6 hrs

1. Spawn Preparation: Hands-on demonstration of spawn production.
2. Substrate Preparation: Composting and sterilization techniques.

3. Inoculation and Incubation: Setting up mushroom beds and monitoring environmental conditions.
4. Harvesting and Post-Harvest Handling: Practical experience in sorting, grading, and packaging.
5. Field Visit: Tour of a local mushroom farm to observe commercial operations.

Suggested Assignment Topics- Theory

1. Spawn production
2. Value added products of mushrooms
3. Canning and packing strategies
4. Toxins from mushrooms
5. Fungal taxonomy

Suggested Assignment Topics- Practical

1. Packaging of spawn
2. Composting of mushroom spent substrate
3. Collection of data on demand and supply ratio

Suggested Readings

Sl. No	Title/Author/Publishers of the Book specific to the module
1	Ashok Agarwal, Yashpal Sharma, Esha Jangra (2022): A Text Book on Mushroom cultivation Theory and Practices
2	http://celkau.in/Agrienterprises/enerprise
3	http://celkau.in/Agrienterprises/enerprise
4	https://agritech.tnau.ac.in/farm_enterprises/Farm%20enterprises_%20Mushroom_Bed%20preparation.html
5	Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K., & Jayarajan, R. (1991). *Oyster Mushrooms*. Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
6	Nita B (2000): Handbook of mushrooms. VolI and II. Oxford and IBH publishing Co. Pvt Ltd. NewDelhi
7	Pandey RK and Ghosh SK 1996: A handbook of Mushroom cultivation. Emkay publication
8	Swaminathan, M. (1990). *Food and Nutrition*. Bappco, The Bangalore Printing and Publishing Co. Ltd.
9	Tewari, P and Kapoor S C (1998): Mushroom cultivation, Mittal Publication, New Delhi

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	

• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Visit reports	5
• Presentations	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. What is the historical significance and current scope of mushroom cultivation?
2. Explain the Five Kingdom Classification and general features of fungi.
3. Describe the life cycle, morphology, and taxonomy of mushrooms.
4. Differentiate between edible and poisonous mushrooms, highlighting their general characteristics.
5. Discuss the nutritional and medicinal importance of mushrooms.
6. Compare the morphology of Agaricus bisporus, Pleurotus spp., Volvariella volvacea, and Ganoderma.
7. Contrast indoor and outdoor mushroom cultivation systems, including low-cost and high-tech setups.
8. Outline the methods of spawn production and sterilization techniques.
9. Explain the composting techniques for preparing substrates like paddy straw, sugarcane trash, and banana leaves.
10. Discuss the techniques for inoculation, incubation, casing, and inducing fruiting in mushroom cultivation.

6 Marks Questions:

1. Discuss the historical development and current scope of mushroom cultivation. How has it evolved from traditional practices to modern commercial production?
2. Explain the Five Kingdom Classification system with a focus on fungi. Highlight the general features that distinguish fungi from other kingdoms.
3. Explain the composting techniques for preparing substrates like paddy straw, sugarcane trash, and banana leaves. How do these substrates influence mushroom growth?
4. Discuss the inoculation and incubation processes in mushroom cultivation. What are the optimal environmental conditions for these stages?
5. Describe the role of casing materials in mushroom cultivation. How do they influence fruiting and overall yield?

7 Marks Questions:

1. Describe the life cycle and morphological characteristics of mushrooms. How do these features contribute to their growth and reproduction?
2. Differentiate between edible and poisonous mushrooms, emphasizing their general characteristics. Provide examples and discuss the importance of proper identification.
3. Analyze the nutritional and medicinal significance of mushrooms. How do their bioactive compounds contribute to health benefits?
4. Compare and contrast indoor and outdoor mushroom cultivation systems. Discuss the advantages and disadvantages of low-cost and high-tech setups.
5. Outline the methods of spawn production and sterilization techniques. Why are these steps crucial for successful mushroom cultivation?

14 Marks Questions:

1. Discuss the historical development and current scope of mushroom cultivation. How has it evolved from traditional practices to modern commercial production?
2. Compare and contrast indoor and outdoor mushroom cultivation systems. Discuss the advantages and disadvantages of low-cost and high-tech setups.
3. Explain the optimal timing and methods of harvesting mushrooms. How do sorting, grading, and packaging affect the quality and shelf life of the produce?
4. Evaluate the role of government schemes and support in promoting mushroom cultivation and marketing. How do subsidies, training programs, and certification contribute to the industry's growth?
5. Propose a comprehensive model integrating traditional knowledge, modern cultivation techniques, and sustainable practices for mushroom farming. How can this model enhance productivity and environmental responsibility?

Employability for the Course / Programme

It is one of the courses in botany which is very helpful for the student to start a life as an entrepreneur.

14	PLANT TISSUE CULTURE LAB SETUP FOR COMMERCIAL PRODUCTION	KU4SECBOT114
SEC	Semester : 4 Hrs/week : 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understand the scope of tissue culture as an industry
CO2	Understand the different steps in tissue culture lab setting up
CO3	Practical skills in tissue culture
CO4	Ability to do start up business in tissue culture

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	

Course Description

This SEC course is designed for all UG students to give basic knowledge about the techniques in tissue culture and its commercialization.

- *First module is introducing the fundamentals of tissue culture.*
- *Second module is related to the design and lay out of a tissue culture lab.*
- *Third module is igniting the idea of entrepreneur mindset to start a venture in tissue culture.*
- *Fourth module giving the background of certification and legal aspects of tissue culture commercialization.*

This course will provide opportunities to study all aspects in tissue culture commercialization through the setting up of a lab.

