KANNUR UNIVERSITY
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(Abstract)

FYUG Forestry Programme - Syllabus of 4-8 Semesters - Approved and Implemented with effect from 2024 Admission - Orders Issued

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ACADEMIC C SECTION

ACAD C/ACAD C3/23394/2024 Dated: 05.01.2026

Read:-1. 1. U.O. of even number dated 11/11/2024

2. U .O of even number dated 01.02.2025

3. Minutes of the Online meeting of all Dean of Faculties held on 04.06.2025.

4.U.O of even number dated 22.09.2025

5.U.O of even number dated 15.10.2025

6.E-mail from the Chairperson, Board of Studies in Forestry(cd) dated 29.10.2025

7.E-mail from the Dean, Faculty of Science dated 04.11.2025

8.Minutes of the Meeting of the Standing Committee of the Academic Council, held on 05.12.2025

9. Orders of the Vice Chancellor in the file of even number dated 01.01.20026

ORDER

1.The Scheme (All semesters) and Syllabus (First & Second Semester only) of the FYUG B.Sc. Forestry Programme were approved and implemented w. e. f 2024 Admission as per the paper read (1) above.

2.The Modified Scheme (All semesters) and First Semester syllabus of FYUG B.Sc. Forestry Programme were approved and Implemented w. e. f . 2024 Admission as per the paper read (2) above.

3.The meeting of all Deans of faculties held online on 04.06.2025, vide paper read (3) recommended to approve the Third and Fourth semester Syllabus of the FYUG Forestry Programme and the same was approved by the Vice-Chancellor, exercising the powers of the Academic Council .

4.Third Semester Syllabus of FYUG Forestry Programme w.e.f 2024 Admission was implemented in affiliated colleges w.e.f 2024 admission as per paper read (4) above.

5.The modified Third Semester Syllabus of FYUG Forestry Programme w.e.f 2024 Admission was approved and implemented in affiliated colleges w.e.f 2024 admission as per paper read (5) above

6.The Chairperson, Board of Studies in Forestry(Cd) vide paper read as (6) above, submitted the Syllabus of the 5-8 Semesters of FYUG Forestry Programme for approval and implementation w e f the Academic year 2024 .

7.The submitted Scheme and Syllabus of the 5-8 Semester FYUG Forestry Programme were forwarded to Dean, Faculty of Science for verification and the Dean vide paper read as (7) above recommended to approve the same.

8. Considering the matter, the Vice Chancellor has ordered to place the 5-8 Semester syllabus of the FYUG Forestry Programme, submitted by the Chairperson, Board of Studies in Forestry(Cd), before the Standing Committee of the Academic Council for consideration .

9. The Standing Committee of the Academic Council, held on 05.12.2025, vide paper read as (8) above, recommended to approve the 5-8 Semester syllabus of the FYUG Forestry Programme for implementation w e f the Academic year 2024.

10.The Vice Chancellor after considering the recommendation of the Standing Committee of the Academic Council and in exercise of the powers of the Academic Council conferred under Section 11(1) Chapter III of the Kannur University Act, 1996 and all other enabling provisions read together with, has approved the 4-8 Semester Syllabus of the FYUG B.Sc.Forestry Programme for implementation w.e.f 2024 admission, subject to reporting to the Academic Council.

11.The approved Scheme and Syllabus are appended with this U.O. and uploaded in the University website.

Orders are issued accordingly.

Sd/-

Jisha K P

Assistant Registrar II

For REGISTRAR

To: 1. The Controller of Examinations (through PA)

2.The Principals of Arts and Science Colleges affiliated to Kannur University

Copy To: 1. The Chairperson, Board of Studies in Forestry (Cd)

2. PS to VC/PA to R/PA TO CE

3. DR/AR (Academic)

4. JR/AR (Examination)

5.The IT Cell (For uploading in the website)

6. SF/DF/FC

Forwarded / By Order

SECTION OFFICER

KANNUR UNIVERSITY

SYLLABUS FOR

FOUR YEAR UNDER GRADUATE PROGRAMME (FYUGP) IN FORESTRY

(2024 Admission onwards)

Foreword

The Four-Year Undergraduate Programme (FYUGP) in Forestry is undergoing significant changes to better meet the needs of students, industries, and society. Education is seen as vital, and it's essential that the courses offered reflect the demands of the modern world. This means regularly updating the curriculum to keep pace with changes in society and the economy.

It is crucial for higher education to equip students with practical skills that are directly relevant to their chosen fields. However, despite the increasing number of people attending college, there are concerns about whether the education they receive adequately prepares them for the workforce. This is particularly true when it comes to skills that employers are looking for.

As our world becomes more interconnected and fast-paced, it's essential for educational institutions to evolve and teach students the skills they need to succeed in the 21st century. This includes not only technical skills but also critical thinking, communication, and adaptability. In the field of forestry, there is an urgent need to focus on forest conservation, biodiversity preservation, and sustainable management of forest resources. The curriculum must address these critical issues to prepare students to tackle the environmental challenges of our time. Topics such as ecosystem services, climate change mitigation, and the socio-economic aspects of forest management are essential components of a modern forestry education.

The government of Kerala is taking proactive steps to improve higher education by setting up commissions to recommend changes to policies, regulations, and evaluation systems. These efforts include a focus on integrating forest conservation principles into the educational framework.

As part of these efforts, the undergraduate curriculum, including the FYUGP in Forestry, is being restructured to better align with the goals of creating a knowledgeable society capable of driving sustainable development. These changes aim to ensure that higher education remains relevant and beneficial for both students and society as a whole, fostering a new generation of forestry professionals equipped to protect and manage our vital forest resources.

Aneesh K S,
Chairperson,
BoS, UG Forestry

Preamble

Welcome to the Four-Year Undergraduate Programme (FYUGP) in BSc Forestry at Kannur University. This syllabus has been carefully crafted to provide students with a comprehensive understanding of the vital field of forestry while equipping them with the necessary skills to thrive in today's dynamic environment.

Forestry, the science and art of managing forests, trees, and related natural resources, is a field of immense importance for ecological balance, biodiversity conservation, and sustainable development. As we witness rapid advancements in science and technology, the study of forestry continues to evolve, presenting new opportunities and challenges.

This syllabus aims to blend theoretical knowledge with practical applications, offering students a well-rounded education that prepares them for both academic pursuits and professional endeavours. Through a combination of classroom lectures, laboratory experiments, fieldwork, and research projects, students will delve deep into the intricate world of forest biology, exploring topics such as forest ecology, silviculture, forest management, conservation biology, wildlife management, and environmental policy.

At Kannur University, we are committed to providing our students with a stimulating learning environment that fosters curiosity, critical thinking, and a passion for discovery. We encourage active participation, independent thinking, and collaborative learning, ensuring that our graduates emerge as confident and competent individuals ready to make meaningful contributions to society.

This syllabus represents our dedication to academic excellence, innovation, and continuous improvement. We believe that by nurturing a deep appreciation for forests and natural resources and instilling a sense of responsibility towards environmental stewardship, our students will become future leaders who can address the pressing challenges facing our planet, including climate change, deforestation, and biodiversity loss.

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

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 Kasaragod and Kannur Revenue Districts and the Manandavady Taluk of Wayanad Revenue District.

Mission:

- To produce and disseminate new knowledge and to find novel avenues for application of such knowledge.
- To adopt critical pedagogic practices which uphold scientific temper, the uncompromised spirit of enquiry and the right to dissent.
- To uphold democratic, multicultural, secular, environmental and gender sensitive lues as the foundational principles of higher education and to cater to the modern notions of equity, social justice and merit in all educational endeavours.
- 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 national vision and international standards.
- To associate with the local self-governing bodies and other statutory as well as nongovernmental organizations for continuing education and also for building public awareness on important social, cultural, and other policy issues.

BOARD OF STUDIES - FORESTRY (UG)

Chairperson		
1	Aneesh K S	Assistant Professor, Department of Forest Resource Management, College of forestry, Vellanikkara, KAU.
Members		
2	Aparna P	Assistant Professor, Department of Botany, Sree Narayana College, Kannur.
3	Resmi P Thomas	Assistant Professor, Department of Botany, Sree Narayana College, Kannur.
4	Malik Fasil M	Assistant Professor, Department of Wildlife Science, College of forestry, Vellanikkara, KAU.
5	Dr. Ganesh Gopal T M	Assistant Professor, Department of Wood Science and Technology, Mangattuparamba Campus, Kannur University.
6	Dr. Manoj K	Assistant Professor, Department of Environmental Studies, Mangattuparamba Campus, Kannur University.
7	Dr. P Balakrishnan Peroth	Sr. Scientist, Department of Wildlife Biology, Kerala Forest Research Institute, Thrissur.
8	Dr.Amruth M	Sr. Scientist, Department of Sociology, Kerala Forest Research Institute, Thrissur.
9	Dr. Santhosh Sreevihar	Assistant Professor, Department of Zoology, Malab ar Christian College, Calicut.
10	Dr. Suresh V	Assistant Professor, Department of Botany, Govt. Victoria College, Palakkad
11	Dr. Sreenivasan E	Industrial Expert, Head R & D, The western India Plywood Ltd.
Special Invitees		
12	Sneha C,	Assistant Professor, Department of Forestry, Sir Syed College, Taliparamba
13	Azhar Ali A	Assistant Professor, Department of Forestry, Sir Syed College, Taliparamba

FYUGP BSc FORESTRY ADHOC COMMITTE

1	Prof. S Sudheesh (Chairperson)	Dean, Faculty of Science
2	Sneha C, (Convener)	Assistant Professor, Department of Forestry, Sir Syed College, Taliparamba
3	Aneesh K S	Assistant Professor, Department of Forest Resource Management, College of forestry, Vellanikkara, KAU.
4	Malik Fasil M	Assistant Professor, Department of Wildlife Science, College of forestry, Vellanikkara, KAU.
5	Azhar Ali A	Assistant Professor, Department of Forestry, Sir Syed College, Taliparamba
6	Dr. Ganesh Gopal T M	Assistant Professor, Department of Wood Science and Technology, Mangattuparamba Campus, Kannur University.
7	Dr. Manoj K	Assistant Professor, Department of Environmental Studies, Mangattuparamba Campus, Kannur University.
8	Dr. P Balakrishnan Peroth	Sr. Scientist, Department of Wildlife Biology, KFRI, Thrissur.
9	Dr.Amruth M	Sr. Scientist, Department of Sociology, KFRI, Thrissur.
10	Dr. Santhosh Sreevihar	Assistant Professor, Department of Zoology, Malabar Christian College, Calicut.
11	Dr. Suresh V	Assistant Professor, Department of Botany, Govt. Victoria College, Palakkad

KANNUR UNIVERSITY

UG PROGRAMME OUTCOMES (PO)

PO1	**CRITICAL THINKING**
1.1	Assess information without bias to form well-founded judgments.
1.2	Derive logical conclusions from data, distinguishing between essential and extraneous details for problem-solving or decision-making.
1.3	Spot logical inconsistencies in others' arguments.
1.4	Assess data, facts, observable events, and research outcomes to produce relevant and valid domain-specific conclusions.
PO2	**COMPLEX PROBLEM SOLVING**
2.1	Address diverse challenges in both familiar and unfamiliar settings, transferring knowledge to practical scenarios.
2.2	Break down problems, devise and execute solutions, and evaluate their effectiveness.
2.3	Consider the impact of solutions on individuals and the environment
PO3	**CREATIVITY**
3.1	Create innovative content, theories, and methodologies.
3.2	Employ diverse approaches to link disparate concepts or occurrences.
3.3	Offer fresh insights or enhance existing concepts and solutions.
3.4	Cultivate, refine, and articulate novel ideas with practical utility or intrinsic worth
PO4	**COMMUNICATION SKILLS**
4.1	Communicate ideas or emotions clearly and effectively.
4.2	Employ language to convey messages with precision
4.3	Captivate and involve the audience adeptly.
4.4	Demonstrate attentive listening, understanding, and empathy towards speakers
4.5	Express opinions and thoughts confidently and assertively.
PO5	**LEADERSHIP QUALITIES**
5.1	Lead diverse teams with effectiveness and respect.
5.2	Foster team cohesion towards shared objectives.
5.3	Inspire and guide individuals to reach optimal solutions collectively
5.4	Provide assistance and encouragement during challenging times, fostering resilience and courage.
PO6	**MASTERING THE ART OF SKILL ACQUISITION**

6.1	Obtain fresh knowledge and expertise, such as mastering the art of learning new skills, vital for continuous learning, through self-guided learning.
6.2	Independently navigate and locate suitable resources necessary for ongoing learning endeavours.
6.3	Develop organizational abilities and time management techniques to establish personal objectives and deadlines.
6.4	Foster a positive mindset to embrace lifelong learning.
PO7	**MASTERING THE ART OF SKILL ACQUISITION**
7.1	Utilize Information and Communication Technology across diverse learning and professional environments, accessing, evaluating, and applying various pertinent information sources.
7.2	Employ suitable software for data analysis tasks.
7.3	Grasp the hazards present in the digital realm and adopt measures to stay secure.
7.4	Embrace and uphold constitutional, humanistic, ethical, and moral principles in life, encompassing universal human values like truth, integrity, peace, compassion, nonviolence, scientific reasoning, and citizenship responsibilities.
7.5	Develop a stance or argument on an ethical matter by considering various viewpoints.

FYUGP IN FORESTRY

PROGRAMME SPECIFIC OUTCOMES (PSOS)

After successful completion of four-year UG programme in Forestry, a student should be able to:

PS0 1	Demonstrate a deep understanding of forest ecosystems, including the interactions between biotic and abiotic components, ecological succession, and the role of forests in global biogeochemical cycles.
PSO 2	Implement and manage sustainable forestry practices, ensuring the balance between economic, ecological, and social values in forest resource utilization and conservation.
PS0 3	Utilize advanced tools and technologies such as Geographic Information Systems (GIS), remote sensing, and drone technology for forest inventory, mapping, monitoring, and management.
PSO 4	Plan and execute wildlife management and habitat conservation strategies, ensuring the protection and restoration of biodiversity within forest ecosystems.
PS0 5	Engage in participatory approaches to forestry that involve local communities, fostering collaboration and integrating traditional knowledge with scientific practices for sustainable forest management.
PSO 6	Effectively communicate forestry-related issues to diverse audiences, advocating for sustainable forestry practices and raising awareness about the importance of forests in addressing environmental and societal challenges.
PS0 7	Promote a sense of environmental stewardship, fostering a positive vision for utilizing forests to combat global challenges, including climate change.

BSc FORESTRY (MAJOR) PATHWAY COURSES

Sl. No.	Level	Course Code	Sem	Name of the course	Credit	ESE	CE	PRACT	TOTAL
				1st YEAR BSc FORESTRY					
I SEMESTER									
1	100-199	KU1DSCFOR101	1	Forest and Forest Ecology	3 +1	50	25	25	100
II SEMESTER									
2	100-199	KU2DSCFOR105	2	Principles and Practices of Silviculture	3+ 1	50	25	25	100
				2nd YEAR BSc FORESTRY					
III SEMESTER									
3	200-299	KU3DSCFOR201	3	Tree Physiology	3 + 1	50	25	25	100
4	200-299	KU3DSCFOR202	3	Wood Structure and Functions	4	70	30	0	100
IV SEMESTER									
5	200-299	KU4DSCFOR206	4	Forest Utilization	3 + 1	50	25	25	100
6	200-299	KU4DSCFOR207	4	Wildlife Science and Conservation Biology	3 + 1	50	25	25	100
7	200-299	KU4DSCFOR208	4	Forest Genetics and Tree Improvement	3+ 1	50	25	25	100
				3rd YEAR BSc FORESTRY					
V SEMESTER									
Sl. No.	**Level**	**Course Code**	**Sem**	**Name of the course**	**credit**	**ESE**	**CE**	**PRACT**	**TOTAL**
8	300-399	KU5DSCFOR301	5	Forest Mesuration	3+ 1	50	25	25	100
9	300-399	KU5DSCFOR302	5	Forest Health and Protection	3+ 1	50	25	25	100
10	300-399	KU5DSCFOR303	5	Agroforestry, Social Forestry and Human Dimension	4	70	30	0	100
11	300-399	KU5DSEFOR304	5	*Wildlife Monitoring Techniques*	4	70	30	0	100

12	300-399	KU5DSEFOR305	5	*Vegetation Analysis and Biodiversity Assessment*	4	70	30	0	100
13	300-399	KU5DSEFOR306	5	Soil Science	4	70	30	0	100
14	300-399	KU5DSEFOR307	5	*Forest Biotechnology*	4	70	30	0	100
VI SEMESTER									
15	300-399	KU6DSCFOR309	6	*Forest Survey and Geoinformatics*	3 + 1	50	25	25	100
16	300-399	KU6DSCFOR310	6	Forest Economics and Elementary Statistics	3+ 1	50	25	25	100
17	300-399	KU6DSCFOR311	6	Forest Management and Plantation Forestry	4	70	30	0	100
18	300-399	KU6DSEFOR312	6	*Wood Defects, Degradation and Preservation*	4	70	30	0	100
19	300-399	KU6DSEFOR313	6	*Certification of Forest Products*	4	70	30	0	100
20	300-399	KU6DSEFOR314	6	*Silviculture of Indian Trees*	4	70	30	0	100
21		KU6DSEFOR315	6	*Forest* Seed Technology and Forest Nursery Technology	4	70	30	0	100
22	300-399	KU6INTFOR317	6	Internship/ Forest Range Training Programme and Forestry Field Experience	2	35	15	0	50
4th YEAR BSc FORESTRY									
VII SEMESTER									
Sl. No.	**Level**	**Course Code**	**Sem**	**Name of the course**	**credit**	**ESE**	**CE**	**PRACT**	**TOTAL**
23	400-499	KU7DCCFOR401	7	Forest Engineering	3+ 1	50	25	25	100
24	400-499	KU7DCCFOR402	7	Forest Hydrology and Watershed Management	4	70	30	0	100
25	400-499	KU7DCCFOR403	7	Wood based Industries	4	70	30	0	100
26	400-499	KU7DCCFOR404	7	Environmental Impact Assessment and Auditing	4	70	30	0	100
27	400-499	KU7DCCFOR405	7	Forest Pathology and Entomology	4	70	30	0	100

VIII SEMESTER									
28	400-499	KU8DCCFOR406	8	Tree Breeding and Advanced Propagation Techniques	3+ 1	50	25	25	100
29	400-499	KU8DCCFOR407	8	Environmental legislation and Management	3+ 1	50	25	25	100
30	400-499	KU8DCCFOR408	8	Climate Change and Disaster Management	3+ 1	50	25	25	100
31	400-499	KU8DCEFOR409	8	*Advanced Bioinformatics*	3+ 1	50	25	25	100
32	400-499	KU8DCEFOR410	8	*Ecological modelling*	3+ 1	50	25	25	100
33	400-499	KU8DCEFOR411	8	*R programming*	3+ 1	50	25	25	100
34	400-499	KU8DCEFOR412	8	*Biostatistics*	3+ 1	50	25	25	100
35	400-499	KU8DCEFOR413	8	*Research Methodology*	3+ 1	50	25	25	100
36	400-499	KU8DCEFOR414	8	*Scientific Writing*	3+ 1	50	25	25	100
37	400-499	KU8DCEFOR415	8	*Global Change Ecology*	3+ 1	50	25	25	100
38	400-499	KU8DCEFOR416	8	*Wood variation*	3+ 1	50	25	25	100
39	400-499	KU8DCEFOR417	8	*Biometrical Genetics*	3+ 1	50	25	25	100
40	PROJECT	KU8PRJFOR426	8	Project	8	140	60	--	200
41	PROJECT	KU8PRJFOR427	8	Project	12	210	90	--	300

BSc FORESTRY (MINOR) PATHWAY COURSES

Sl. No.	Level	Course Code	Sem	Name of the course	credit	ESE	CE	PRACT	TOTAL
I SEMESTER									
42	100-199	KU1DSCFOR102	1	Introduction to Forest Resources	3 + 1	50	25	25	100
43	100-199	KU1DSCFOR103	1	Introduction to Wildlife Sciences	3 + 1	50	25	25	100
II SEMESTER									
44	100-199	KU2DSCFOR105	2	Forest Botany	3 + 1	50	25	25	100
45	100-199	KU2DSCFOR106	2	Field Ornithology and Bird Watching	3 + 1	50	25	25	100
III SEMESTER									
46	200-299	KU3DSCFOR203	3	Introduction to Agroforestry	3 + 1	50	25	25	100
47	200-299	KU3DSCFOR204	3	Wildlife Management	3 + 1	50	25	25	100
VIII SEMESTER									
48	300-399	KU8DSEFOR418	8	*Ethnobiology and Intellectual Property Rights*	3+ 1	50	25	25	100
49	300-399	KU8DSEFOR419	8	*Entrepreneurial Forestry*	3+ 1	50	25	25	100
50	300-399	KU8DSEFOR420	8	*Green technology and Sustainable Development*	3+ 1	50	25	25	100
51	300-399	KU8DSEFOR421	8	*Remote Sensing and GIS*	3+ 1	50	25	25	100
52	300-399	KU8DSEFOR422	8	*Medicinal and Aromatic Plants*	3+ 1	50	25	25	100
53	300-399	KU8DSEFOR423	8	*Zoonotic Disease Management*	3+ 1	50	25	25	100
54	300-399	KU8DSEFOR424	8	*Biochemistry*	3+ 1	50	25	25	100
55	300-399	KU8DSEFOR425	8	*Instrumentation and Biological Techniques*	3+ 1	50	25	25	100

VALUE ADDITION AND SKILL ENHANCEMENT COURSES

Sl. No.	Course Code	Name of the course	credit	ESE	CE	PRACT	TOTAL
VAC							
56	KU3VACFOR220	Basic Life Support Skills and First Aid	3	50	25		75
57	KU3VACFOR221	Civic Education	3	50	25		75
58	KU4VACFOR222	Field Etiquettes in Forestry	3	50	25		75
59	KU4VACFOR223	Towards Environmental Stewardship	3	50	25		75
60	KU4VACFOR224	Citizen Science in Conservation	3	50	25		75
61	KU4VACFOR225	Bioethics and IPR	3	50	25		75
SEC							
62	KU4SECFOR230	Dendrology	3	50	25		75
63	KU4SECFOR231	Ornithology	3	50	25		75
64	KU4SECFOR232	Herpetology	3	50	25		75
65	KU4SECFOR233	Forest Biometry	3	50	25		75
66	KU5SECFOR330	Introduction to IT	3	50	25		75
67	KU5SECFOR331	Indoor Plantscaping	3	50	25		75
68	KU5SECFOR332	Urban Greenscaping	3	50	25		75
69	KU5SECFOR333	Commercial Bee Keeping	3	50	25		75
70	KU6SECFOR334	Drone Application in Natural Resource Management	3	50	25		75
71	KU6SECFOR335	Conservation photography	3	50	25		75
72	KU6SECFOR336	IOT in Plant Nursery Automation	3	50	25		75
73	KU6SECFOR337	Woodworking and Finishing Techniques	3	50	25		75

SYLLABUS INDEX

Name of the Major: **Forestry**

SEMESTER I

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours /week	Hour Distribution			
					L	T	P	O
KU1DSCFOR101	Forest and Forest Ecology	DSC A	4	5	3		2	
KU1DSCFOR102	Introduction to Forest Resources	DSC B	4	5	3		2	
KU1DSCFOR103	Introduction to Wildlife Sciences	DSC C	4	5	3		2	
KU1MDCFOR104	Ecotourism	MDC 1	3	4	3		0	
		AEC 1 (E)	3	3	3		0	
		AEC 2 (L)	3	3	3		0	

SEMESTER II

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours /week	Hour Distribution			
					L	T	P	O
KU2DSCFOR105	Principles and Practices of Silviculture	DSC A	4	5	3		2	
KU2DSCFOR106	Forest Botany	DSC B	4	5	3		2	
KU2DSCFOR107	Field Ornithology and Bird Watching	DSC C	4	5	3		2	

KU2MDCFOR108	Wildlife Photography	MDC 2	3	3	3		0	
		AEC 1 (E)	3	3	3		0	
		AEC 2 (L)	3	3	3		0	
SEMESTER III								
Course Code	**Title of the Course**	**Type of the Course DSC, MDC, SEC etc.**	**Credit**	**Hours /week**	**Hour Distribution**			
					L	**T**	**P**	**O**
KU3DSCFOR201	Tree Physiology	DSC A	4	5	3		2	
KU3DSCFOR202	Wood Structure and Functions	DSC A	4	4	4		0	
KU3DSCFOR203	Introduction to Agroforestry	DSC B	4	5	3		2	
KU3DSCFOR204	Wildlife Management	DSC C	4	5	3		2	
KU3VACFOR220	Basic Life Support Skills and First Aid	VAC - 1 *(Any one)*	3	3	3		0	
KU3VACFOR221	Civic Education							
	MDC 3 in Kerala specific content shall be offered by language disciplines only	MDC 3	3	3	3		0	
SEMESTER IV								
Course Code	**Title of the Course**	**Type of the Course DSC, MDC, SEC etc.**	**Credit**	**Hours /week**	**Hour Distribution**			
					L	**T**	**P**	**O**
KU4DSCFOR206	Forest Utilization	DSC A	4	5	3		2	

KU4DSCFOR207	Wildlife Science and Conservation Biology	DSC A	4	5	3		2	
KU4DSCFOR208	Forest Genetics and Tree Improvement	DSC A	4	5	3		2	
KU4VACFOR222	Field Etiquettes in Forestry	VAC - 2 *(Any one)*	3	3	3		0	
KU4VACFOR223	Towards Environmental Stewardship							
KU4VACFOR224	Citizen Science in Conservation	VAC - 3 *(Any one)*	3	3	3		0	
KU4VACFOR225	Bioethics and IPR							
KU4SECFOR230	Dendrology	SEC - 1 *(Any one)*	3	3	3		0	
KU4SECFOR231	Ornithology							
KU4SECFOR232	Herpetology							
KU4SECFOR233	Forest Biometry							

SEMESTER V

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours /week	Hour Distribution			
					L	T	P	O
KU5DSCFOR301	*Forest Mensuration*	DSC A	4	5	3		2	
KU5DSCFOR302	Forest Health and Protection	DSC A	4	5	3		2	
KU5DSCFOR303	Agroforestry, Social Forestry and Human dimension	DSC A	4	4	4			
KU5DSEFOR304	*Wildlife Monitoring Techniques*	DSE 1	4	4	4			
KU5DSEFOR305	*Vegetation Analysis and Biodiversity Assessment*		4	4	4			
KU5DSEFOR306	Soil Science	DSE 2	4	4	4			

KU5DSEFOR307	*Forest Biotechnology*		4	4	4			
KU5SECFOR330	Introduction to IT	SEC - 2 *(Any one)*	3	3	3			
KU5SECFOR331	Indoor Plantscaping							
KU5SECFOR332	Urban Greenscaping							
KU5SECFOR333	Commercial Bee Keeping							
SEMESTER VI								
Course Code	**Title of the Course**	**Type of the Course DSC, MDC, SEC etc.**	**Credit**	**Hours /week**	**Hour Distribution**			
					L	**T**	**P**	**O**
KU6DSCFOR309	*Forest Survey and Geoinformatics*	DSC A	4	5	3		2	
KU6DSCFOR310	Forest Economics and Elementary Statistics	DSC A	4	5	3		2	
KU6DSCFOR311	Forest Management and Plantation Forestry	DSC A	4	4	4		0	
KU6DSEFOR312	*Wood Defects, Degradation and Preservation*	DSE 3	4	4	4		0	
KU6DSEFOR313	*Certification of Forest Products*		4	4	4		0	
KU6DSEFOR314	*Silviculture of Indian Trees*	DSE 4	4	4	4		0	
KU6DSEFOR315	Seed Technology and Forestry Nursery Technology		4	4	4		0	
KU6SECFOR334	Drone Application in Natural Resource Management	SEC - 3 *(Any one)*	3	3	3		0	
KU6SECFOR335	Conservation photography							
KU6SECFOR336	IOT in Plant Nursery Automation							
KU6SECFOR337	Woodworking and Finishing Techniques							
KU6INTFOR317	Internship/ Forest Range Training Programme and Forestry Field Experience		2				2	

SEMESTER VII

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours /week	Hour Distribution			
					L	T	P	O
KU7DCCFOR401	Forest Engineering	DCC	4	5	3		2	
KU7DCCFOR402	Forest Hydrology and Watershed Management	DCC	4	4	4		0	
KU7DCCFOR403	Wood based Industries	DCC	4	4	4		0	
KU7DCCFOR404	Environmental Impact Assessment and Auditing	DCC	4	4	4		0	
KU7DCCFOR405	Forest Pathology and Entomology	DCC	4	4	4		0	

SEMESTER VIII

Course Code	Title of the Course	Type of the Course DSC, MDC, SEC etc.	Credit	Hours /week	Hour Distribution			
					L	T	P	O
KU8DCCFOR406	Tree Breeding and Advanced Propagation Techniques	DCC	4	5	3		2	
KU8DCCFOR407	Environmental legislation and Management	DCC	4	5	3		2	
KU8DCCFOR408	Climate Change and Disaster Management	DCC	4	5	3		2	
KU8DCEFOR409	*Advanced Bioinformatics*	DCE	4	5	3		2	
KU8DCEFOR410	*Ecological modelling*		4	5	3		2	

KU8DCEFOR411	*R programming*		4	5	3		2	
KU8DCEFOR412	*Biostatistics*	DCE	4	5	3		2	
KU8DCEFOR413	*Research Methodology*		4	5	3		2	
KU8DCEFOR414	*Scientific Writing*		4	5	3		2	
KU8DCEFOR415	*Global Change Ecology*	DCE	4	5	3		2	
KU8DCEFOR416	*Wood variation*		4	5	3		2	
KU8DCEFOR417	*Biometrical Genetics*		4	5	3		2	
KU8DSEFOR418	*Ethnobiology and Intellectual Property Rights*	DSE *(For Minor Pathway)*	4	5	3		2	
KU8DSEFOR419	*Entrepreneurial Forestry*		4	5	3		2	
KU8DSEFOR420	*Green technology and Sustainable Development*	DSE *(For Minor Pathway)*	4	5	3		2	
KU8DSEFOR421	*Remote Sensing and GIS*		4	5	3		2	
KU8DSEFOR422	*Medicinal and Aromatic Plants*	DSE *(For Minor Pathway)*	4	5	3		2	
KU8DSEFOR423	*Zoonotic Disease Management*		4	5	3		2	
KU8DSEFOR424	*Biochemistry*	DSE *(For Minor Pathway)*	4	5	3		2	
KU8DSEFOR425	*Instrumentation and Biological Techniques*		4	5	3		2	

KU8PRJFOR426	*PROJECT*	8 Credit						
KU8PRJFOR427		12 Credit						

DSC - Discipline Specific Pathway components (Major/Minor); DSE - Discipline Specific Pathway components (Elective); DCC - Discipline Specific Capstone Components; DCE - Discipline Specific Capstone Components (Elective); AEC - Ability Enhancement courses; SEC - Skill Enhancement Courses; VAC - Value Addition Courses; MDC - Multi-disciplinary Courses.

Course Distribution for Students in the Fourth Year of KUFYUGP

(i) Three PG level core courses (level 400 & above) in the Major discipline (for Honours); or (ii) Combination of Major core courses of level 400 & project up to 12 credits in the Major discipline (for Honours); or (iii) One 12-credit Research Project in the Major discipline (for Honours with Research) (iv) In the case of Honours students who go to another institution for doing the Project, the remaining Major core course can be in the online mode or in the in-person mode from the institution where the Project is being done. ***AND*** *(i) Three Minor Pathway Courses of level 300 & above / level 400 & above; or (ii) Three Elective Courses in Major discipline of level 400 & above; or (iii) Two courses in Minor discipline + One course in Major / any other discipline; or (iv) Three Courses in any other discipline of level 300 & above / level 400 & above; or (v) Two courses in Major / Minor / any other discipline + One course in research methodology (vi) Two of these courses can be in the online mode. These online courses can be taken either in semester VII or in semester VIII, but their credits shall be added to the student's account only in semester VIII. (vii) For those students who go to another institution for doing the Project, all these three courses can be in the online mode or in the in-person mode from the institution where the Project is being done.*

GENERAL RULES

ELIGIBILITY FOR ADMISSION AND SELECTION OF COURSES

Admission, enrolment, 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 Forestry major along with minors in Chemistry, Botany 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/ Forest Range Training Programme and Forestry Field Experience

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, 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 honours, 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 logbook/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 framework. - 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)

FA 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 incharge. 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 Honors with research must complete a mandatory research project worth 12 credits by the end of the eighth semester. For other UG Honors 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)

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

KU1DSCFOR101 FOREST AND FOREST ECOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
I	DSC	100-199	KU1DSCFOR101	4	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course offers an in-depth exploration of forests, forestry, and ecological principles, focusing on biomes, forest types, and their management. Students will examine the characteristics of various biomes, with special emphasis on forest ecosystems. The course also delves into the historical and contemporary aspects of forestry, particularly in India and Kerala, and covers ecological principles and succession theories relevant to forest management. Through theoretical learning and practical exercises, students will gain a comprehensive understanding of forest ecology, biodiversity, and sustainable management practices.