Course Objectives:

1. To equip the students for commercial propagation for starting up of enterprises on tissue culture.
2. Understand the scope of tissue culture industry.
3. To study different techniques in plant tissue culture.
4. To develop practical skills in tissue culture

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total

3	0	3	3 +0 + 0 (45 +0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to tissue culture: 7 hrs

a. Overview of Plant Tissue Culture: History, principles, and applications in agriculture and horticulture.
b. Terms related to Tissue culture: totipotency, Differentiation, redifferentiation, Dedifferentiation, explant and callus.
c. Sterilization Techniques: Chemical, Heat, Autoclave, HEPA filters and Laminar Airflow. methods for sterilizing plant materials and culture media.
d. Basic steps in plant tissue culture: explant selection, establishment of culture, multiplication, rooting, hardening in green house and field.

Module 2: Laboratory Design and Layout of a Tissue Culture Unit 8 hrs

2.1. Infrastructure requirements for a tissue culture laboratory- Space for equipment, Incubation room with proper temperature, light and humidity; working space as wet lab.
2.2. Planning the physical space for a tissue culture lab, including clean rooms, laminar flow hoods, and sterilization areas.
2.3. Equipment and instruments necessary for tissue culture operations. Chemicals and media formulations required for culture maintenance. Importance of proper glassware and sterilization techniques.
2.4. Composition of Culture Media: Murashige and Skoog (MS) medium and its variants. Role of Plant Growth Regulators: Understanding the influence of auxins, cytokinins, and other hormones on plant development.

Module 3: Scaling Up and Commercialization of Tissue Culture 13 hours

3.1. Micropropagation Techniques: Methods for large-scale propagation of plants such as banana, orchids, and medicinal plants.
3.2. Hardening and Acclimatization: Techniques for transferring in vitro plants to ex vitro conditions.
3.3. Quality Control and Genetic Fidelity: Ensuring uniformity and disease-free status of tissue-cultured plants.
3.4. Commercial Aspects: Setting up a commercial tissue culture laboratory, including cost analysis, marketing strategies, and regulatory requirements.

Module 4. Certification procedure and starting of commercial production: 8hrs

4.1. Safety Protocols and Regulatory Compliance: Implementing safety measures and adhering to local and international regulations.
4.2. Certification procedures and regulations for commercial tissue culture production. 4.3. Steps involved in starting a tissue culture business in India (planning, developing innovative ideas, identifying demand, marketing strategies, taking permits etc.).
4.4. Funding sources and financial planning for establishing a tissue culture unit.

Module 5. TEACH SPACE (9 hrs):

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4hrs

1. Case Studies: Analysis of successful commercial tissue culture operations and lessons

learned.

2. Tissue culture of medicinal plants; tissue culture for secondary metabolites.

Practicals 5 hrs

1. Media Preparation: Students will prepare MS medium and other media formulations.
2. Sterilization Techniques: Demonstrations on sterilizing plant material and culture vessels.
3. Culture Initiation: Initiating cultures from various explants.
4. Hardening Techniques: Transferring plants from in vitro to ex vitro conditions. Project
5. Work: Students will design a business plan for establishing a tissue culture laboratory, including market analysis and financial projections
6. Field visit – tissue culture lab

Suggested Assignment Topics- Theory

1. Various explants used in crops
2. Various culture media and its composition
3. Protocol for various types of tissue culture – callus, anther, etc

Suggested Assignment Topics- Practical

1. Callus development from various crop plants
2. Autoclaving demonstration

Suggested Readings

Sl. No	Title/Author/Publishers of the Book /ONLINE resources
1	Bajaj, Y.P.S. (1986). *Biotechnology in Agriculture and Forestry: Volume 1, High-Tech and Micropropagation I*. Springer.
2	Bajaj, Y.P.S. (1991). *Biotechnology in Agriculture and Forestry: Volume 16, Medicinal and Aromatic Plants II*. Springer.
3	Gamborg, O. L., Miller, R. A., & Ojima, K. (1968). Nutrient Requirements of Suspension Cultures of Soybean Root Cells. Experimental Cell Research, 50(1), 151-158.
4	George, E.F., Hall, M.A., & De Klerk, G.J. (2008). *Plant Propagation by Tissue Culture*. Springer.
5	Gupta, P.K. (1996). *Elements of Biotechnology*. Rastogi Publications.
6	Hammond, J., McGarvey, B., & Yusibov, V. (2000). *Plant Biotechnology: Recent Advances*. Springer.
7	Murashige, T., & Skoog, F. (1962). A revised medium for rapid growth and bioassays with tobacco tissue cultures. *Physiologia Plantarum*, 15(3), 473-497.
8	Plant Tissue Culture Protocol Database: http://www.plantcellculture.org/
9	Prakash, J., & Rao, J. (2010). Plant Tissue Culture: Theory and Practice. Universities Press.
10	Purohit, S. S., & Mukherjee, P. K. (2003). Modern Techniques in Plant Biotechnology. I. K. International Publishing House Pvt. Ltd.
11	Rajasekaran, T., & Sathyanarayana, B. N. (2019). Plant Tissue Culture: Theory and Practice. New Age International.
12	Skoog, F., & Miller, C.O. (1957). Chemical regulation of growth and organ formation in plant tissues cultured in vitro. *Symposia of the Society for Experimental Biology*, 11, 118-130.
13	Thakur, M. (2008). Biotechnology: Microbes and Microbial Technology. Anmol

	Publications Pvt. Ltd.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits ➢ Documentaries	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstration

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Comprehensive Assessment CCA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations	5
• Field reports	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. What is totipotency in plant cells?
2. Define explant in the context of tissue culture.
3. What is callus formation in plant tissue culture?
4. Explain the term 'hardening' in tissue culture.
5. What is the role of a laminar airflow hood in a tissue culture laboratory?
6. Why is sterilization crucial in tissue culture laboratories?
7. What is Murashige and Skoog (MS) medium?
8. Describe micropropagation in tissue culture.
9. What is the importance of quality control in tissue culture?
10. What are the steps involved in starting a tissue culture business in India?