Course Prerequisite

- Basic knowledge in Ecology at 10th level, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the various definitions and classifications of forests based on regeneration methods, age, composition, management objectives, growing stock, ownership, and legal status.	***U***
2	Apply classification systems, such as Champion & Seth's revised classification, to identify forest types in India and Kerala.	***A***

3	Analyze the structure and function of forest ecosystems, including energy flow, nutrient cycling, and succession processes.	***An***
4	Assess the impact of global climate change on forests and the role of forests in carbon sequestration and climate change mitigation.	***E***
5	Develop sustainable forest management and conservation strategies that consider both local and global contexts.	***©***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create ©***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓			
CO 2			✓				
CO 3	✓					✓	
CO 4							✓
CO 5		✓			✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO WORLD FORESTS (10 Hours)**	
	1	Biomes of the world- Biotic and abiotic characteristics
		a) Tundra

		b) Temperate Coniferous Forests
		c) Deciduous Forests
		d) Tropical Rain Forests
		e) Grasslands
		f) Deserts
		g) Water biomes
	2	Temperate and Tropical Forests- Comparison
	3	Forest: various definitions
	4	Classification of forests based on
		a) Method of regeneration
		b) Age
		c) Composition
		d) Objects of management
		e) Growing stock
		f) Ownership
		g) Legal status
2	**MODULE TITLE: FORESTRY AND STATE OF FOREST (15 Hours)**	
	1	Definition, History, and Development of Indian Forestry
	2	Branches of Forestry and their relationships
	3	Forest types in India and Kerala: systems of classification
	4	State of the forests: global, Indian, and Kerala scenario
	5	Distribution, species composition, and characteristic features of forests with special reference to Kerala

		a) Evergreen forests
		b) Deciduous forests
		c) Shola forests
		d) Mangroves
		e) Myristica swamp forests
3	**MODULE TITLE: BASICS OF ECOLOGY (10 Hours)**	
	1	Levels of biological organization – abiotic and biotic components and their interaction.
	2	Trophic levels, food chains, ecological pyramids and energy flow.
	3	Forest Ecology – Forest ecosystem, structure and dynamics.
	4	Horizontal and vertical stratification.
	5	Formation of forest communities
		a) Consociation
		b) Association
4	**MODULE TITLE: Ecological Succession (10 Hours)**	
	1	Succession Types
		a) Primary and Secondary Succession
		b) Autogenic and Allogenic Succession
		c) Xerarch and Hydrarch
	2	Causes of succession
	3	Forest succession and climax vegetation types
	4	Succession theories

		a) Monoclimax
		b) Polyclimax
		c) Mosaic theory
	5	Models of succession
5	**Teacher Specific Module (30 Hours)**	
	Directions: 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.	
	5.1 Visit a local biome (e.g., a forest, grassland, or wetland) to observe and document biotic and abiotic factors. 5.2 Collect soil, water, and plant samples from different biomes for laboratory analysis of physical and chemical properties. 5.3 Use microscopes to examine soil microorganisms from different biomes. 5.4 Collect data on temperature, humidity, soil composition, and biodiversity from both temperate and tropical forests. 5.5 Assess species composition in different forest types using quadrat sampling. Space to fill the selected area/ activity	

Essential Readings:

1. Archibold, O.W., 2012. *Ecology of world vegetation*. Springer Science & Business Media.
2. Terborgh, J., 1985. The vertical component of plant species diversity in temperate and tropical forests. *The American Naturalist*, *126*(6), pp.760-776.
3. Khanna, L.S.1989. Principles and Practice of Silviculture. KhannaBandhu, Dehra Dun. 473 p
4. Negi, S.S., 1994. *Indian forestry through the ages*. Indus Publishing.
5. Parthiban, K.T., Krishnakumar, N. and Karthick, M., 2018. *Introduction to Forestry & Agroforestry*. Scientific Publishers.
6. **https://fsi.nic.in/**
7. Sundarapandian, S.M. and Swamy, P.S., 2000. Forest ecosystem structure and composition along an altitudinal gradient in the Western Ghats, South India. *Journal of tropical forest Science*, pp.104-123.

8. Simonetta, A.M., 2009. LEVELS OF BIOTIC ORGANIZATION. *BIOLOGICAL SCIENCE FUNDAMENTALS AND SYSTEMATICS-Volume I*, p.107.
9. Mishra, R. Ecology Work Book. Oxford and IBH Publishing Co, Calcutta.
10. Lal J. B. Forest Ecology. Natraj Publishers, Dehra Dun
11. Luken, J.O., 1990. *Directing ecological succession*. Springer Science & Business Media.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
	4	3
2	1	4
	2	3
	3	5
	4	6
	5	7
3	1	8
	2	9
	3	10
	4	10
	5	10
4	1	11
	2	11
	3	11
	4	11
	5	11

Suggested Readings:

- Odum, E.P. 1983. Basic Ecology. Saunders College Publishing, Holt Saunders, Japan
- Odum, E.P. Fundamentals of Ecology. Natraj Publisher, Dehradun
- Misra KC. Manual of Plant Ecology. Oxford & IBH Pub Co. New Delhi etc. 491p
- Michael P. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub.Co. New Delhi, 404p
- Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p
- Negi, S.S. 1993. Biodiversity and its Conservation in India. India Publishing company, New Delhi
- Saggwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**
Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Compare and contrast the abiotic factors of tundra and tropical rain forests.
2. Explain the main differences between temperate and tropical forests in terms of biodiversity and climate.
3. Apply Champion & Seth's classification to identify and describe the main forest types in Kerala.
4. Describe the characteristic features and species composition of Myristica swamp forests in Kerala.

6 Mark Questions

1. Analyze the structure and dynamics of a temperate forest ecosystem.
2. Explain the difference between consociation and association in the formation of forest communities.
3. Identify and discuss the primary causes of ecological succession in forests.
4. Compare and contrast monoclimax and polyclimax theories of succession.

14 Mark Questions

1. Develop a sustainable forest management strategy for a deciduous forest in India, considering both local and global contexts.
2. Assess the impact of global climate change on tropical rain forests and their role in carbon sequestration.

Employability for the Course:

- Environmental Educator
- Conservation Scientist
- Environmental Consultant
- Ecologist

KU1DSCFOR102 INTRODUCTION TO FOREST RESOURCES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100-199	KU2DSCFOR102	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: Introduction to Forest Resources is a foundation course offering an in-depth examination of the ecological, social, and economic significance of forest ecosystems. Students will explore the multifaceted roles of forests in biodiversity conservation, climate regulation, and sustainable development while also addressing the myriad threats they face, including deforestation and habitat degradation. Through interdisciplinary study, students will learn about the principles and practices of sustainable forest management, conservation strategies, and the integration of indigenous knowledge systems. Emphasizing a holistic approach, the course will equip students with the knowledge and skills necessary to contribute to the preservation and responsible stewardship of forest resources on a global scale.

Course Prerequisite:

Basic knowledge in Biology at 10th level, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify the key characteristics and distribution patterns of different forests	***R***
2	Apply knowledge of forest biomes to analyze and predict the distribution of specific species.	***A***

3	Analyze the interconnectedness of these ecological services and their importance for ecosystem health.	***An***
4	Evaluate the adaptive strategies of flora and fauna in evergreen and deciduous forests.	***E***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			
CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: GENERAL INTRODUCTION TO WORLD FORESTS (15 Hours)**	
	1	World forests
		a) Distribution
		b) Classification
		c) Characteristics
	2	Temperate and Tropical Forests- Comparison
	3	Evergreen and Deciduous Forest

		a) Distribution
		b) species composition
		c) characteristic features
2	**MODULE TITLE: ROLE OF FORESTS (5 Hours)**	
	1	Direct benefits from forests
	2	Indirect benefits from forests
	3	Social and cultural values of forest
3	**MODULE TITLE: Threats to Forest Health (10 Hours)**	
	1	Deforestation
	2	Forest degradation
	3	Invasive species
	4	Pest and Disease
4	**MODULE TITLE: Conservation Strategies of Forest resources (15 Hours)**	
	1	Reserve Forest and Protected Area
	2	Conservation Strategies: National Perspectives
	3	Organization structure of Kerala Forest Department
5	**Teacher Specific Module (30 Hours)**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Perry, D.A., Oren, R. and Hart, S.C., 2008. *Forest ecosystems*. JHU press.
2. Terborgh, J., 1985. The vertical component of plant species diversity in temperate and tropical forests. *The American Naturalist*, *126*(6), pp.760-776.
3. Bahuguna, V.K., Swaminath, M.H., Tripathi, S., Singh, T.P., Rawate, V.R.S. and Rawatf, R.S., 2016. Revisiting forest types of India. *International Forestry Review*, *18*(2), pp.135-145.
4. https://fsi.nic.in/forest-report-2021
5. Sills, E.O. and Abt, K.L. eds., 2003. *Forests in a market economy* (Vol. 72). Springer Science & Business Media.
6. Kettunen, M. and ten Brink, P. eds., 2013. *Social and economic benefits of protected areas: an assessment guide*. Routledge.
7. Hosonuma, N., Herold, M., De Sy, V., De Fries, R.S., Brockhaus, M., Verchot, L., Angelsen, A. and Romijn, E., 2012. An assessment of deforestation and forest degradation drivers in developing countries. *Environmental research letters*, *7*(4), p.044009.
8. Ciesta, W.M., 1998. Climate Change Forests and Forest Management: An Overview.
9. Simberloff, D., 2013. *Invasive species: what everyone needs to know*. Oxford University Press.
10. Tainter, F.H. and Baker, F.A., 1996. *Principles of forest pathology*. John Wiley & Sons.
11. Varghese, M.I., 2022. Treatise on Forest Laws in Kerala. Swamy Law House.
12. Babu, M.U. and Nautiyal, S., 2015. Conservation and management of forest resources in India: ancient and current perspectives. *Natural Resources*, *6*(4), pp.256-272.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6

	3	6
3	1	7
	2	8
	3	9,10
4	1	11
	2	12

Suggested Readings:

- Grebner, D.L., Bettinger, P., Siry, J.P. and Boston, K., 2021. *Introduction to forestry and natural resources*. Academic press.
- Sahana, M., Areendran, G., Raj, K., Sivadas, A., Abhijitha, C.S. and Ranjan, K., 2022. Introduction to Forest Resources in India: Conservation, Management and Monitoring Perspectives. In *Conservation, Management and Monitoring of Forest Resources in India* (pp. 3-31). Cham: Springer International Publishing.
- Banerjee, A., Jhariya, M.K., Yadav, D.K. and Raj, A. eds., 2020. *Environmental and sustainable development through forestry and other resources*. CRC press.
- Shit, P.K., Pourghasemi, H.R., Das, P. and Bhunia, G.S., 2020. *Spatial Modeling in Forest Resources Management*. Springer.
- Shit, P.K., Pourghasemi, H.R., Adhikary, P.P., Bhunia, G.S. and Sati, V.P. eds., 2021. *Forest resources resilience and conflicts*. Elsevier.
- Singh, M.P., Singh, J.K. and Mohanka, R., 2007. *Forest environment and biodiversity*. Daya Books.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10

c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. What are the primary characteristics of tropical, temperate, and boreal forests?
2. Given a specific forest biome, predict the type of flora and fauna you would expect to find there and explain why.
3. Describe the differences in species diversity between tropical and temperate forests.
4. How does altitude affect the distribution and characteristics of forests?

6 Mark Questions

1. Discuss how biodiversity conservation in forests contributes to overall ecosystem health.
2. Analyze the relationship between soil conservation provided by forests and agricultural productivity in surrounding areas.
3. How does the availability of sunlight and water affect the distribution of species within a forest biome?

14 Mark Questions

1. Discuss how biodiversity conservation in forests contributes to overall ecosystem health.

2. Explain the role of forests in carbon sequestration and its impact on climate regulation.
3. Describe how watershed protection by forests benefits both the forest ecosystem and human populations.

Employability for the Course:

- Wildlife Biologist/Ornithologist
- Environmental Educator/Interpretive Guide
- Conservation Officer/Environmental Consultant
- Ecotourism Guide
- Research Technician/Field Assistant
- Citizen Science Coordinator

KU1DSCFOR103 INTRODUCTION TO WILDLIFE SCIENCES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	DSC	100-199	KU1DSCFOR103	4	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces the fundamental principles of wildlife science, including the study of wildlife ecology, conservation biology, and management practices. It covers the behaviour, population dynamics, and habitat requirements of various wildlife species, as well as the human dimensions of wildlife conservation.

Course Prerequisite: Basic knowledge in biology at 10th level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Define and explain key concepts in wildlife science, including ecology, behaviour, and conservation.	***R***
2	Describe the ecological roles and habitat requirements of various wildlife species.	***U***
3	Analyze the factors affecting wildlife populations and their dynamics.	***An***
4	Understand and apply the principles of wildlife management and conservation strategies.	***A***

5	Evaluate human impacts on wildlife and develop strategies to mitigate these effects.	***E***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓			
CO 2	✓			✓			
CO 3	✓			✓		✓	
CO 4	✓	✓				✓	✓
CO 5	✓	✓			✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: Fundamentals of Wildlife Science (15 Hours)**	
	1	Wildlife Science
		a) Definitions and values of wildlife
		b) Characteristics of wildlife in different biomes and zoogeographic regions of the world
	2	Behaviour of Wild animals
		a) Instinctive behaviour, learned behaviour, dispersal behaviour, social behaviour, and reproductive behaviour
		b) Clutch size and litter size and age of maturity
		c) Territory, Home range and significance of territory

	3	Adaptations of wild animals
		a) Aestivation, hibernation, torpor and diapause
		b) Predator avoidance – camouflage, mimicry and schooling
2	**MODULE TITLE: Mammalogy and Indian mammals (15 Hours)**	
	1	Characteristics of class mammalia
	2	Classification of mammals and the detailed account on mammalian orders of Indian sub-continent:
		a) Primata, Carnivora, Proboscidea, Artiodactyla
		b) Rodentia, Chiroptera, Lagomorpha
	3	Zoogeography of Indian mammals
3	**MODULE TITLE: Herpetology (10 Hours)**	
	1	Reptiles and Amphibians
	2	Role of temperature in sex determination in reptiles
	3	Identification of venomous and nonvenomous snakes
	4	Snake bites, Venom, Anti-venom, First Aid and Management of snake bite cases.
4	**MODULE TITLE: Conservation Strategies (5 Hours)**	
	1	Conservation Principles
		ex-situ conservation
		d species and Endemic species
	2	Conservation projects in India
		a) Project Tiger
		b) Project Lion

		c) Project Elephant
		d) Project crocodile
	3	Causes of Extinction
5	**Teacher Specific Module (30 Hour)**	
	Prepare based on the current trends in wildlife science. Include human animal interactions and its implications	
	Space to fill the selected area/ activity	

Essential Readings:

1. Dasmann, R.F. 1982. Wildlife Biology. Wiley Pub. New York.
2. Gee EP. 2000. The wildlife of India. Harper Collins Publication.
3. Johnsingh AJT. (Ed.). 2003. The Mammals of South Asia: Ecology, Behaviour and Conservation. Permanent Black.
4. Prater, S.H. 1971. The Book of Indian Animals. Oxford University press, Bombay.
5. Daniel JC. 1980. Book of Indian reptiles. OUP
6. Whitaker R and Ashok Captain. 2004. Snakes of India: The Field Guide. Draco Books, Chennai.
7. Primack, R.B. 1993. Essentials of Conservation Biology. Soiner, MA.

Reference Distribution:

Module	**Unit**	**Reference No.**
1	1	1
	2	1
	3	2
2	1	3

	2	3
	3	4
3	1	5
	2	5
	3	6
	4	6
4	1	7
	2	7
	3	7

Suggested Readings:

- VivekMenon. 2003. Field Guide to Indian Mammals. Penguin Books, India.
- Whitaker R and Ashok Captain. 2004. Snakes of India: The Field Guide. Draco Books, Chennai.
- Kumar and Asija. Biodiversity – Principles and conservation. UpdeshPurohit, Agrobios, Jodhpur
- Negi, S.S. 1993. Biodiversity and its Conservation in India. India Publishing company, New Delhi

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Total	75

Evaluation Type – Practical		Marks
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Differentiate between instinctive behaviour and learned behaviour in wild animals with examples.
2. What are the primary ecological roles of apex predators in an ecosystem?
3. Describe the term 'biodiversity' and explain why it is crucial for ecosystem stability.

6 Mark Questions

1. Discuss the symbiotic relationships found in coral reef ecosystems and their significance for marine life.
2. Explain the concept of carrying capacity and its relevance to wildlife management.
3. Describe the principles of in-situ conservation and provide examples of its application.
4. Analyze the impact of urbanization on local wildlife populations and their habitats.
5. Discuss the importance of community involvement in wildlife conservation efforts.
6. Explain how population viability analysis (PVA) is used in wildlife management.

14 Mark Questions

1. Analyze the effects of climate change on migration patterns and reproductive cycles of wildlife.
2. Develop a comprehensive plan to mitigate the impact of climate change on a specific wildlife species.

KU1MDCFOR104 ECOTOURISM

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
1	MDC	100-199	KU1MDCFOR104	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course provides an in-depth exploration of ecotourism, focusing on its principles, objectives, and impact. Students will learn about the historical context of tourism, different forms and categories, and the classification and dimensions of tourism. Special emphasis will be placed on the principles of ecotourism, its potential in India, stakeholder roles, environmental and social impacts, and sustainable development practices.

Course Prerequisite:

- Ability to write examinations in English

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Recall the definition and historical evolution of tourism and ecotourism.	***R***
2	Discuss the potential of ecotourism in India and the role of various stakeholders.	***U***
3	Apply zoning and carrying capacity concepts to plan ecotourism in protected areas.	***A***
4	Analyze the environmental and social impacts of ecotourism on local communities and ecosystems.	***An***
5	Design an ecotourism project plan, including marketing and business strategies	***C***

6	Evaluate the effectiveness of ecotourism initiatives in contributing to sustainable development	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2		✓		✓			
CO 3							✓
CO 4		✓					✓
CO 5		✓				✓	
CO 6			✓		✓		

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: Introduction to Tourism (10 Hours)**	
	1	Tourism-Definition and History
		a) a) Definition of tourism
		b) Historical development of tourism
	2	Forms and Categories of Tourism
		a) Classification of tourism: domestic, international, inbound, and outbound
		b) Different forms: adventure, cultural, sustainable, and ecotourism

	3	Dimensions and Basic Components of Tourism
		a) Key components: attractions, accessibility, amenities, and ancillary services
2	**MODULE TITLE: Fundamentals of Ecotourism (10 Hours)**	
	1	Ecotourism-Definition and Elements
		a) Defining ecotourism
		b) Core elements of ecotourism
	2	Principles and Objectives of Ecotourism
	3	Potential of Ecotourism in India
		a) Key ecotourism sites in India
		b) Forms of Ecotourism: Hard and Soft Ecotourism
3	**MODULE TITLE: Impacts of Ecotourism (10 Hours)**	
	1	Impacts on the Environment
		a) Positive and negative environmental impacts
	2	Social Impacts
		a) Community involvement and cultural impacts
4	**MODULE TITLE: Ecotourism and Sustainable Development (10 Hours)**	
	1	Planning Ecotourism in Protected Areas
		a) Carrying capacity and zoning
		b) Ecotourism in important protected areas of India-
	2	Economic Valuation of Ecotourism Sites
		a) Travel cost method
	3	World Ecotourism Summit

5	**Teacher Specific Module (5 Hours)**
	Directions: Prepare a visitor satisfaction survey for different ecotourism sites in Kannur
	Space to fill the selected area/ activity

Essential Readings:

1. Chiranjeev, A. 2008.Concept of tourism.JnanadaPrakashan.
2. Hosetti, B.B. 2007.Ecotourism development and management, Pointer publishers, Jaipur
3. Chiranjeev, A. 2008.Ecotourism planning and Development.JnanadaPrakashan.
4. Aaradhana, S. 2009. Indian tourism, Wildlife tourism and Ecotourism.JnanadaPrakashan. 288 p
5. Honey, M. 2008. Ecotourism and Sustainable development.Island Press.
6. Chiranjeev, A. 2008. Ecological, Social and Cultural aspects of Ecotourism.JnanadaPrakashan.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1
	3	2
2	1	3
	2	3
	3	3
3	1	4
	2	4
	3	4
	4	4
4	1	5

	2	5
	3	6
	4	6

Suggested Readings:

1. Thampi, Santosh P. Ecotourism in Kerala, India: Lessons from the eco-development project in Periyar Tiger Reserve. Vol. 13. ECOCLUB, 2005.
2. Pujar, Sachin C., and Niharranjan Mishra. "Ecotourism industry in India: a review of current practices and prospects." Anatolia 32.2 (2021): 289-302.
3. Singh, Gurinder, Vikas Garg, and Shalini Srivastav. "Ecotourism in India: social trends and pathways on sustainable tourism and eco-travelling." International Journal of Business and Globalisation 28.4 (2021): 468-480.
4. Das, Suchismita. "Ecotourism, sustainable development and the Indian state." Economic and Political Weekly 46.37 (2011): 60-67.
5. Das, Madhumita, and Bani Chatterjee. "Ecotourism: A panacea or a predicament?." Tourism management perspectives 14 (2015): 3-16.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define tourism and explain its primary components.

2. Trace the historical development of tourism from ancient times to the modern era.
3. What is ecotourism, and how does it differ from traditional forms of tourism?
4. Discuss the historical milestones in the development of ecotourism.

6 Mark Questions

1. Identify and describe key ecotourism sites in India.
2. Discuss the different forms of ecotourism practiced in India, highlighting examples of hard and soft ecotourism.
3. Analyze the roles of government agencies, NGOs, and local communities in promoting ecotourism in India.
4. What are the objectives of ecotourism, and how do they align with sustainable development goals in India?
5. Explain the impact of ecotourism on local economies and biodiversity conservation in India.

14 Mark Questions

1. Discuss the concept of zoning in ecotourism planning and provide examples of its application in protected areas.
2. Analyze the challenges and benefits of implementing carrying capacity limits in popular ecotourism destinations.
3. Develop a zoning plan for an ecotourism site, considering environmental, social, and economic factors.

KU2DSCFOR105 PRINCIPLES AND PRACTICE OF SILVICULTURE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCFOR105	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: The course "Principles and Practices of Silviculture" provides a comprehensive understanding of forestry principles, focusing on ecological processes, sustainable resource management, and biodiversity conservation. Students explore fundamental concepts such as the definitions of forests, forestry, and silviculture, alongside the objectives and scope of silviculture and its interrelation with other branches of forestry. Through the application of knowledge on silvicultural systems, students analyze forest management practices, assess site suitability for regeneration based on principles of tree growth and development, and engage in field techniques such as forest inventory and monitoring. Emphasizing sustainable forestry practices, the course fosters environmental stewardship and equips students to contribute to the advancement of forestry knowledge and practices, addressing global challenges including climate change.

Course Prerequisite:

Basic knowledge in Biology at 10th level, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains

1	Recall fundamental concepts of silviculture, including definitions of forests, forestry, and silviculture.	***R***
2	Explain the objectives and scope of silviculture and its relationship with other branches of forestry.	***U***
3	Apply knowledge of silvicultural systems to classify and analyze forest management practices.	***A***
4	Utilize principles of tree growth and development to assess site suitability for regeneration.	***A***

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓				✓		
CO 3		✓	✓			✓	
CO 4		✓		✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO SILVICULTURE (10 Hours)**	
	1	Silviculture

		a) Objectives
		b) Scope
	2	Relation with Other Branches of Forestry
	3	Silvics and Site Factors
		a) Climatic Factors
		b) Edaphic Factors
		c) Physiographic Factors
		d) Biotic Factors
		e) Interactions among Site Factors
	4	TREE GROWTH AND DEVELOPMENT
		a) Trees and Their Distinguishing Features
		b) Growth and Development of Trees

2	**MODULE TITLE: SILVICULTURAL SYSTEMS (15 Hours)**	
	1	Definition, Scope, and Classification of Silvicultural Systems
	2	Systems of Concentrated Regeneration
		a) Clear Felling Systems
		b) Shelterwood System
	3	Systems of Diffused Regeneration
		a) Selection System and Its Modifications
	4	Accessory Systems

		a) Coppice Systems
		b) Culm Selection System in Bamboo
		c) Canopy Lifting System in Andaman

3	**MODULE TITLE: REGENERATION OF FORESTS (15 Hours)**	
	1	Objectives and Ecology of Regeneration
	2	Natural Regeneration Processes
		a) Seed Production
		b) Seed Dispersal
		c) Germination and Establishment
		d) Requirements for Natural Regeneration
		e) Advance Growth
		f) Coppice and Root Sucker Regeneration
		g) Regeneration Survey
		h) Natural Regeneration Supplemented by Artificial Regeneration
	3	Artificial Regeneration
		a) Objectives and Advantages of Artificial Regeneration
		b) Factors Governing the Choice of Regeneration Techniques

4	**MODULE TITLE: TREE PLANTING AND CULTURAL OPERATIONS (5 Hours)**	
	1	Tree Planting Techniques
		a) Sowing vs. Planting

		b) Different Kinds of Pits
	2	Tending and Cultural Operations
		a) Weeding (Kinds of Weeding)
		b) Release Operations
		c) Singling and Cleaning
		d) Liberation Cutting

5	**Teacher Specific Module (30 Hours)**
	Directions: 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.
	5.1 Visit a local forest or plantation to observe different silvicultural practices. 5.2 Set up a small weather station to collect data on temperature, precipitation, humidity, and wind speed over a period of time. 5.3 Identify and classify different silvicultural systems (clear felling, shelterwood, selection) in a local forest or through case studies. 5.4 Visit a site where clear felling is practiced. Study the regeneration process and document the species regenerating naturally. 5.5 Compare sites with natural regeneration and those with artificial regeneration techniques (e.g., planting, seeding). Evaluate the success and challenges of each method. Space to fill the selected area/ activity

Essential Readings:

1. Günter, S., 2011. Introduction to silviculture in the tropics. In *Silviculture in the tropics* (pp. 3-10). Berlin, Heidelberg: Springer Berlin Heidelberg.
2. Khanna, L.S.1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehra Dun

3. Kozlowski, T.T., 1971. Growth and development of trees. Volume I: Seed germination, ontogeny and shoot growth. *Growth and development of trees. Volume I: Seed germination, ontogeny and shoot growth.*
4. Matthews, J.D., 1991. *Silvicultural systems*. Oxford University Press.
5. Duryea, M.L. and Dougherty, P.M., 1991. *Forest regeneration manual* (Vol. 36). Springer Science & Business Media.
6. Toumey, J.W. and Korstian, C.F., 1942. Seeding and planting in the practice of forestry. *Seeding and planting in the practice of forestry.*, (3rd ed.).
7. Evans, Julian, and John W Turnbull, 'Plantation maintenance', Plantation Forestry in the Tropics: The Role, Silviculture, and Use of Planted Forests for Industrial, Social, Environmental, and Agroforestry Purposes (Oxford, 2004; online edn, Oxford Academic, 31 Oct. 2023),

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	2
	4	3
2	1	4
	2	4
	3	4
	4	4
	5	4
3	1	5
	2	5
	3	5
4	1	6
	2	7

	3	7

Suggested Readings:

- Nyland, R. D. (2016). Silviculture: Concepts and Applications, Third Edition. Waveland Press, 680 pages
- Ram Parkash (1991). Theory and Practice of Silvicultural Systems International Books & Periodicals, Dehra Dun, 298 pages
- Smith, D.M. (1986). Practice of Silviculture, Edn 8. New York, John Wiley.

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2

Total	**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define silviculture and explain how it differs from general forestry.
2. Give general and ecological definitions of forest
3. Explain the term 'forestry' and describe its main components.
4. Discuss the primary objectives of silviculture.
5. How does silviculture contribute to sustainable forest management?

6 Mark Questions

1. Describe the scope of silviculture in modern forestry practices.
2. Explain the relationship between silviculture and forest ecology.
3. How does silviculture integrate with forest economics and policy?
4. Discuss the role of silviculture in forest conservation and biodiversity management.

14 Mark Questions

1. Define silvicultural systems and explain their importance in forest management.
2. Compare and contrast the clear felling system and the shelterwood system.
3. Explain the selection system of diffused regeneration and its advantages.
4. What are the key characteristics of the coppice system, and where is it commonly used?
5. Analyze the culm selection system in bamboo and discuss its benefits for sustainable management.

Employability for the Course:

- Forest managers
- Silviculturists
- Ecological restoration specialists
- Forest ecologists
- Wildlife biologists
- Environmental planners.

KU2DSCFOR106 FOREST BOTANY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCFOR106	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course offers a comprehensive study of plant taxonomy, focusing on the classification, identification, and nomenclature of plants. Students will learn about the morphological characteristics, evolutionary relationships, and ecological significance of plants. Fieldwork and laboratory sessions will provide hands-on experience in identifying and classifying plants.

Course Prerequisite:

- Basic understanding of botany or plant science

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Recall and define basic concepts and terminology related to plant taxonomy, such as taxonomic hierarchy, species, and botanical nomenclature.	***R***
2	Demonstrate understanding by explaining the principles of plant classification and the significance of morphological characteristics in identifying plant species.	***U***
3	Apply their knowledge to identify plant species using taxonomic keys and field guides during field trips and laboratory exercises.	***A***
4	Create herbarium specimens and comprehensive documentation for plant species they have identified, integrating morphological data.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓			✓			
CO 3			✓	✓			
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO PLANT BIOLOGY (10 Hours)**	
	1	External plant morphology- Vegetative characters
		a) Root types and functions
		b) Stems – functions and branching pattern
		c) Leaves – Parts, Form and Phyllotaxy
	2	External plant morphology- Reproductive characters
		a) Flowers - Unisexual and bisexual, symmetry
		b) Fruits – Simple, Aggregate and Multiple
		c) Seeds – Monocot and dicot
	3	Classification of Plant Life Forms
		a) Herbs
		b) Shrubs
		c) Trees
		d) Other forms
2	**MODULE TITLE: INTRODUCTION TO PLANT TAXONOMY (15 Hours)**	
	1	Definition and significance of taxonomy
	2	History and development of plant taxonomy

	3	Principles of classification
	4	Nomenclature and binomial system
3	**MODULE TITLE: PLANT IDENTIFICATION TECHNIQUES (15 Hours)**	
	1	Morphological characteristics of plants
	2	Reproductive characteristics of plants
		a) Salient features and Parts of the Flower- Bract, Calyx, Corolla, Androecium, Gynoecium
		b) Floral arrangement- types
		c) Relative position, cohesion, adhesion, Symmetry of flower
		d) Aestivation
		e) Placentation- types
		f) Inflorescence: Racemose, Cymose, Special type and Mixed types
	3	Use of dichotomous keys
	4	Herbarium techniques
	5	Modern tools in plant identification
4	**MODULE TITLE: ECONOMIC BOTANY (5 Hours)**	
	1	Economic importance of common trees
		a) Timber
		b) NTFP
	2	Phytogeography
		a) Factors affecting plant distribution
		b) Phytogeographic zones of India

5	**Teacher Specific Module (30 Hours)**
	Directions: 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.
	5.1 Conduct a Field trip to collect plant specimens 5.2 Use of dichotomous keys for plant identification 5.3 Techniques for pressing, drying, and mounting plant specimens 5.4 Labelling and cataloguing herbarium sheets 5.6 Preparation of Plant identification charts 5.7 Collection and Identification of Non-Timber Forest Products in Kerala Space to fill the selected area/ activity

Essential Readings:

1. Kaplan, D.R., 2001. The science of plant morphology: definition, history, and role in modern biology. *American journal of botany*, *88*(10), pp.1711-1741.
2. Waller, D.M., 1988. Plant morphology and reproduction. *Plant reproductive ecology: patterns and strategies*, pp.203-227.
3. Lawrence, G.H., 1955. *An introduction to plant taxonomy*. Central Book Depot.
4. Backlund, A. and Bremer, K., 1998. To be or not to be. Principles of classification and monotypic plant families. *Taxon*, *47*(2), pp.391-400.
5. Roseline, A., 2019. *Botanical nomenclature*. MJP Publisher.
6. Foster, A.S. and Gifford, E.M., 1959. Comparative morphology of vascular plants. *Comparative morphology of vascular plants.*
7. Waller, D.M., 1988. Plant morphology and reproduction. *Plant reproductive ecology: patterns and strategies*, pp.203-227.
8. Fisher, P.L., Houseal, A.K., Tuthill, D. and Shim, J., 2016. Lesson 6: Plant Identification and Dichotomous Keys.
9. Paul, P., Dhar, S., Chowdhury, M. and Das, D., 2020. *Herbarium technique: evolution from conventional to digitization*. Orange Books Publication.
10. Finger, A., Groß, J. and Zabel, J., 2022. Plant Identification in the 21st Century—What Possibilities Do Modern Identification Keys Offer for Biology Lessons. *Education Sciences*, *12*(12), p.849.