6 Marks Questions:

1. Describe the sterilization techniques used in plant tissue culture laboratories, including chemical methods, heat sterilization, autoclaving, HEPA filters, and laminar airflow.
2. Outline the basic steps involved in plant tissue culture, from explant selection to hardening in the greenhouse and field.
3. Discuss the infrastructure requirements for establishing a plant tissue culture laboratory, including space for equipment, incubation rooms, and wet lab areas.
4. Discuss micropropagation techniques for large-scale propagation of crop plants
5. Define and differentiate between terms such as differentiation, dedifferentiation, redifferentiation, explant, and callus in the context of plant tissue culture

7 Marks Questions:

1. Explain the principle of totipotency in plant cells and its significance in tissue culture.
2. Explain the importance of proper laboratory design, including clean rooms, laminar flow hoods, and sterilization areas, in maintaining aseptic conditions.
3. List the essential equipment and instruments necessary for tissue culture operations and the role of proper glassware and sterilization techniques.
4. Describe the composition of Murashige and Skoog (MS) medium and its variants, and the role of plant growth regulators in influencing plant development.
5. Explain the process of hardening and acclimatization in tissue culture, and the importance of quality control and genetic fidelity in commercial production.

14 Marks Questions:

1. Discuss the historical development and principles of plant tissue culture. How have advancements in this field influenced agricultural and horticultural practices?
2. Explain the essential infrastructure requirements for establishing a plant tissue culture laboratory. How do factors like space, equipment, and environmental control contribute to successful tissue culture operations?
3. Evaluate the challenges and strategies involved in scaling up plant tissue culture for commercial production. Discuss the role of micropropagation, hardening, and quality control in this process.
4. Outline the certification procedures and regulatory requirements for establishing a commercial tissue culture production unit. How do safety protocols and compliance with regulations ensure the quality and success of the venture?

Employability for the Course / Programme

This is one of the SEC courses which is intended to help the stakeholder to initiate a startup in tissue culture and to become an entrepreneur.

23	BASICS OF ENVIRONMENTAL SCIENCE	KU4VACBOT123
VAC	Semester : 4 Hrs/week : 3 Theory + 0 Practical	Credits: 3

Course Pre-requisite:

7. Knowledge in Biology at 10th Standard
8. Ability to write examination in English

Course Outcomes	
CO1	Describe Ecosystem Structure and Function
CO2	Assess Biodiversity and Its Importance
CO3	Evaluate Health Impacts of Pollution
CO4	Apply Critical Thinking to Environmental Issues
CO5	Communicate Environmental Concepts Effectively

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	
CO5									√	√	√	√

Course Description

This is a general foundation course in botany for all UG students. The aim of the course is to give basic knowledge about the environmental science.

- *First module gives an idea on the basics of ecology.*
- *Second module is dealing with an idea on the ecosystems and biodiversity.*
- *Third module describes the basics of environmental pollution and its impacts.*
- *Fourth module develops the concept of sustainable development.*

This course will also provide you opportunities to observe diverse ecosystems and impacts of pollution in global environment.

Course Objectives:

14. To understand the interdisciplinary nature of Environmental Science.
15. To analyze ecosystem dynamics and biodiversity in the surroundings.
16. To assess the width and depth of environmental issues and also to internalize sustainable practices
17. To develop critical thinking and thereby enhancing the skill of problem solving in the era of climate change.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Environmental Science (8 hours)

1.1. Definition and Scope: Understanding environmental science as an interdisciplinary field.

1.2. Multidisciplinary Nature: Integration of biology, chemistry, physics, geography, and social sciences.

1.3. Importance of Environmental Science: Role in addressing environmental challenges.

1.4. Concepts of Sustainability and Sustainable Development: Principles and practices for sustainable living.

Module 2: Ecosystems and Biodiversity (10 hours)

8.1. Ecosystem Structure and Function: Components and energy flow. Biogeocehmical cycles.

8.2. Types of Ecosystems: Forest, grassland, desert, and aquatic ecosystems.

8.3. Biodiversity: Definition, importance, and levels (genetic, species, ecosystem). Threats to Biodiversity: Habitat loss, poaching, invasive species.

8.4. Conservation of Biodiversity: In-situ and ex-situ conservation methods.

Module 3: Environmental Pollution and Health (9 hours)

3.1. Types of Pollution: Air, water, soil, noise, and thermal pollution.

3.2. Sources and Effects: Industrial, agricultural, and domestic sources.

3.3. Health Impacts: Diseases related to environmental pollution.

3.4. Control Measures: Technological and policy interventions.

Module 4: Environmental Issues and Sustainable Practices 9 hours

4.1. Climate Change: Causes, impacts, and mitigation strategies.

4.2. Deforestation and Desertification: Consequences and preventive measures.

4.3. Water Resources Management: Conservation and sustainable usage.

4.4. Waste Management: Solid waste, recycling, and composting.

Module 5: TEACH SPACE 9 hrs

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 Hrs

Sustainable Agriculture and Energy: Practices for sustainable development.

Environmental Policies and Legislation: National and international frameworks. Biodiversity hot spots. Case study: Pollution sites and its reclamation. Brahmapuram of Ernakulam.

Practical Component (5 hours)

Field Visit: Visit to a local ecosystem (e.g., forest, wetland) to observe biodiversity and ecosystem functions.

Pollution Assessment: Collecting and analyzing water or soil samples for pollution indicators.

Waste Audit: Conducting a waste audit in the campus or community to understand waste generation patterns.

Sustainable Practices Workshop: Demonstration of composting, rainwater harvesting, and energy conservation techniques.

Suggested Assignment Topics- Theory

16. Ecosystem
17. Environmental Pollution
18. Climate Change
19. Waste management
20. Biodiversity hotspots

Suggested Assignment Topics- Practical

1. Case studies on Biodiversity hotspots
2. Waste audit
3. Sustainable development Goals and Daily life

Sl. No	Title/Author/Publishers of the Book specific to the module
1	Baird, C., & Cann, M. (2012). *Environmental Chemistry*.
2	Gupta, P.K. (1996). *Elements of Environmental Science and Engineering*.
3	Kormondy, E.J. (2013). *Concepts of Ecology*.
4	Meadows, D.H., Meadows, D.L., & Randers, J. (2004). *Limits to Growth: The 30-Year Update*.
5	Miller, G.T. (2013). *Living in the Environment: Principles, Connections, and Solutions.*
6	Odum, E.P. (2004). *Fundamentals of Ecology*.
7	Primack, R.B. (2014). *Essentials of Conservation Biology*.
8	Stern, P.C., & Fineberg, H.V. (1996). *Understanding Risk: Informing Decisions in a Democratic Society*.
9	Koparde A A, Patil A A and Doijad R C, (2020). A Textbook of Basic Concepts in Environmental Science. Akinik Publications.
10	Thakur, V. (2019). A text book of Environmental Science. Sciencetific Publishers.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Evaluation CAA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations	5
• Field visit reports	5

Sample Questions to test Outcomes.

2 Marks Question

1. What is the scope of environmental science?
2. Name any two interdisciplinary fields integrated into environmental science.
3. Explain the concept of sustainability.
4. What is sustainable development?
5. List the three levels of biodiversity.
6. Mention any two threats to biodiversity.
7. Name any two types of pollution.
8. What are biodegradable pollutants?
9. List any two causes of deforestation.
10. What is desertification?
11. Explain recycling.
12. What is composting?

6 Marks Questions:

1. Explain the interdisciplinary nature of environmental science and its significance in addressing environmental issues.
2. Discuss the concept of sustainability and its importance in promoting sustainable development practices.
3. Analyze the relationship between environmental pollution and public health, emphasizing the role of policy interventions.
4. Examine the causes and consequences of climate change, and propose strategies for its mitigation.
5. Discuss the importance of waste management and recycling in promoting sustainable living practices.

7 Marks Questions:

1. Describe the structure and function of an ecosystem, highlighting the roles of producers, consumers, and decomposers.
2. Define biodiversity and explain its significance in maintaining ecological balance and supporting ecosystem services.
3. Identify the major threats to biodiversity and discuss strategies for its conservation.
4. Explain the different types of environmental pollution and their impact on human health and the environment.
5. Discuss the sources and effects of water pollution, and suggest measures to prevent and control it.

14 Marks questions

1. Discuss the interdisciplinary nature of environmental science and its significance in addressing contemporary environmental challenges.
2. Explain the structure and function of ecosystems, highlighting the role of organisms in different trophic levels. Add a short note on the importance of biodiversity in maintaining ecosystem stability.
3. Analyze the various types of environmental pollution, their sources, and their impacts on human health and the environment. Propose effective control measures for each type of pollution.
4. Examine the causes and consequences of climate change. Discuss global and local mitigation strategies.
5. Evaluate the role of government policies and individual actions in promoting environmental conservation. Does legislation is effective in achieving environmental sustainability?

Employability for the Course / Programme

It is one of the VAC courses in botany which is very helpful in understanding the basics of environmental science; directing to the passionate world of environmentalist.

24	CLIMATE CHANGE AND DISASTER MANAGEMENT	KU4VACBOT124
VAC	Semester : 4 Hrs/week : 3 Theory + 0 Practical	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Understand the fundamental concepts of climate and weather
CO2	Analyze the effect of Global Warming in various natural disasters and climate change
CO3	Analyze the effects of climate change on ecosystems and human systems
CO4	Explore Mitigation Strategies and Policy Frameworks

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3							√	√	√	√		
CO4								√	√	√	√	

Course Description

This is a GFC VAC course in botany designed for all UG students.The aim of the course is to give basic knowledge about the climate change and disaster managements.

- *First module is unraveling the basic concepts on climate change.*
- *Second module is giving an idea on disasters and their management strategies.*
- *Third module delves into the impacts of climate change.*
- *Fourth module tells about various national and international mitigation strategies and agreements.*

This course will also provide you opportunities to observe diverse forms of plant life in forests

Course Objectives:

1. To know about Earth's climate systems and its variability.
2. To understand the concept greenhouse effect and global warming
3. To assess the role of disaster management in reducing the impact on human life.
4. To analyze the impacts of climate change on biosphere.

Credit	Teaching Hours	Assessment

L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total
3	0	3	3+ 0+ 0 (45+ 0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Climate Change (8 hours)

1.1. Climate and Weather. Climate Systems and Variability: Understanding Earth's climate systems and natural variability. Concept of microclimates.

1.2. Greenhouse Effect and Global Warming: Mechanisms and implications.

1.3. Anthropogenic activities leading to Global warming. Other causes of Global warming.

1.4. Direct and indirect impacts of global warming: Rising temperatures, sea-level rise, and extreme weather events. future projections.

Module 2: Disasters and Their Management (10 hours)

2.1. Types of Disasters: Natural (earthquakes, floods, cyclones) and anthropogenic (industrial accidents, nuclear incidents).