11. Seth, M.K., 2003. Trees and their economic importance. *The Botanical Review*, *69*(4), pp.321-376.
12. Croizat, L., 2013. *Manual of phytogeography: an account of plant-dispersal throughout the world*. Springer.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
2	1	3
	2	3
	3	4
	4	5
3	1	6
	2	7
	3	8
	4	9
	5	10
4	1	11
	2	12

Suggested Readings:

- Sambamurthy, A. V. S. S. 2005. Taxonomy of Angiosperms. I.K International Pvt. Ltd. 892 p.
- Jeffrey, C. 1982. An Introduction to plant taxonomy. Allied publishers. 154p.
- Henry, A. N. and Chandrabose, M. 1980. An Aid to the International Code of Botanical Nomenclature. Today and Tomorrow printers and publishers. 100p.
- Johri, R. M and SnehLata. 2005. Taxonomy- 1 (Systematics and Morphology). Sonali Publications. 340 p
- Johri, R. M and SnehLata. 2005. Taxonomy- 2 (Polypetalae). Sonali Publications. 300 p

- Johri, R. M and SnehLata. 2005. Taxonomy- 3 (Gamopetalae). Sonali Publications. 190 p

Assessment Rubrics:

Evaluation Type – Theory	**Marks**
End Semester Evaluation	**50**
Continuous Evaluation	**25**
a) Test Paper- 1	10
b) Test Paper-2	10
c) Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d) Viva-Voce	2
Total	**75**

Evaluation Type – Practical	**Marks**
End Semester Evaluation	**15**
Continuous Evaluation	**10**
a) Test Paper	4
b) Practical Record and Submissions	4
c) Viva-Voce	2
Total	**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define plant taxonomy and explain its significance in the study of botany.
2. What is the taxonomic hierarchy, and how is it used to classify plants?
3. Explain the concept of species in botanical nomenclature.
4. Describe the binomial system of nomenclature and its importance in plant taxonomy.
5. What are the major taxonomic ranks in the hierarchical classification of plants?

6 Mark Questions

1. Discuss the history and development of plant taxonomy, highlighting key milestones.

2. Explain the principles of plant classification and their application in modern botany.
3. Describe the various types of root systems and their functions in plants.
4. What are the different branching patterns of stems, and how do they contribute to plant identification?
5. Explain the parts of a leaf and the different forms and phyllotaxy observed in plants.
6. Differentiate between unisexual and bisexual flowers, and explain the significance of floral symmetry.

14 Mark Questions

1. Explain the different types of placentation observed in plants.
2. Describe the various types of inflorescence (racemose, cymose, special, and mixed) and their significance in taxonomy.

Employability for the Course:

- Botanist
- Taxonomist
- Environmental Consultant

KU2DSCFOR107 FIELD ORNITHOLOGY AND BIRD WATCHING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	DSC	100-199	KU2DSCFOR107	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course delves into the captivating world of avian species, offering insights into their biology, behaviours, and habitats. Through a blend of theoretical knowledge and practical field experiences, students will develop skills in bird identification, observation, and conservation, fostering a deep appreciation for the diverse avifauna around them.

Course Prerequisite:

- Basic knowledge in Biology

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify various bird species using visual and auditory cues.	***R***
2	Explain the anatomical features and physiological functions of birds.	***U***
3	Analyze bird behaviors and their ecological significance.	***A***
4	Differentiate between similar bird species by analyzing key physical and behavioral characteristics.	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create ©***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1				✓			
CO 2	✓						
CO 3	✓		✓				
CO 4				✓			
CO 5						✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO ORNITHOLOGY (10 Hours)**	
	1	Ornithology
		a) Definition and scope
		b) Renowned ornithologists and their contribution.
	2	Characteristics of birds
	3	Importance of birds in ecosystems
2	**MODULE TITLE: BIRD IDENTIFICATION TECHNIQUES (15 Hours)**	
	1	Bird identification features
		a) Visual Identification
		b) Auditory identification
	2	Techniques for bird watching
		1. Principles of Bird Watching
		2. Bird Watching Equipment and Tools
		3. Techniques for Effective Bird Watching
3	**MODULE TITLE: HABITATS AND BEHAVIOR (15 Hours)**	
	1	Bird Habitats
		a) Types of Habitats
		b) Habitat Preferences

	2	Bird Activities
		a) Movement
		b) Feeding
		c) Nesting and Breeding
		d) Flocking and roosting
	3	Migration in Birds
		a) Types
		b) Causes
		c) Significance
4	**MODULE TITLE: FIELD TECHNIQUES IN ORNITHOLOGY (5 Hours)**	
	1	Field Study Methods
		a) Banding and Tagging
	2	Data Collection
	3	Citizen Science and Community Involvement
5	**Teacher Specific Module (30 Hours)**	
	Directions: 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.	
	5.1 Overview of binoculars, spotting scopes, and cameras. 5.2 Practice using field guides and bird identification apps. 5.3 Introduction to field notebooks and data recording techniques. 5.4 Guided bird watching session in a local area 5.5 Focus on identifying common local species. 5.6 Practice using field guides to confirm identifications. 5.7 Audio session for learning bird calls and songs.	

	5.8 Field trip to a diverse range of habitats (forests, wetlands, grasslands). 5.9 Habitat mapping and description exercises. 5.10 Recording species observed in different habitats. 5.11 Participation in a citizen science project such as eBird, the Christmas Bird Count, or a local bird survey. Space to fill the selected area/ activity

Essential Readings:

1. Morrison, M.L., Rodewald, A.D., Voelker, G., Colón, M.R. and Prather, J.F. eds., 2018. *Ornithology: foundation, analysis, and application*. JHU Press.
2. Mainwaring, M.C., 2017. Why birds matter: avian ecological function and ecosystem services. *The Condor: Ornithological Applications*, *119*(2), pp.354-355.
3. Dunne, P., 2012. *The Art of Bird Identification: A Straightforward Approach to Putting a Name to the Bird*. Stackpole Books.
4. Dunne, P., 2003. *Pete Dunne on bird watching: The how-to, where-to, and when-to of birding*. Houghton Mifflin Harcourt.
5. Fuller, R.J. ed., 2012. *Birds and habitat: relationships in changing landscapes*. Cambridge University Press.
6. Wallace GJ and HD Mahan. 20015. An introduction to ornithology. Mc Million Publishing Company, New York.
7. Collias, N.E. and Collias, E.C., 2014. *Nest building and bird behavior* (Vol. 857). Princeton University Press.
8. Newton, I., 2023. *The migration ecology of birds*. Elsevier.
9. Ali, S., 1979. Bird study in India: its history and its importance. *India International Centre Quarterly*, *6*(2), pp.127-139.
10. Shyamal, L., 2007. Opinion: Taking indian ornithology into the information age. *Indian Birds*, *3*(4), pp.122-137.
11. Chandler, M., See, L., Copas, K., Bonde, A.M., López, B.C., Danielsen, F., Legind, J.K., Masinde, S., Miller-Rushing, A.J., Newman, G. and Rosemartin, A., 2017. Contribution of citizen science towards international biodiversity monitoring. *Biological conservation*, *213*, pp.280-294.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1
	3	2
2	1	3
	2	4
3	1	5
	2	6,7
	3	8
4	1	9
	2	10
	3	11

Suggested Readings:

1. Neelakantan,K.K.1984. "KeralathilePakshikal". Kerala Sahithya Academy, Thrissur. 584pp.
2. Grimmet, R. Inskipp T and Inskipp, I. 2000. Pocket Guide to the of Birds of Indian subcontinent.Christopher Helm series
3. Grimmet, R. Inskipp, T and Nameer, P.O. 2007. Birds of southern India, BNHS series.
4. Sashikumar C., Praveen J., Palot M. J. and Nameer P. O. 2012. Birds of Kerala – status and distribution. DC Books.

Assessment Rubrics:

Evaluation Type – Theory	Marks
End Semester Evaluation	**50**

Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Briefly explain the significance of Archaeopteryx in the evolution of birds.
2. Name two renowned ornithologists and describe one significant contribution from each.
3. List three key visual features used to identify birds.
4. What are the primary reasons birds migrate?

6 Mark Questions

1. Why are birds considered important indicators of environmental health?
2. How can bird calls and songs be used to identify species?

3. Describe three different types of habitats where birds are commonly found.

14 Mark Questions

1. What are the essential tools for bird watching, and why are they important?
2. Explain the significance of foraging behavior in birds.
3. What are the common methods used for conducting bird surveys?

Employability for the Course:

- Wildlife Biologist/Ornithologist
- Environmental Educator/Interpretive Guide
- Conservation Officer/Environmental Consultant
- Ecotourism Guide
- Research Technician/Field Assistant
- Citizen Science Coordinator

KU2MDCFOR108 WILDLIFE PHOTOGRAPHY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
2	MDC	100-199	KU1MDCFOR108	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: Wildlife Photography is a Skill Enhancement course aims in photography of wildlife and nature, and story-telling using visual tools. Through a blend of theoretical lectures, hands-on practical sessions, and immersive field trips, students learn the fundamentals of wildlife photography, mastering essential techniques such as composition, camera settings, and understanding animal behaviour. They explore the intricacies of capturing dynamic shots of birds, mammals, and macro subjects, guided by ethical principles and a deep appreciation for wildlife conservation.

Course Prerequisite: Nil

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Define and explain the principles of wildlife and nature photography, including camera settings, composition techniques, and ethical considerations.	***U***
2	Develop the knowledge and skills to capture well-exposed and composed photographs of wildlife and natural landscapes in various environmental conditions.	***A***

3	Analyze photographs to interpret wildlife behavior, habitat characteristics, and environmental relationships, identifying patterns and connections within the natural world.	***An***
4	Generate visually compelling narratives through photography that communicate stories, emotions, and concepts	***C***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓			✓			
CO 2			✓	✓			
CO 3	✓			✓		✓	
CO 4					✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: BASIC ELEMENTS OF WILDLIFE PHOTOGRAPHY (10 Hours)**
	1	Photography and overview of wildlife photography as a genre
	2	Essential gear and equipment for wildlife photography
	3	Workings of different kinds of cameras and lenses
	4	Use of light and speed for different kinds of photographs
		a) Motion photography

		b) Camera settings and exposure for wildlife Photography
2	**MODULE TITLE: COMPOSING AN IMAGE (10 Hours)**	
	1	Basic rules for composing good wildlife and nature photography
	2	Ethical considerations in wildlife photography
	3	Using photography as an effective tool for conservation story telling
		a) Storytelling and Portfolio Development
	4	Photography in research and conservation
3	**MODULE TITLE: POST-PROCESSING AND IMAGE EDITING (10 Hours)**	
	1	Introduction to post-processing software for wildlife photography
	2	Adjustments for exposure: techniques for fine-tuning exposure and brightness
	3	Color: understanding color correction and white balance adjustments
		a) Enhancing Contrast
		b) Sharpening techniques
	4	Preserving authenticity and ethical considerations in post-processing.
4	**MODULE TITLE: ADVANCED FIELD TECHNIQUES AND SKILLS (10 Hours)**	
	1	Mastering manual settings for challenging conditions
		a) Techniques for capturing fast-moving subjects
		b) Low-light photography
	2	Using remote cameras and drones for unique perspectives
	3	Developing a narrative through a series of images
	4	Selecting and curating images for a cohesive wildlife photography portfolio

5	**Teacher Specific Module (5 Hours)**
	Directions: 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.
	Space to fill the selected area/ activity

Essential Readings:

1. John and Barbara Gerlach. 2012. Digital Wildlife Photography. Routledge.
2. Excell, L. S. (2011). Wildlife Photography: From snapshots to great shots. Peachpit Press.
3. Parmenter, T. (1982). Wildlife and Nature Photography, by Michael Freeman. Croom Helm. London,£ 13.95. Oryx, 16(4).
4. Young, S. (2022). Wildlife Photography Fieldcraft. Pelagic Publishing Ltd.
5. Caruso, R. D., & Postel, G. C. (2002). Image editing with Adobe Photoshop 6.0. Radiographics, 22(4).
6. Mangelson, T. D. (2013). Images of Nature: The Photographs of Thomas D. Mangelson. Rizzoli International Publications.
7. Frost, J. (2018). Creating a Wildlife Photography Portfolio. Ammonite Press.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1
	3	2
	4	2

2	1	3
	2	3
	3	4
	4	4
3	1	5
	2	5
	3	5
	4	5
4	1	6
	2	6
	3	7
	4	7

Suggested Readings:

- Prakel, D. (2007). Basics Photography 02: Lighting (Vol. 2). AVA Publishing.
- Smith, J. (2020). The Positive and Negative Effects of Photography on Wildlife.
- Banek, C., & Banek, G. (2013). Learning to Photograph-Volume 1: Camera, Equipment, and Basic Photographic Techniques. Rocky Nook, Inc.

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Assessment Rubrics:

Total	**75**

Sample questions to Test Outcome

2 Mark Questions

1. How would you adjust your camera settings for photographing wildlife in a dense forest with low light?
2. What is an ethical consideration to keep in mind during post-processing?
3. Name two popular post-processing software programs and describe one key feature of each.

6 Mark Questions

1. What criteria should you consider when selecting images for a wildlife photography portfolio?
2. How can you develop a strong narrative through a series of wildlife photographs?
3. What are some techniques for successful low-light wildlife photography?
4. What is the best approach for tracking and capturing sharp images of fast-moving wildlife?
5. What is the purpose of sharpening in wildlife photography, and how should it be applied?

14 Mark Questions

1. Describe a scenario where using a drone could enhance wildlife photography.
2. Describe a technique for enhancing contrast in a wildlife photo without losing detail.
3. How can wildlife photography contribute to conservation efforts?

KU3DSCFOR201 TREE PHYSIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCFOR201	3 + 1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">1.5</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides a comprehensive understanding of the physiological processes that govern tree growth, development, and adaptation. Topics include water and nutrient transport, photosynthesis, respiration, hormonal regulation, and environmental stress responses in trees. Emphasis will be placed on integrating structure-function relationships and understanding how trees interact with their environment over long lifespans.

Course Prerequisite:

Basic knowledge in Forest Ecology

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the fundamental physiological processes in trees.	***U***
2	Analyze how trees manage water, nutrients, and energy.	***An***

3	Apply knowledge of tree physiology to assess growth and productivity under varying environments.	***A***
4	Evaluate stress responses and adaptive strategies of trees.	***E***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓		✓		✓
CO 2	✓	✓		✓		✓	✓
CO 3	✓	✓	✓		✓	✓	✓
CO 4	✓	✓	✓				✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF TREE PHYSIOLOGY (15 HOURS)**	
	1	Scope, importance and applications of tree physiology
	2	Water relations
		a) Absorption
		b) Transport

		c) Transpiration
		d) Water potential
	3	Mineral nutrition
		d) Uptake
		e) Transport
		f) Deficiency symptoms
2	**MODULE TITLE: PHOTOSYNTHESIS AND RESPIRATION (15 HOURS)**	
	1	Photosynthesis
		a) Light and dark reactions
		b) Factors affecting photosynthesis
	2	Translocation of assimilates
	3	Respiration
		a) Glycolysis
		b) TCA cycle
		c) Electron Transport Chain
3	**MODULE TITLE: HORMONAL REGULATION AND GROWTH (10 HOURS)**	
	1	Plant growth regulators
		a) Auxins
		b) Gibberellins
		c) Cytokinins
		d) ABA
		e) Ethylene

4	**MODULE TITLE: STRESS PHYSIOLOGY AND ADAPTATION (15 HOURS)**	
	1	Drought, salinity, and temperature stress
	2	Physiological adaptations in different forest types
	3	Tree responses to climate change
5	**Teacher Specific Module (20 Hours)**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

13. Kramer, P.J., 1986. The role of physiology in forestry. *Tree physiology*, *2*(1-2-3), pp.1-16.
14. Kramer PJ and Kozlowshi TT. 1979. Physiology of Woody Plants. Academic Press.
15. Kramer PJ and Boyer JS 1995. *Water Relations of Plants and Soils*. San Diego, CA: Academic Press.
16. Kathpalia, R., Bhatla, S.C. (2018). Plant Mineral Nutrition. In: Plant Physiology, Development and Metabolism. Springer, Singapore. https://doi.org/10.1007/978-981-13-2023-1_2
17. Taiz, L. and Zeiger, E. 2007. Plant Physiology 4th Ed. Sinauer Associates Inc. Publishers, Sunderland.
18. Kozlowski TT. 1971. Growth and Development of Trees. Vol. I. Academic Press.
19. Larcher W. 1980. Physiological Plant Ecology. Springer-Verlag.
20. Raghavendra AS. 1991. Physiology of Trees. John Wiley & Sons.
21. Kumar, S., Sachdeva, S., Bhat, K.V. and Vats, S., 2018. Plant responses to drought stress: physiological, biochemical and molecular basis. *Biotic and abiotic stress tolerance in plants*, pp.1-25.
22. Raza, A., Ashraf, F., Zou, X., Zhang, X. and Tosif, H., 2020. Plant adaptation and tolerance to environmental stresses: mechanisms and perspectives. *Plant ecophysiology and adaptation under climate change: Mechanisms and perspectives I: General consequences and plant responses*, pp.117-145.