2.2. Disaster Risk Reduction (DRR): Strategies for minimizing disaster risks.

2.3. Disaster Management Cycle: Phases of disaster management: mitigation, preparedness, response, and recovery.

2.4. Institutional Frameworks: Roles of national and international agencies in disaster management. Case Studies: Analysis of major disasters : Prediction of cyclones in the Indian East coast.

Module 3: Climate Change Impacts and Adaptation (10 hours)

3.1. Impacts on Ecosystems: Effects on biodiversity, forests, and marine life.

3.2. Impacts on Human Systems: Agriculture, water resources, health, and infrastructure.

3.3. Vulnerable Populations: Impacts on marginalized and low-income communities.

3.4. Adaptation Strategies: Climate-resilient agriculture, water management, and urban planning. Climate Justice: Equity considerations in adaptation efforts.

Module 4: Mitigation Strategies and Policy Frameworks (8 hours)

4.1. Mitigation Measures: Renewable energy, energy efficiency, and carbon capture.

4.2. International Agreements: Kyoto Protocol, Paris Agreement, and their implications.

4.3. National Policies: India's National Action Plan on Climate Change (NAPCC) and state action plans.

4.3. Role of Technology and Innovation: Technological advancements in mitigation efforts. Public Awareness and Education: Strategies for promoting climate change awareness.

Module 5. PRACTICALS (9 hrs):

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 hrs

Case studies on Floods of Kerala; Covid-19 Pandemic; Landslides in Kerala

Practicals 5 hours

1. Field Visit: Visit to a local disaster-prone area or climate-resilient project.
2. Simulation Exercise: Disaster response simulation using role-playing.
3. Data Analysis: Analysis of climate data and disaster statistics.

4. Project Presentation: Students present a project on climate adaptation or disaster risk reduction strategies.

Suggested Assignment Topics- Theory

1. Disaster management
2. Climate change
3. Impacts of Global warming
4. Biodiversity of Kerala
5. India as megadiversity centre

Suggested Assignment Topics- Practical

1. Reports after field visits
2. Projects on various pollution studies

Suggested readings	
Sl. No	**Title/Author/Publishers of the Book specific to the module**
1	Adger, W. N., et al. (2007). *Assessment of Adaptation Practices, Options, Constraints, and Capacity*. Cambridge University Press.
2	Coppola, D. P. (2015). *Introduction to International Disaster Management*. Elsevier.
3	Government of India (2008). *National Action Plan on Climate Change*. Ministry of Environment, Forest and Climate Change.
4	Houghton, J. (2009). *Global Warming: The Complete Briefing*. Cambridge University Press.
5	IPCC (2021). *Climate Change 2021: The Physical Science Basis*. Cambridge University Press.
6	Paul, B. K. (2003). *Environmental Hazards and Disasters: Contexts, Perspectives, and Management*. Wiley-Blackwell.
7	Smit, B., et al. (2001). *Adaptation to Climate Change in the Context of Sustainable Development and Equity*. Cambridge University Press.
8	UNFCCC (2015). *Paris Agreement*. United Nations Framework Convention on Climate Change.
9	Khullar D R, 2021. Environment and Disaster Management
10	Agrahari R P, 2023. Environmental Ecology, Bio-Diversity, Climate Change & Disaster Management, MaC Graw Hill.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Evaluation CAA	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations	5

• Field reports	5

Sample Questions to test Outcomes.

2 Marks Questions:

1. What is the greenhouse effect, and how does it contribute to global warming?
2. Identify two major anthropogenic activities that lead to global warming.
3. Explain the concept of microclimates and provide an example.
4. Differentiate between natural and anthropogenic disasters with examples.
5. Outline the four phases of the disaster management cycle.
6. Discuss the role of national and international agencies in disaster risk reduction.
7. Describe the impact of climate change on biodiversity.
8. Explain how climate change affects agriculture and water resources.
9. What are renewable energy sources, and how do they mitigate climate change?
10. Summarize the objectives of the Paris Agreement in addressing global warming.

6 Marks Questions:

1. Analyze the objectives and outcomes of the Paris Agreement in addressing global warming.
2. Describe the role of national and international agencies in disaster risk reduction.
3. Differentiate between natural and anthropogenic disasters with examples.
4. Discuss the direct and indirect impacts of global warming on the environment.
5. Discuss the vulnerability of marginalized communities to climate change impacts.

7 Marks Questions:

1. Evaluate the effectiveness of renewable energy sources in mitigating climate change.
2. Explain the effects of climate change on biodiversity and ecosystems.
3. Identify and explain two major anthropogenic activities that lead to global warming.
4. Outline the four phases of the disaster management cycle and their significance.
5. What is the greenhouse effect, and how does it contribute to global warming?

14 Marks Questions:

1. Explain the greenhouse effect and its role in global warming. Discuss the anthropogenic activities contributing to global warming and their implications for Earth's climate systems.

2. Analyze the various types of natural and anthropogenic disasters. Discuss the disaster management cycle and the roles of national and international agencies in disaster risk reduction and response.

3. Assess the impacts of climate change on ecosystems and human systems, with a focus on agriculture, water resources, health, and infrastructure. Discuss adaptation strategies and the concept of climate justice in addressing these challenges.

4. Evaluate the effectiveness of mitigation measures such as renewable energy, energy efficiency, and carbon capture in combating climate change. Discuss about various international agencies and agreements on Climate change.

5. Discuss the role of technology, innovation, and public awareness in addressing climate change. Evaluate the effectiveness of educational initiatives and policy frameworks in promoting sustainable practices and climate resilience.

Employability for the Course / Programme

It is one of the advanced courses which is very helpful in understanding the diversity of plant life

25	ENTRPRENEURESHIP IN COMPOST MAKING	KU4VACBOT125
VAC	Semester : 4 Hrs/week : 3 Theory	Credits : 3

Course Pre-requisite:

1. Knowledge in Biology at 10th Standard
2. Ability to write examination in English

Course Outcomes	
CO1	Utilize appropriate composting methods tailored to specific organic waste types
CO2	Enhance Environmental Sustainability by selecting proper waste management system
CO3	Expand composting initiatives from small-scale setups to larger operations
CO4	Develop and implement business plans for sustainable and profitable composting ventures.

Mapping of Course Outcomes to PSOs/Pos

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√						
CO3					√	√	√	√	√	√		
CO4								√	√	√	√	√

Course Description

This is an advanced botany course designed for UG students in general and BSc Zoology and BSc Forestry in particular. The aim of the course is to give basic knowledge about the diversity of plant life forms.

- *First module is giving basics of composting and its environmental benefits.*
- *Second module delves into the basic techniques of composting prevailing in India and abroad.*
- *Third module is giving directions to setup composting ventures.*
- *Fourth module is inducing the student to start a business plan on composting enterprises.*

This course will also provide opportunities to observe various types of composting present in our premises.

Course Objectives:

6. To gather knowledge on various composting techniques
7. To articulate the knowledge on decomposing microorganisms in solid waste management through composting.
8. To design and establish small- to large-scale composting systems.
9. To create business models on composting ventures.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 +0)	3 (45)	25	50	75

COURSE CONTENT

Module1: Introduction to Composting 9 Hrs

1.1. Definition and Importance of Composting: Understanding composting as a sustainable waste management practice. Microbes and other organisms in composting.
1.2. Environmental Benefits: Reduction of landfill waste, greenhouse gas emissions, and the role in soil health.
1.3. Types of Composting: Aerobic vs. anaerobic, vermicomposting, and their applications.
1.4. Composting Materials: Organic waste types, carbon to nitrogen ratio, and moisture content.

Module 2: Compost Production Techniques 10 Hrs

2.1. Composting Methods: Windrow, pit (Heap composting and Tank composting), and bin composting techniques.
2.2. Vermicomposting and importance: Introduction to earthworm species, bed preparation, and harvesting. Vermi wash.
2.3. Small- and Large-scale composting. Kitchen waste composting, farm waste composting.
2.4. Quality Parameters: Temperature, pH, moisture, and maturity indicators. Troubleshooting: Common issues like odor, pests, and improper decomposition.

Module 3: Practical Implementation and Scaling of Composting Ventures 10 hours

3.1. Site Selection and Setup: Choosing appropriate locations, infrastructure requirements, and equipment.
3.2. Operational Management: Daily operations, labor management, and inventory control.
3.3. Scaling Strategies: Expanding production capacity, diversifying product lines, and exploring new markets. Value addition of compost, activated compost, weed compost, compost sieving and packing
3.4. Sustainability Practices: Implementing eco-friendly practices and achieving sustainability goals. Composting Kerala model: Thumboormuzhi. Biocomposting Methods: Coimbatore method, Indore method, Bangalore method.

Module 4. Business Planning and Market Strategies for Compost Enterprises 7hrs

4.1. Business Model Development: Identifying target markets, value proposition, and revenue streams.
4.2. Legal and Regulatory Aspects: Licensing, certifications, and environmental regulations.
4.3. Marketing Strategies: Branding, pricing, distribution channels, and customer engagement.
4.4. Financial Planning: Cost analysis, pricing models, and profitability projections.

Module 5. PRACTICALS 9 hrs

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 4 hrs

Biodegradation mechanism in composting process- various new initiatives in composting, case studies.

Practicals 5 hrs

1. Biocomposting lab visits
2. Identification of vermicompost worms
3. preparation of vermiwash
4. Identification of different composting bins and equipment
5. A start up project proposal writing in composting
6. Prepare and submit an innovative model for composting

Suggested Assignment Topics- Theory

1. Biocomposting
2. Thumboormuzhi
3. Banglore model of biocomposting
4. Indore model of biocomposting
5. Meachanism in composting
6. Organisms in composting

Suggested Assignment Topics- Practical

7. Collection of photos and life histories of composting organisms
8. Exhibition and album preparations on successful composting methods.

Suggested readings

Sl. No	Title/Author/Publishers of the Books/ Online resources
1	Ayilara, M. S., Olanrewaju, O. S., Babalola, O. O., & Odeyemi, O. (2020). Waste Management through Composting: Challenges and Potentials. *Sustainability*, *12*(11), 4456. https://doi.org/10.3390/su12114456
2	Cummings D, 2015.Organic Composting Handbook: Techniques for a Healthy, Abundant Garden, Skyhorse Publishers
3	Dabral, M. (2025). Basics of Vermicomposting Business. Retrieved from Udemy
4	Entrepreneur India. (2025). The Complete Book on Organic Farming and Production of Organic Compost (3rd Edition). Retrieved from entrepreneurindia.co.in
5	Forsyth County Cooperative Extension. (2025). *Composting Basics*. Retrieved from forsyth.ces.ncsu.eduUdemyforsyth.ces.ncsu.edu
6	Gupta M K, 2007.Handbook of Organic Farming and Biofertilizers, ABD Publishers.
7	https://www.nyc.gov/assets/dsny/docs/nyc-master-composter-manual-mcm.pdf
8	Institute for Local Self-Reliance. (2025). Community Composting 101 Online Certificate Course. Retrieved from ilsr.org
9	Madhav V N, Geetha S and N Gangadhar, 2022. Biofertilizers and Organic Farming, BFC Publications
10	North Carolina Cooperative Extension. (2025). Composting Basics. Retrieved from forsyth.ces.ncsu.edu
11	Urban Worm Company. (2025). Commercial Worm Farm Course. Retrieved from urbanwormcompany.com
12	Wilson J, 2020. Composting: Sustainable and Low-Cost Techniques for Beginners. Drip Digital.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION

➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	**Marks**
End Semester Evaluation ESE	
• University Examination	50
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations on composting techniques	5
• Reports of field visits	5

Sample Questions to test Outcomes.