23. Mattheck, C., 1995. Wood—the internal optimization of trees. *Arboricultural Journal*, *19*(2), pp.97-110.
24. Archer, R.R., 2013. *Growth stresses and strains in trees* (Vol. 3). Springer Science & Business Media.
25. Mohren, G.M.J., Kramer, K. and Sabaté, S. eds., 1997. *Impacts of global change on tree physiology and forest ecosystems* (Vol. 52). Springer Science & Business Media.
26. Brubaker, L.B., 1986. Responses of tree populations to climatic change. *Vegetatio*, *67*, pp.119-130.
27. Leites, L. and Benito Garzón, M., 2023. Forest tree species adaptation to climate across biomes: Building on the legacy of ecological genetics to anticipate responses to climate change. *Global Change Biology*, *29*(17), pp.4711-4730.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3,4
2	1	5
	2	6,6
	3	5,6,7
3	1	7,8
4	1	9
	2	10,11,12
	3	13,14,15

Suggested Readings:

1. Goldstein, G. and Santiago, L.S., 2016. *Tropical tree physiology*. Springer Berlin Heidelberg.
2. Pallardy, S.G., 2010. *Physiology of woody plants*. academic press.
3. Kramer, P., 2012. *Physiology of woody plants*. Elsevier.
4. Landsberg, J. and Sands, P., 2011. *Physiological ecology of forest production: principles, processes and models* (Vol. 4). Amsterdam.
5. Raghavendra, A.S. ed., 1991. *Physiology of trees* (pp. x+-509).

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2

Total	**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define *water potential* and list its components.
2. Name two deficiency symptoms of nitrogen in trees.
3. Write the net equation of photosynthesis.
4. What role does RuBisCO play in the Calvin cycle?
5. Name two functions of auxins in tree growth.
6. How does ethylene influence leaf abscission?
7. List two physiological changes in trees under temperature stress.

6 Mark Questions

1. Compare the pathways of *apoplastic* and *symplastic water transport* in roots.
2. Analyze how *transpiration* affects mineral uptake in trees.
3. Using a graph, explain how light intensity affects the rate of photosynthesis in shade-tolerant vs. shade-intolerant trees.
4. Design an experiment to compare respiratory rates in tropical vs. temperate tree species. Justify your methodology and predict outcomes.
5. Analyze how gibberellins and ABA antagonistically regulate seed dormancy.
6. Contrast the osmotic adjustment strategies of mangroves and alpine trees.

14 Mark Questions

1. *"Drought stress alters tree physiology more profoundly than salinity stress."* Critically evaluate this statement with examples of adaptive mechanisms.
2. "Climate change will disproportionately impact boreal forests." Evaluate this claim by integrating physiological, hormonal, and photosynthetic adaptations.

Employability for the Course:

- *Forest Ecologist*
- *Silviculturist*
- *Conservation Scientist*

KU3DSCFOR202 WOOD STRUCTURE AND FUNCTIONS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCFOR202	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: This course explores the anatomical, physical, and chemical properties of wood, emphasizing its biological formation, structural diversity, and functional roles in trees and human applications. Topics include wood cell types, growth rings, density variations, mechanical properties, and industrial uses. The course integrates laboratory techniques for wood identification and analysis.

Course Prerequisite:

Basic knowledge of Plant Anatomy & Physiology

Ability to write examinations in English

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe the cellular and chemical composition of wood.	***U***
2	Analyze the relationship between wood structure and its mechanical properties.	***An***
3	Apply wood identification techniques using microscopic and macroscopic features.	***A***
4	Evaluate the suitability of wood for different industrial and ecological applications.	***E***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO1	✓	✓					✓
CO2	✓	✓		✓			
CO3	✓	✓	✓				
CO4	✓	✓	✓	✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE 1: FUNDAMENTALS OF WOOD ANATOMY (15 HOURS)**	
	1	Introduction to Wood Science
		Scope, importance, and applications in forestry/industry.
	2	Cellular Structure of Wood
		a) Tracheids, fibers, vessels, parenchyma
		b) Softwood vs. hardwood anatomy
	3	Wood Formation (Cambial Activity)
		a) Growth rings
		b) Earlywood vs. latewood
2	**MODULE 2: PHYSICAL & CHEMICAL PROPERTIES (15 HOURS)**	

	1	Wood Density and Moisture Relations
		a) Specific gravity
		b) Shrinkage and swelling
	2	Chemical Composition
	3	Mechanical Properties
3	**MODULE 3: WOOD IDENTIFICATION & CLASSIFICATION (15 HOURS)**	
	1	Macroscopic Features
		a) Grain
		b) Texture
		c) Figure
		d) Color
	2	Microscopic Techniques
4	**MODULE 4: FUNCTIONAL APPLICATIONS (15 HOURS)**	
	1	Ecological Roles of Wood
	2	Industrial Uses
5	**Teacher Specific Module (15 Hours)**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Panshin, A. J., & de Zeeuw, C. (1980). *Textbook of Wood Technology* (4th ed.). McGraw-Hill.
2. Schweingruber, F. H. (2007). *Wood Structure and Environment*. Springer.

3. Carlquist, S. (2001). Comparative Wood Anatomy. Springer.
4. Walker, J. C. F. (2006). Primary Wood Processing (2nd ed.). Springer.
5. Larson, P. R. (1994). The Vascular Cambium: Development and Structure. Springer.
6. Bowyer, J. L., et al. (2007). Forest Products and Wood Science (6th ed.). Wiley-Blackwell.
7. Fengel, D., & Wegener, G. (1989). Wood: Chemistry, Ultrastructure, Reactions. De Gruyter.
8. Hoadley, R. B. (1990). *Identifying Wood: Accurate Results with Simple Tools*. Taunton Press.
9. Dinwoodie, J. M. (2000). Timber: Its Nature and Behaviour (2nd ed.). Taylor & Francis.
10. Rowell, R. M. (2012). Handbook of Wood Chemistry and Wood Composites. CRC Press.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1,2
	3	2,3
2	1	4,5
	2	6,7
	3	7
3	1	8
	2	8
4	1	9,10
	2	9,10

Suggested Readings:

1. Carlquist, S., 2013. *Comparative wood anatomy: systematic, ecological, and evolutionary aspects of dicotyledon wood*. Springer Science & Business Media.
2. Krabel, D., 2016. Fundamentals of tree biology. *Urban Tree Management: For the Sustainable Development of Green Cities*, p.20.
3. Wiedenhoeft, A. and Eberhardt, T., 2021. Structure and function of wood. *Chapter 3 in FPL-GTR-282*, pp.3-1.
4. Stevanovic, T., 2016. *Chemical composition and properties of wood* (pp. 49-106). Scrivener Publishing, Beverly, MA.
5. Niemz, P., Sonderegger, W., Keplinger, T., Jiang, J. and Lu, J., 2023. Physical properties of wood and wood-based materials. In *Springer handbook of wood science and technology* (pp. 281-353). Cham: Springer International Publishing.
6. Silva, J.L., Bordalo, R. and Pissarra, J., 2020. Wood identification: an overview of current and past methods. *Estudos de Conservacao e Restauro*, (12), pp.45-68.
7. Schmitt, U., Singh, A.P. and Kim, Y.S., 2021. Wood as an ecological niche for microorganisms: Wood formation, structure, and cell wall composition. In *Forest microbiology* (pp. 17-34). Academic Press.
8. Wiedenhoeft, A., 2010. Structure and function of wood. *Wood handbook: wood as an engineering material: chapter 3. Centennial ed. General technical report FPL; GTR-190. Madison, WI: US Dept. of Agriculture, Forest Service, Forest Products Laboratory, 2010: p. 3.1-3.18.*, *190*, pp.3-1.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	5
d)	Viva-Voce	5

Total	**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define *tracheids* and state their function in softwoods.
2. Differentiate between earlywood and latewood based on cellular structure.
3. List the three major chemical components of wood.
4. Name two mechanical properties affected by the orientation of wood fibers.
5. What macroscopic feature helps distinguish oak from pine?
6. Why is *microscopic analysis* essential for accurate wood identification?
7. Give one ecological role of wood in forest ecosystems.
8. Why is teak preferred for outdoor furniture?

6 Mark Questions

1. Given a wood sample with diffuse-porous vessels and abundant parenchyma, identify its likely hardwood group. Justify.
2. Compare the microscopic features of softwood (e.g., pine) and hardwood (e.g., oak) using labeled diagrams.
3. How do growth ring patterns (e.g., narrow vs. wide rings) correlate with mechanical strength? Use examples.
4. Predict the shrinkage behavior of a high-density wood (e.g., ebony) vs. low-density wood (e.g., balsa) when dried.
5. Why is bamboo structurally suitable for scaffolding despite being a grass? Link to its fiber arrangement.

14 Mark Questions

1. "Wood is a sustainable material for construction." Critically assess this statement.
2. Design a flowchart for a timber company to select the optimal wood species for manufacturing musical instruments.

Employability for the Course:

- *Wood Technologist*
- *Timber Grading Specialist*
- *Pulp & Paper Technologist*

KU3DSCFOR203 INTRODUCTION TO AGROFORESTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCFOR203	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides a foundational understanding of agroforestry systems which include agroforestry systems classification, traditional and modern practices, species selection, design principles and policy framework. Students will explore the ecological, economic and social benefits of agroforestry practices, with a focus on sustainability, biodiversity conservation and climate resilience on forest ecosystems. Through theoretical learning and practical exercises, the course aims to equip students with the knowledge and skills necessary to assess and implement agroforestry strategiesin diverse landscapes.

Course Prerequisite

- Basic knowledge in Ecology at 10th level, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand management of tree species along with agriculture crops.	***U***
2	Identify suitable species and design appropriate agroforestry models.	***A***
3	Analyze the environmental and socio-economic benefits of agroforestry.	***An***

4	Evaluate the role of agroforestry in sustainable agriculture and climate change mitigation.	***E***
5	Design suitable agroforestry practice based on demand and site conditions.	***©***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create ©***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2			✓				
CO 3	✓	✓				✓	
CO 4					✓		✓
CO 5		✓			✓		✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: FUNDAMENTALS OF INDIAN AGRICULTURE & AGROFORESTRY (10 HOURS)**
	1	Indian agriculture: structure, challenges, and land use planning.
	2	Introduction to Agroforestry: definition and objective
	3	Agroforestry classification: Structural, functional, socio-economic, and ecological.

	4	Importance and role of agroforestry in sustainable land use.
2	**MODULE TITLE: AGROFORESTRY SYSTEMS AND THEIR APPLICATIONS (15 HOURS)**	
	1	Silvoagriculture Systems:
		a) shifting cultivation
		b) Taungya system
		c) Plantation agriculture and plantation forestry
	2	Agrosilviculture Systems:
		a) Trees in crop fields, alley cropping
		b) Boundary planting and shaded commercial cropping
	3	Silvopastoral Systems**:**
		a) Grassland and tree management
		b) Protein banks
	4	Agrosilvopastoral Systems:
		a) Home gardens, windbreaks, shelterbelts
		b) Multipurpose tree gardens
3	**MODULE TITLE: CROP INTERACTION AND AGROFORESTRY MANAGEMENT (10 HOURS)**	
	1	Tree-crop interaction:
		a) Positive: mutualism, compatibility
		b) Negative: allelopathy, competition

	2	Interaction management:
		a) Aboveground & belowground
		b) Crown and root manipulation, spacing
	3	Tree and canopy management: Coppicing, thinning, pollarding, pruning
	4	Crop planning in agroforestry: Crop selection, nutrient, water, and weed management
4	**MODULE TITLE: AGROFORESTRY PRACTICES, POLICY, AND ORGANIZATIONS (10 HOURS)**	
	1	Multipurpose tree species: Characteristics desirable in agroforestry
	2	Canopy and tree architecture management: Lopping, hedging
	3	Pros and cons of agroforestry systems
	4	National Agroforestry Policy (2014)
	5	National and international agroforestry organizations
5	**Teacher Specific Module (30 Hours)**	
	Directions: 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.	
	5.6 Visit a local biome (e.g., a forest, grassland, or wetland) to observe and document biotic and abiotic factors. 5.7 Collect soil, water, and plant samples from different biomes for laboratory analysis of physical and chemical properties. 5.8 Use microscopes to examine soil microorganisms from different biomes. 5.9 Collect data on temperature, humidity, soil composition, and biodiversity from both temperate and tropical forests. 5.10 Assess species composition in different forest types using quadrat sampling. Space to fill the selected area/ activity	

Essential Readings:

1. Nair, P.K.R. 1993. An introduction to agroforestry. Kluwer Academic Publishers. 499 p.
2. Young, A. 1997. Agroforestry for soil management. CAB Intl. Wellingford.320p
3. Dwivedi, A.P. 1992. Agroforestry principles and practices. Oxford and IBH Publication Co.
4. SenSarma, P.K. and Jha, L.K. 1993. Agroforestry. Indian Perspectives. Ashish Publishers, Delhi
5. Patra A. 2013. Agroforestry: Principles and Practices, New India Publishing Agency, 260 p
6. Raj A. J. and S. B. Lal (eds.) 2013. Agroforestry-Theory and Practice. Scientific Publishers (India), Jodhpur
7. Huxley P. A. 1999. Tropical Agroforestry. Wiley: 384p.
8. Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1
	3	1
	4	2
2	1	3
	2	3
	3	3
	4	2
	5	4
3	1	2
	2	2
	3	2
	4	4
	5	7

4	1	3
	2	7
	3	4
	4	8
	5	7

Suggested Readings:

- Odum, E.P. 1983. Basic Ecology. Saunders College Publishing, Holt Saunders, Japan
- Odum, E.P. Fundamentals of Ecology. Natraj Publisher, Dehradun
- Misra KC. Manual of Plant Ecology. Oxford & IBH Pub Co. New Delhi etc. 491p
- Michael P. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub.Co. New Delhi, 404p
- Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p
- Negi, S.S. 1993. Biodiversity and its Conservation in India. India Publishing company, New Delhi
- Saggwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical	**Marks**
End Semester Evaluation	**15**

Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. How does agroforestry differ from traditional agriculture?
2. Discuss the environmental benefits of agrosilvopastoral systems.
3. Discuss how agroforestry can contribute to climate change mitigation.
4. How does shelterbelt planting help in soil conservation?

6 Mark Questions

1. How can tree canopy management reduce crop competition?
2. Compare coppicing and pollarding as tree management strategies.
3. Compare functional and structural classifications of agroforestry.

14 Mark Questions

1. Analyse the benefits of integrating trees with crops in arid regions.
2. Analyse the ecological classification of agroforestry systems.
3. Evaluate the role of home gardens in biodiversity conservation.

Employability for the Course:

- Agroforestry Extension Officer
- Conservation Scientist
- Environmental Consultant
- Ecologist

KU3DSCFOR204 WILDLIFE MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	DSC	200-299	KU3DSCFOR204	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces students to the principles, practices, and ethics of conservation biology, a multidisciplinary field addressing the protection and restoration of biodiversity. It explores the ecological, genetic, and biogeographical foundations of conservation, while emphasizing the critical role of in-situ and ex-situ strategies, protected area networks, and global and national conservation efforts. The course also discusses threats to biodiversity, causes of extinction, and real-world conservation case studies, equipping students with foundational knowledge for ecological research, policy-making, and environmental stewardship.

Course Prerequisite:

Basic knowledge in Wildlife Science (Level 100-199).