2 Marks Questions

1. What is composting, and why is it important?
2. List two environmental benefits of composting.
3. Differentiate between aerobic and anaerobic composting.
4. What is the ideal carbon-to-nitrogen (C:N) ratio for composting?
5. Explain any two features of windrow composting method.
6. What is vermiwash, and how is it used?
7. Name one method for small-scale composting.
8. What temperature range is ideal for composting?
9. How does the Thumboormuzhi model of composting is different from other composting?
10. Name one biocomposting method.

6 Marks Questions

1. Detail the process of vermicomposting, including bed preparation, suitable earthworm species, and the benefits of vermiwash.
2. Discuss strategies for scaling composting operations, including site selection, operational management, and exploring new markets.
3. Discuss the environmental benefits of composting, focusing on its impact on landfill reduction and soil health.
4. Discuss the Indore method of composting, focusing on its layering process and the role of periodic turning.
5. Explain the Coimbatore method of composting, emphasizing its unique features and benefits.

7 Marks Questions

1. Compare aerobic and anaerobic composting methods, highlighting their differences and suitable applications.
2. Describe the ideal carbon-to-nitrogen (C:N) ratio for composting and its importance in the decomposition process.
3. Describe the Thumboormuzhi model of composting in Kerala, highlighting its community involvement and sustainability practices.
4. Explain the process of composting and its significance in sustainable waste management.
5. Outline the steps involved in windrow composting and its advantages for large-scale composting operations.

14 Marks Questions

1. Discuss the principles and environmental significance of composting.

2. Compare and contrast various composting methods, emphasizing their applications and advantages.
3. Elaborate on the Thumboormuzhi model of composting in Kerala and its impact on community waste management.
4. Analyze the business planning aspects of establishing a composting enterprise.
5. Explore scaling strategies for composting ventures, focusing on operational management and sustainability practices.

Employability for the Course / Programme

It is one of the foundation course in Botany to get an environmental awareness which is very helpful in the progression as an active social worker as well as an industrialist.

26	BIOFERTILISER AND MARKETING	KU4VACBOT126
VAC	Semester: 4 Hrs/week: 3 Theory	Credits: 3

Course Pre-requisite:

5. Knowledge in Biology at 10th Standard
6. Ability to write examination in English

Course Outcomes	
CO1	Apply Biofertilizer Knowledge in Agricultural Practices
CO2	Demonstrate Practical Skills in Biofertilizer Production
CO3	Ensure Quality Control in Biofertilizer Production
CO4	Design and Implement Biofertilizer-Based Business Models

Mapping of Course Outcomes to PSOs/POs

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	√	√	√									
CO2			√	√	√	√	√	√				
CO3							√	√	√	√		
CO4								√	√	√	√	√

Course Description

This is a GFC VAC course in botany designed for all UG students. The aim of the course is to give basic knowledge in setting up of biofertilizer units and their business opportunities.

- *First module is an introduction to biofertilisers.*
- *Second module is dealing with the production techniques of biofertlisers.*
- *Third module is directing the stakeholders to the world of biofertiliser business.*
- *Fourth module is inducing the student for a start up in biofertliser venture.*

This course will provide you opportunities to observe diverse biofertliser techniques.

Course Objectives:

1. To gather knowledge on biofertilizers and their importance
2. To identify various types of biofertilizers
3. To understand mechanisms of enhancement of soil fertility and plant growth
4. To assess the benefits and limitations in developing business and marketing ventures in the field of biofertilisers.

Credit			Teaching Hours		Assessment		
L/T	P/I	Total	L/T/P	Total	CAA	ESE	Total
3	0	3	3 +0 + 0 (45 +0 + 0)	3 (45)	25	50	75

COURSE CONTENT

Module 1: Introduction to Biofertilizers (8 hours)

1.1. Definition and Importance: Understanding biofertilizers as sustainable alternatives to chemical fertilizers.

1.2. Types of Biofertilizers: Nitrogen fixers (e.g., *Rhizobium, Azotobacter*), phosphorus solubilizers, potassium mobilizers, mycorrhizae, and cyanobacteria.

1.3. Mechanisms of Action: How biofertilizers enhance soil fertility and plant growth.

1.4. Benefits and Limitations: Advantages of biofertilizers in agriculture and potential challenges.

Module 2: Production Techniques of Biofertilizers (10 hours)

6.1. Microbial Strain Selection: Criteria for selecting effective microbial strains for biofertilizer production. Isolation and Purification: Techniques for isolating and purifying beneficial microorganisms.

6.2. Mass Production Methods: Solid-state fermentation and submerged fermentation techniques.

6.3. Formulation Types: Carrier-based and liquid formulations; advantages and disadvantages.

6.4. Quality Control: Standards for biofertilizer quality, including microbial count, viability, and shelf life.

Module 3: Business Planning and Marketing of Biofertilizers (10 hours)

3.1. Market Analysis: Identifying target markets, customer needs, and competition.

3.2. Business Model Development: Creating a sustainable business model for biofertilizer production.

3.3. Regulatory Compliance: Understanding national and international standards for biofertilizer production and marketing.