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify the fundamental concepts, principles, and objectives of wildlife management and major wildlife projects in India.	***R***
2	Apply various wildlife census and survey techniques to estimate population size and distribution.	***A***

3	Analyze different wildlife monitoring and tagging methods, including telemetry and visual marking.	***An***
4	Evaluate threats to wildlife, including trade, habitat loss, and man-wildlife conflict, and recommend mitigation strategies.	***E***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			
CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF WILDLIFE MANAGEMENT (10 Hours)**	
	1	Definition and Scope of Wildlife Management
	2	Historical development of wildlife management in India
	3	Objectives of Wildlife Management
		g) Species conservation

		h) Habitat preservation
		i) Conflict mitigation
	4	Principles and approaches
		a) Preservation vs. management
		b) In-situ and ex-situ conservation
		c) Adaptive management
		d) Conservation projects in India
2	**MODULE TITLE: WILDLIFE CENSUS AND SURVEY TECHNIQUES (12 Hours)**	
	1	Purpose and importance of wildlife census
	2	Census Techniques
		a) Direct and Indirect methods
		b) Sample counts and total counts
		c) Encounter rates and indices
	3	Census Methods
		a) Block counts & Roadside counts
		b) Dung counts & Pugmark census
		c) Waterhole census & Line transect
		d) Capture-mark-recapture method
	4	Traps Used in Wildlife Surveys
		a) Sherman traps
		b) Mist nets

		c) Funnel trapping
		d) Glue trapping
		e) Pitfall traps
3	**MODULE TITLE: WILDLIFE MONITORING (12 Hours)**	
	1	Wildlife monitoring techniques
		a) Radio and satellite telemetry
		b) Visual tagging
		c) Bird ringing: methods and significance
	2	Darting and Chemical Immobilization
		a) Purpose and significance in wildlife management
		b) Types of darts and darting guns
		c) Common tranquilizers, anaesthetics, and drug combinations
		d) Ethical concerns and guidelines (IWRC, CZA protocols)
	3	Wildlife Trade and its Impact
		a) Overview of illegal wildlife trade
		b) CITES and its functioning
		c) TRAFFIC: objectives and role
4	**MODULE TITLE: CONSERVATION BIOLOGY (15 Hours)**	
	1	Principles and Ethics of Conservation
	2	Endemism, Rarity, and Species Extinction
	3	IUCN Red List categories and criteria

	4	Captive breeding programmes, introduction and reintroduction – case studies.
5	**Teacher Specific Module (30 Hours)**	
	• *Visit to ex-situ and in-situ conservation approaches* • *Field Training in Census techniques – Line transect survey, pitfall traps, Sherman trapping, mistnetting, camera trapping, pugmark analysis* • *Wildlife survey methods – visual encounter survey, open and bounded quadrat sampling, stream line survey, belt transects, glue trapping, mistnetting, Sherman trapping, funnel trapping, cover board survey, bat detectors, mark-recapture surveys, radio-collaring and telemetry studies.* • *Use of software for analysis of census data*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. OUP, New
2. Dasmann, R.F. 1982. Wildlife Biology.
3. Davil, J.W. et al. (1981). Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.
4. Karanth, K.U. and Nichols, J.D. eds., 2002. Monitoring tigers and their prey: a manual for researchers,
5. managers, and conservationists in tropical Asia (pp. 121-138). Bangalore, India: Centre for Wildlife Studies.
6. Krebs C & Davis N. (1978). Introduction to behavioral ecology. Oxford University Press
7. Lever, C. (1985). Naturalised mammals of the world. John Wiley, London
8. Mills, L. S. (2013). Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2).
9. Wiley-Blackwell.
10. Rajesh, G. Fundamentals of Wildlife Management, Justice Home, Allahabad.
11. Reena Mathur. 1985. Animal Behaviour. OUP, Delhi.481pp.
12. Sawarkar B. Wildlife Management. WII. Dehra Dun
13. Sukumar, R. Asian Elephant. Ecology and Management. OUP Cambridge.
14. Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6
	3	6
3	1	7
	2	8
	3	9,10
4	1	11
	2	12

Suggested Readings:

Auk Bioone Wildlife Management Journal, Current Science, European Journal of Wildlife Research, Journal of biodiversity, bioprosperity and management, Journal of Threatened Taxa, Journal of Wildlife Management, Journal of Wildlife Rehabilitation, Wildlife Biology, Wildlife Research, Wildlife Society Bulletin.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define wildlife management.
2. Name two direct methods used in wildlife census.
3. What is telemetry in wildlife monitoring?
4. Mention one major wildlife project in India.
5. List two threats to wildlife.

6 Mark Questions

1. Explain the difference between sample count and total count methods in wildlife census.
2. Describe the role of protected areas in wildlife conservation in India.
3. Discuss the importance of indirect methods like dung counts and pugmark census in wildlife surveys.
4. Explain the concept of man-wildlife conflict and suggest two mitigation measures.
5. Describe the principle and applications of radio telemetry in wildlife studies.

14 Mark Questions

1. Discuss the different methods of wildlife census and their respective advantages and limitations.
2. Explain the role of CITES and TRAFFIC in regulating wildlife trade and conserving endangered species.
3. Critically evaluate the threats faced by wildlife in the Western Ghats and the conservation strategies implemented to mitigate these threats.
4. Describe the process, importance, and ethical considerations of chemical immobilization (darting) in wildlife management.
5. Elaborate on the structure and significance of the protected area network in India, highlighting the role of national parks, wildlife sanctuaries, and community reserves.

KU3VACFOR220 BASIC LIFE SUPPORT SKILLS AND FIRST AID

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	VAC	200-299	KU3VACFOR220	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: Basic Life Support Skills and First Aid is a foundational course designed to equip students with essential knowledge and practical skills to respond effectively in emergency situations. The course offers a comprehensive introduction to the principles of first aid, cardiopulmonary resuscitation (CPR), and basic life support techniques. Emphasizing the importance of timely and informed intervention, students will learn to assess and manage common medical emergencies, injuries, and life-threatening conditions with confidence and composure. Through hands-on training and scenario-based learning, the course fosters critical thinking, preparedness, and a sense of responsibility in safeguarding individual and community health and safety.

Course Prerequisite:

Basic knowledge in Biology at 10th level, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify common medical emergencies and the appropriate first aid responses	***R***
2	Identify common medical emergencies and the appropriate first aid responses	***A***
3	Analyze emergency situations to prioritize care and make informed decisions	***An***

4	Evaluate the effectiveness of first aid interventions in various real-life scenarios	***E***

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			
CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: UNDERSTANDING FIRST-AID PROCEDURES (5 HOURS)**
	1	What is First Aid?
		d) Good Samaritan Law
		e) Items you'll need in a medical kit.
		f) Personal Protective Equipment.
2		**MODULE TITLE: EMERGENCY SITUATIONS AND FIRST AIDS (20 HOURS)**
	1	Wounds and treatment for each type:

		a) Open Chest Wounds & Punctured Wounds
		b) Amputations, Cuts & Scrapes,
		c) Fractures, Sprains & Strains
	2	Other Emergency Situations and First Aids
		a) Types of Burns
		b) Poisoning
		c) Hemorrhages & Hypoglycemia.
		d) Choking & Dehydration
		e) Shocks, Seizures & Strokes
		f) Snake Bite
3	**MODULE TITLE: CARDIOPULMONARY RESUSCITATION (CPR) (10 HOURS)**	
	1	Understanding CPR
		a) Definition and importance of CPR
		b) Indications and goals of CPR
		c) Chain of survival concept
	2	Automated External Defibrillator (AED)
		a) Components and functions of an AED
		b) Steps in using an AED safely and effectively
		c) Integration of AED with CPR
4	**MODULE TITLE: ESSENTIAL LIFE-SAVING TECHNIQUES (10 Hours)**	
	1	Hands-Only CPR
		a) Identifying cardiac arrest

		b) Chest compression technique: position, depth, and rhythm
		c) Practicing uninterrupted compressions
	2	Artificial Respiration and Full CPR
	3	Heimlich Maneuver (Abdominal Thrusts)
	4	Dressing Open Wounds
	5	Temporary Immobilization of Limb Fractures
5	**Teacher Specific Module**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

1. **American Heart Association (AHA).** *Basic Life Support (BLS) Provider Manual*.– Latest edition.
2. **St. John Ambulance, British Red Cross, and St. Andrew's First Aid.** *First Aid Manual: The Authorised Manual of St. John Ambulance*.
3. **International Federation of Red Cross and Red Crescent Societies (IFRC).** *First Aid Guidelines*.
4. **National Safety Council (NSC).** *First Aid, CPR, and AED Standard*.

5. **World Health Organization (WHO).** *Emergency and Essential Surgical Care: First Aid Manual*.
6. **Dr. R.S. Gopalan.** *Emergency First Aid and Management of Common Injuries*.
7. **National Institute of Disaster Management (India).** *First Aid and Emergency Care Training Manuals*.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6
	3	6
3	1	7
	2	8
	3	9,10
4	1	11
	2	12

Suggested Readings:

1. **First Aid Manual** By St. John Ambulance, St. Andrew's First Aid, and British Red Cross. – Step-by-step guide to first aid procedures with illustrations and real-life scenarios.

Assessment Rubrics:

Evaluation Type	Marks
End Semester Evaluation	**50**
Continuous Evaluation	**25**

a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2-MARK QUESTIONS

1. Define first aid.
2. What is the Good Samaritan Law?
3. Name any four items commonly found in a first aid kit.
4. Mention two examples of Personal Protective Equipment (PPE).
5. What is an open chest wound?
6. List two signs of a fracture.
7. What is hypoglycemia?
8. Define the term CPR.
9. State any two functions of an AED.
10. What is the "Chain of Survival" in CPR?

6-MARK QUESTIONS

1. Explain the steps to manage a puncture wound and an open chest wound.
2. Compare the first aid measures for cuts & scrapes vs. amputations.
3. Discuss the different types of burns and the appropriate first aid for each.
4. Describe the symptoms and first aid management of a person suffering from poisoning.
5. Explain the steps involved in performing hands-only CPR.
6. Differentiate between artificial respiration and full CPR with procedures.
7. Describe the use and safety precautions of an Automated External Defibrillator (AED).
8. Analyze the first aid procedures for shock and seizures.

9. Describe the technique of dressing open wounds.
10. What steps should be taken to temporarily immobilize a suspected limb fracture?

14-MARK QUESTIONS

1. A person is found unconscious with no signs of breathing. Explain how you would assess the situation and perform CPR, including the use of an AED.
2. Create a detailed first aid plan for managing a person with multiple injuries including a fracture, bleeding wound, and suspected hypoglycemia.
3. Evaluate the importance of the "Chain of Survival" and describe how each link contributes to saving lives.
4. You are the first responder to a burn victim and another person who has inhaled poisonous fumes. Discuss the differences in assessment and first aid procedures in both cases.
5. Demonstrate your understanding of essential life-saving techniques by explaining the Heimlich maneuver, temporary immobilization of fractures, and artificial respiration procedures in a mass casualty scenario.
6. Discuss in detail how to respond to three life-threatening emergencies: choking, snakebite, and stroke. Include signs, symptoms, and first aid steps for each.

KU3VACFOR221 CIVIC EDUCATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
3	VAC	200-299	KU3VACFOR221	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course is designed to cultivate informed, responsible, and active citizenship among students. The course introduces learners to the foundational principles of democracy, the structure and functions of government, the Constitution of India, and the rights and duties of citizens. It explores the role of individuals and institutions in upholding democratic values, promoting social justice, and ensuring accountable governance. Through discussions, case studies, and community engagement, the course empowers students to critically examine societal issues and actively participate in civic life with integrity and purpose.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the core principles of democracy, citizenship, and governance.	***U***
2	Appreciate the values of social justice, equality, and diversity.	***A***
3	Engage in civic activities and public discourse responsibly.	***An***
4	Develop skills for critical thinking, participation, and ethical decision-making in civic life.	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2				✓			
CO 3		✓					✓
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: FOUNDATIONS OF CIVIC LIFE (5 HOURS)**	
	1	Meaning, scope, and importance of civic education
	2	Principles of democracy and responsible citizenship
	3	Civic values: tolerance, equality, justice, and integrity
2	**MODULE TITLE: CONSTITUTION, RIGHTS, AND GOVERNANCE (20 HOURS)**	
	1	Overview of the Indian Constitution
		a) Preamble
		b) Fundamental Rights and Duties

	2	Directive Principles of State Policy
	3	Structure and functions of the Government
		a) Legislature
		b) Executive
		c) Judiciary
	4	Electoral process and the role of the Election Commission
	5	Local self-governance and decentralization (Panchayati Raj)
3	**MODULE TITLE: LAW, JUSTICE, AND HUMAN RIGHTS (10 HOURS)**	
	1	Rule of law and access to justice
	2	Universal Declaration of Human Rights (UDHR) and national human rights bodies
	3	Writs
	4	Community service, volunteering, and youth civic action
4	**MODULE TITLE: MAJOR LEGAL PROVISIONS FOR PROTECTION OF WOMEN (10 HOURS)**	
	1	The Protection of Women from Domestic Violence Act, 2005
	2	The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013
	3	POCSO Act, 2012
	4	Role of National Commission for Women (NCW)
	5	State Commissions for Women
5	**Teacher Specific Module**	

	• *Case study analysis (e.g., Nirbhaya Case, Vishaka Case)* • *Legal literacy campaigns or poster presentations* • *Visit to Family Court / Women's Commission (if feasible)* • *Role play: Mock trial or counselling session*
	Space to fill the selected area/ activity

Essential Readings:

1. NCERT Textbooks (Civics – Class IX to XII)
2. The Constitution of India (Bare Act)
3. Jayapalan, N. – *Indian Political System*
4. UNDP – *Civic Education Toolkit*
5. Bhargava, R. – *Politics and Ethics of the Indian Constitution*

Suggested Readings:

1. Baxi, Upendra. The Future of Human Rights
2. Kaushik, Rajni. Democracy and Good Governance
3. Flavia Agnes. Law and Gender Inequality: The Politics of Women's Rights in India

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Total	**75**

Sample questions to Test Outcome

2 Marks Questions

1. Define civic education.
2. What do you mean by fundamental duties?
3. Mention any two Directive Principles of State Policy.
4. Name two constitutional rights available to Indian women.
5. What is meant by the rule of law?
6. Who is the current Chief Election Commissioner of India? *(Update during exam)*
7. Mention two functions of the National Human Rights Commission.
8. What is the purpose of the Preamble in the Indian Constitution?
9. Name any two civic responsibilities of a citizen.
10. What is the full form of NCW? What is its role?

6 Marks Questions

1. Explain the role of civic education in a democracy.
2. Discuss the importance of Fundamental Rights and Duties.
3. Briefly describe the structure of the Indian Parliament.
4. Write a short note on the role of youth in promoting civic responsibility.
5. Explain any three laws enacted for the protection of women in India.
6. Describe the powers and functions of the Election Commission of India.
7. How does media influence public opinion in a democracy?
8. Explain the significance of local self-governance in India.
9. Describe the role of NGOs in promoting human rights.
10. Distinguish between equality and equity with suitable examples.

14 Marks Questions

1. Describe the key features of the Indian Constitution and discuss its role in safeguarding democracy.
2. Critically evaluate the effectiveness of civic education in promoting active citizenship in India.
3. Discuss various laws available in India for the protection and empowerment of women.
4. Explain the structure and functions of the three organs of government with suitable examples.
5. Analyze the role of civil society and public participation in ensuring good governance.
6. Examine the major challenges to human rights in India and suggest measures to address them.
7. “Media is the fourth pillar of democracy.” Discuss the statement with examples.
8. Elaborate on the importance of ethical leadership and its impact on public life.
9. How does the Indian electoral system work? Evaluate its strengths and weaknesses.
10. Discuss the role of constitutional bodies in upholding democracy in India.

KU4DSCFOR206 FOREST UTILIZATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCFOR206	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course introduces students to the science and techniques involved in the harvesting and utilization of forest resources. It covers traditional and mechanized methods of timber logging, conversion, transportation, and storage. Students will explore the manufacturing processes and applications of various wood products. The course also highlights the significance of Non-Timber Forest Products (NTFPs) focusing on their industrial value and role in local economies. Emphasis is placed on sustainable practices and value addition in forest resource management.