3.4. Marketing Strategies: Branding, pricing, distribution channels, and promotional tactics. Sales and Distribution: Establishing sales networks and partnerships with agricultural stakeholders.

Module 4: Practical Implementation and Scaling of Biofertilizer Ventures (8 hours)

4.1. Site Selection and Infrastructure: Choosing appropriate locations and setting up production facilities.

4.2. Operational Management: Managing production processes, inventory, and quality assurance.

4.3. Scaling Strategies: Expanding production capacity and diversifying product offerings.

4.4. Sustainability Practices: Implementing eco-friendly practices and achieving sustainability goals.

Module 5. TEACH SPACE (9 hrs):

This module is having a list of suggested activities that helps to achieve the aim, objectives and outcome of the course; which will be determined by the concerned teacher. Assessment for this module is ***strictly internal***.

Theory 2hrs

Case study: Successful stories on biofertilizer technique and marketing

Practicals 7 Hrs

- Production Demonstration: Demonstrating the production of biofertilizers using different methods.
- Quality Control Testing: Conducting tests to assess the quality of produced biofertilizers.
- Market Survey: Conducting surveys to understand market demand and customer preferences.
- Business Plan Presentation: Developing and presenting a business plan for a biofertilizer enterprise.

Suggested Assignment Topics- Theory

1. Biofertilizer
2. Mechanism of decomposition used in biofertilizer technique
3. Microorganisms in biofertilizer tehcnology

Suggested Assignment Topics- Practical

1. Survey on biofertliser industry
2. Feasibility study on biofertilizer marketing

Suggested readings

Sl. No	Title/Author/Publishers of the Books/ online resources
1	Amrita Vishwa Vidyapeetham. (2025). Biofertilizer Technology. Retrieved from amrita.edu
2	B. N. Johri and V. K. Sharma (2014). *Biofertilizers: Commercial Production Technology and Quality Control*, Springer.
3	BASIC BIOFERTILIZER TECHNOLOGY (Skill Enhancement Course). (2025). Retrieved from biotech.iisuniv.ac.in
4	Centurion University. (2025). Bio-Fertilizer Preparation – Courseware. Retrieved from courseware.cutm.ac.in
5	Gupta M K, 2007.Handbook of Organic Farming and Biofertilizers, ABD Publishers.
6	https://www.nyc.gov/assets/dsny/docs/nyc-master-composter-manual-mcm.pdf
7	Institute for Local Self-Reliance. (2025). Community Composting 101 Online Certificate Course. Retrieved from ilsr.org
8	Institute of Agriculture, Kumulur. (2025). *Commercial Courses*. Retrieved from tnau.ac.inmaraugusthinosecollege.org
9	Madhav V N, Geetha S and N Gangadhar, 2022. Biofertilizers and Organic Farming, BFC Publications
10	Mar Augusthinose College. (2025). Biofertilizers and Its Applications. Retrieved from maraugusthinosecollege.org
11	Organic Farming – Courseware. (2025). Retrieved from course.cutm.ac.inbiotech.iisuniv.ac.in
12	Pankaj Bhatt and Ajar Nath Yadav (2019). *Biofertilizers for Sustainable Agriculture*, Springer Publication.

TEACHING LEARNING STRATEGIES	MODE OF TRANSACTION
➢ Hands-on experiments ➢ Collaborative learning-Group discussion ➢ Field visits	➢ Lecturing ➢ ICT ➢ Practicals ➢ Demonstrations

ASSESSMENT RUBRICS	Marks
End Semester Evaluation ESE	
• University Examination	50
Continuous Evaluation CE	
• Examinations (multiple choice, true-false, fill-in-the-blank, matching, short answer and critical thinking questions)	10
• Writing assignment	5
• Presentations	5
• Field reports	5

Sample Questions to test Outcomes.

2 Marks Question

1. Define biofertilizers.
2. Explain the term 'carrier-based formulation' in biofertilizer production.
3. Identify one advantage of using biofertilizers over chemical fertilizers.
4. List two nitrogen-fixing bacteria used as biofertilizers.
5. Mention a regulatory aspect important in biofertilizer marketing.
6. Name a free-living nitrogen-fixing cyanobacterium used as a biofertilizer.
7. Write down the primary purpose of seed treatment with biofertilizers.
8. What is the role of biofertilizers in integrated nutrient management?
9. What is meant by mycorrhizal fungi? Mention its role in biofertilization.
10. Give a brief account on the significance of quality control in biofertilizer production.

6 Marks Questions:

1. Outline the steps involved in the production of biofertilizers.
2. Discuss the importance of quality control in biofertilizer production.
3. Explain the regulatory compliance requirements for biofertilizer production and marketing.
4. What are biofertilizers, and how do they contribute to sustainable agriculture?
5. What are the key components of a business model for biofertilizer production?

7 Marks Questions:

1. Compare carrier-based and liquid formulations of biofertilizers.
2. Describe the different types of biofertilizers and their specific functions.
3. Explain the mechanisms through which biofertilizers enhance plant growth.
4. Describe the strategies for scaling up biofertilizer production operations.
5. What are the advantages and limitations of using biofertilizers in agriculture?

14 Marks Questions

1. Discuss the role of biofertilizers in sustainable agriculture.
2. Compare and contrast different types of biofertilizers and their applications.
3. Explain the methods of biofertilizer production and quality control measures.
4. Analyze the business planning and marketing strategies for biofertilizer enterprises.
5. Evaluate the challenges and strategies in scaling biofertilizer production.

Employability for the Course / Programme

It is a basic course in Botany for becoming an entrepreneur in the field of biofertilizer production and marketing.