Course Prerequisite

- Must studied wood structure and functions, Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the principles and techniques of timber harvesting, conversion, and transportation, including reduced impact logging and timber storage methods.	***U***
2	Apply knowledge of manufacturing processes to produce various wood-based and composite products such as veneers, plywood, fiberboards, and improved wood types.	***A***

3	Analyse the properties, uses, and industrial relevance of Non-Timber Forest Products (NTFPs) especially in the context of India and Kerala.	***An***
4	Evaluate the economic and ecological significance of forest-based products with a focus on their sustainable use and value addition.	***E***
5	Create innovative solutions or product concepts using timber and non-timber resources, incorporating sustainable practices and modern processing techniques	***©***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create ©***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2							
CO 3	✓	✓			✓	✓	
CO 4			✓		✓		✓
CO 5		✓			✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: LOGGING AND TIMBER HANDLING (10 HOURS)**
	1	Felling
		a) Principles of tree felling, conversion and log making.

		b) Methods of felling and felling rules
		c) Reduced Impact Logging
	2	Mechanized harvesting systems
		a) Felling equipments,
		b) Extraction equipments
		c) Loading equipments.
	3	Timber transportation
	4	Storage of timber and timber depots
2	**MODULE TITLE: MANUFACTURING OF WOOD PRODUCTS (15 HOURS)**	
	1	Composite Wood Products
		a) Plywood
		b) Fibreboard
		c) Particle board
		d) Hardboard
	2	Adhesives in Wood Industry
		c) Natural adhesives
		d) Synthetic adhesives
	3	Improved Wood
		c) impregnated wood
		d) heat stabilized wood
		e) compressed wood

		f) compregnated wood
		g) heat stabilized compressed wood
		h) chemically modified wood
	4	Wood based composites
		c) wood plastic composites
		d) wood metal composites
	5	Cellulose-Derived Products
		a) Paper and Pulp
		b) rayon
	6	Destructive Distillation of Wood
	7	Saccharification of Wood
3	**MODULE TITLE: WOOD BASED INDUSTRIES (10 HOURS)**	
	1	Major wood industries – sawn timber, paper and pulp, plywood aqnd particle board, matchwood
	2	Other wood-based industries – Packing case, dendro-biomass power generation industries and value addition industries
	3	Constraints in wood based industries – wood demand and supply
	4	Measures for development of wood based industries – technological measures, precision silviculture technology, value addition technology, And contract farming
4	**MODULE TITLE: NON-TIMBER FOREST PRODUCTS, MEDICINAL AND AROMATIC PLANTS (10 HOURS)**	
	1	Introduction to NTFPs: Definition, significance in rural and industrial economies

	2	Major NTFPs of India and Kerala
		a) Fodder, Canes, and Bamboos
		b) Oils and Oleoresins
		c) Gums and Resins
		d) Tans and Dyes
		e) Fibres and flosses
		f) Animal derived products
	3	Important aromatic and medicinal plants in Kerala
		a) Aromatic plants- lemon grass, citronella, vetiver, eucalyptus and mint
		b) Medicinal plants – *santalum album, Rauolfia serpentine, saraca ashoka, cassia fistula, embilica officinalis, Terminalia spp, wrightia tinctorea,and holarrhena pubescens*
5	**Teacher Specific Module (5 Hours)**	
	Directions: 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.	
	5.11 Visits to the following wood based industries to learn the manufacturing procedures 5.12 Visit to a sawmill or timber depot to observe log conversion and storage 5.13 Field trip: Visit a paper mill, match factory, or biomass unit 5.14 Survey: Local timber and sawn wood market – pricing, demand-supply analysis 5.15 Guest lecture: From a wood industry expert or forest department official 5.16 Market study**:** Survey local NTFP-based products (e.g., beedi leaves, gums)	

Essential Readings:

1. Mehta, T. 1981. A Handbook of Forest Utilization. International Book Distributors. 208 p.

2. John G. Haygreen, Jim L. Bowyer. 1996. Forest Products and Wood Science, an Introduction.
3. Rao, P.S. 1988. A Handbook on Indian Wood and Wood Panels, Solid Wood. Oxford University Press.
4. Brown HP. 1985. A Manual of Indian Wood Technology.
5. Desch, H. E and Dinwoodie, J.M. 1981. Timber: Its Structure, Properties and Utilization. The Macmillan Press. Indian Forest Utilization. Vol I and II. Forest Research Institute Dehra Dun
6. Rydhom S.A. 1965. Pulping process inter Science Publishers. New York
7. K.W. Brit. Hand Book of pulp and paper technology. C.B.S. Publication New Delhi.
8. Nair K.K.N. 2000. Manual of Non-wood Forest produce plants of Kerala. Kerala Forest Department Government of Kerala, Thiruvananthapuram. 449 p.
9. Krishnamurthy, T. Minor Forest Products of India. Oxford & IBH Publishing Co. Pvt. Ltd. 645 p.
10. Sharma, L.C. 1988. The Indian Pulp and Paper Industry at a glance. Bishen Singh Mahendra PalSingh, Dehradun. 280p.
11. Singh, M.P. 2011. Wild Medicinal Plants. Daya Publishing House. 368p
12. Jain, S. K. 1995. A manual of Ethnobotany. Scientific publishers. 193 p

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	1
	3	1
	4	2
2	1	3
	2	3
	3	3
	4	2
	5	6
	6	7
	7	4
3	1	6

	2	6
	3	2
	4	4
4	1	8
	2	11
	3	12

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4

c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Describe the methods of timber felling and the general felling rules followed in Kerala.
2. Explain the process of veneer manufacturing and its various types.
3. Describe the major non-timber forest products (NTFPs) of Kerala and their uses.
4. List the steps involved in the mechanized harvesting of timber.
5. Describe the importance of medicinal plants like Rauvolfia serpentina and Phyllanthus emblica in Ayurveda.

6 Mark Questions

1. Compare the characteristics, manufacturing processes, and uses of plywood, fibre board, and particle board.
2. Differentiate between essential and non-essential oils in terms of sources, extraction, and applications.
3. Compare gum and resin in terms of plant origin, classification, and industrial uses.

14 Mark Questions

1. Analyze the impact of Reduced Impact Logging (RIL) on forest sustainability.
2. Examine the role of composite wood industries in reducing dependence on natural forests.
3. Analyze the factors affecting the demand and supply gap in the wood-based industry in India.
4. What are the economic and ecological implications of overexploitation of NTFPs in Kerala?

Employability for the Course:

- Scientist
- Technician, quality control assistant, production supervisor (plywood, particle board, veneer units)
- Raw material manager, technical operator in Pulp and Paper Industry

KU4DSCFOR207 WILDLIFE SCIENCE AND CONSERVATION BIOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCFOR207	4	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces students to the principles, practices, and ethics of conservation biology, a multidisciplinary field addressing the protection and restoration of biodiversity. It explores the ecological, genetic, and biogeographical foundations of conservation, while emphasizing the critical role of in-situ and ex-situ strategies, protected area networks, and global and national conservation efforts. The course also discusses threats to biodiversity, causes of extinction, and real-world conservation case studies, equipping students with foundational knowledge for ecological research, policy-making, and environmental stewardship.

Course Prerequisite:

Basic knowledge in Wildlife Science (Level 100-199).

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify the fundamental concepts, principles, and objectives of wildlife management and major wildlife projects in India.	***R***
2	Apply various wildlife census and survey techniques to estimate population size and distribution.	***A***
3	Analyze different wildlife monitoring and tagging methods, including telemetry and visual marking.	***An***

4	Evaluate threats to wildlife, including trade, habitat loss, and man-wildlife conflict, and recommend mitigation strategies.	***E***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			
CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: FUNDAMENTALS OF WILDLIFE SCIENCE (15 Hours)**	
	1. Wildlife Science	
		a) Definitions and values of wildlife
		b) Characteristics of wildlife in different biomes and zoogeographic regions of the world
	2. Behaviour of Wild animals	

	a) Instinctive behaviour, learned behaviour, dispersal behaviour, social behaviour, and reproductive behaviour	
	b) Clutch size and litter size and age of maturity	
	c) Territory, Home range and significance of territory	
	3. Adaptations of wild animals	
	a) Aestivation, hibernation, torpor and diapause	
	b) Predator avoidance – camouflage, mimicry and schooling	
	4. Mammalogy and Indian mammals	
	a) Characteristics of class mammalia	
	b) Classification of mammals and the detailed account on mammalian orders of Indian sub-continent: Primata, Carnivora, Proboscidea, Artiodactyla, Rodentia, Chiroptera, Lagomorpha.	
	c) Zoogeography of Indian mammals	
	2 MODULE TITLE: WILDLIFE MANAGEMENT (15 HOURS)	
	1	Definition and Scope of Wildlife Management
	2	Historical development of wildlife management in India
	3	Objectives of Wildlife Management
		a) Species conservation
		b) Habitat preservation
		c) Conflict mitigation
	4	Principles and approaches
		a) Preservation vs. management

		b) In-situ and ex-situ conservation
		c) Adaptive management
		d) Conservation projects in India
3	**MODULE TITLE: WILDLIFE CENSUS, MONITORING, AND CONSERVATION TECHNIQUES (25 Hours)**	
	1	Wildlife Census Methods
		d) Purpose and significance of wildlife census
		e) Census techniques using direct and indirect methods
		f) Sample counts, total counts, encounter rates and indices
		g) Census methods - block counts, roadside counts, dung counts, pugmark census, waterhole census, line transect, and capture-mark-recapture method.
	2	Wildlife Monitoring and Survey Tools
		e) Monitoring techniques - radio and satellite telemetry, visual tagging, bird ringing
		f) Significance of monitoring techniques
		g) Traps used in wildlife surveys - Sherman traps, mist nets, funnel trapping, glue trapping, and pitfall traps.
	3	Darting, Chemical Immobilization, and Ethical Guidelines
		d) Purpose and significance in wildlife management, and ethical concerns and guidelines following IWRC and CZA protocols.
		e) Darting methods, types of darts and darting guns, common tranquilizers, anaesthetics, and drug combinations,
		f) Ethical concerns and guidelines following IWRC and CZA protocols.
	4	Wildlife Trade and Conservation Measures
		a) Overview of illegal wildlife trade

		b) CITES and its functioning
		c) TRAFFIC - objectives and role in conservation.
4	**MODULE TITLE: CONSERVATION BIOLOGY (14 Hours)**	
	1	Principles and Ethics of Conservation
		a) Ex-situ and in-situ methods of conservation
		b) Protected areas - Concept and examples in Kerala and India
	2	Endemism, Rarity, and Species Extinction
	3	IUCN Red List categories and criteria
	4	Captive breeding programmes, introduction and reintroduction – case studies.
5	**Teacher Specific Module (6 Hours)**	
	• *Visit to ex-situ and in-situ conservation approaches* • *Field Training in Census techniques – Line transect survey, pitfall traps, Sherman trapping, mistnetting, camera trapping, pugmark analysis* • *Wildlife survey methods – visual encounter survey, open and bounded quadrat sampling, stream line survey, belt transects, glue trapping, mistnetting, Sherman trapping, funnel trapping, cover board survey, bat detectors, mark-recapture surveys, radio-collaring and telemetry studies.* • *Use of software for analysis of census data*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. OUP, New
2. Dasmann, R.F. 1982. Wildlife Biology.
3. Davil, J.W. et al. (1981). Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.

4. Karanth, K.U. and Nichols, J.D. eds., 2002. Monitoring tigers and their prey: a manual for researchers,
5. managers, and conservationists in tropical Asia (pp. 121-138). Bangalore, India: Centre for Wildlife Studies.
6. Krebs C & Davis N. (1978). Introduction to behavioral ecology. Oxford University Press
7. Lever, C. (1985). Naturalised mammals of the world. John Wiley, London
8. Mills, L. S. (2013). Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2).
9. Wiley-Blackwell.
10. Rajesh, G. Fundamentals of Wildlife Management, Justice Home, Allahabad.
11. Reena Mathur. 1985. Animal Behaviour. OUP, Delhi.481pp.
12. Sawarkar B. Wildlife Management. WII. Dehra Dun
13. Sukumar, R. Asian Elephant. Ecology and Management. OUP Cambridge.
14. Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England.

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6
	3	6
3	1	7
	2	8
	3	9,10

4	1	11
	2	12

Suggested Readings:

Auk Bioone Wildlife Management Journal, Current Science, European Journal of Wildlife Research, Journal of biodiversity, bioprosperity and management, Journal of Threatened Taxa, Journal of Wildlife Management, Journal of Wildlife Rehabilitation, Wildlife Biology, Wildlife Research, Wildlife Society Bulletin.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**
Evaluation Type – Practical		**Marks**

End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define wildlife management.
2. Name two direct methods used in wildlife census.
3. What is telemetry in wildlife monitoring?
4. Mention one major wildlife project in India.
5. List two threats to wildlife.

6 Mark Questions

1. Explain the difference between sample count and total count methods in wildlife census.
2. Describe the role of protected areas in wildlife conservation in India.
3. Discuss the importance of indirect methods like dung counts and pugmark census in wildlife surveys.
4. Explain the concept of man-wildlife conflict and suggest two mitigation measures.
5. Describe the principle and applications of radio telemetry in wildlife studies.

14 Mark Questions

1. Discuss the different methods of wildlife census and their respective advantages and limitations.
2. Explain the role of CITES and TRAFFIC in regulating wildlife trade and conserving endangered species.
3. Critically evaluate the threats faced by wildlife in the Western Ghats and the conservation strategies implemented to mitigate these threats.
4. Describe the process, importance, and ethical considerations of chemical immobilization (darting) in wildlife management.
5. Elaborate on the structure and significance of the protected area network in India, highlighting the role of national parks, wildlife sanctuaries, and community reserves.

KU4DSCFOR208 FOREST GENETICS AND TREE IMPROVEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	DSC	200-299	KU4DSCFOR208	4	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces students to the fundamental concepts and applications of forest genetics, tree improvement, and biotechnology in forestry. It explores the genetic, environmental, and phenotypic expressions of trees while emphasizing breeding methods, selection strategies, and hybridization techniques for enhancing forest productivity. Students will engage with cutting-edge approaches in plant tissue culture, genetic engineering, and conservation genetics, gaining insight into the role of biotechnology in sustainable forestry. The course also examines challenges in in-vitro propagation, transgenic varieties, and germplasm preservation, equipping students with essential knowledge for forestry research, policy development, and tree breeding programs.

Course Prerequisite:

Basic knowledge in Plant reproduction and growth (Level 100-199).

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the genetic, environmental, and phenotypic expression of trees.	***R***
2	Explain the significance of tree improvement and its role in forestry.	***U***
3	Apply various tree breeding methods, including selection, hybridization, and introduction.	***A***

4	Analyse plant tissue culture techniques and their applications in forestry.	***An***
5	Evaluate genetic engineering approaches and their impact on forest conservation.	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			
CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: FOREST GENETICS (10 Hours)**
	1	Reproduction and Genetic Expression in Forest Trees
		a) Anthesis and pollination in forest trees
		b) Importance of reproductive processes in tree breeding
		c) Genetic, environmental, and phenotypic expression of trees
		Principles of Quantitative Genetics in Forestry

	2	a) Quantitative inheritance in trees
		b) Heritability, genetic advance, and genetic gain
		c) Combining ability and its application in tree breeding
2	**MODULE TITLE: TREE IMPROVEMENT AND BREEDING METHODS (16 Hours)**	
	1	Fundamentals of Tree Improvement
		a) Introduction, history, and development of tree improvement
		b) Genetic basis of tree breeding and natural variability in trees
		c) Forces influencing variability in tree populations
	2	Tree Breeding Methods and Applications
		a) Selection, hybridization, and introduction
		b) Exotic forestry and provenance testing
		c) Seed production areas, seed orchards, progeny trials, and seed orchard improvement
	3	Advanced Breeding Strategies in Forestry
		a) Backcross breeding and heterosis breeding
		b) Clonal forestry and vegetative propagation techniques
		c) Breeding for resistance against insect pests, diseases, and air pollution
		d) Breeding for improved wood properties
	4	Conservation and Genetic Resource Management
		a) Conservation of forest tree germplasm
		b) Applications of tree breeding in forestry
		c) Conservation strategies for rare and threatened species

3	**MODULE TITLE: PLANT TISSUE CULTURE (12 Hours)**	
	1	Principles and Techniques of Tissue Culture
		a) Introduction, advantages, and historical developments
		b) Tissue culture techniques and explant collection
		c) Culture media: types and components
	2	Sterilization and Laboratory Protocols
		a) Sterilization of living and non-living materials
		b) Inoculation, incubation, hardening, and planting-out procedures
	3	Pathways of Plant Regeneration
		a) Organogenesis and somatic embryogenesis
		b) Synthetic seeds and embryo culture significance
		c) Protoplast isolation and culture
	4	Clonal Propagation and Hybridization Techniques
		a) Somatic hybridization and clonal multiplication
		b) Applications of tissue culture in forestry improvement
4	**MODULE TITLE: GENETIC ENGINEERING IN FORESTRY (12 Hours)**	
	1	In-vitro Propagation and Challenges
		a) Problems of in-vitro propagation
		b) Applications of in-vitro techniques in forestry
	2	Genetic Engineering and Biotechnological Applications
		a) Genetic engineering principles and recombinant DNA technology
		b) Applications in forestry and tree improvement

	3	Transgenic Varieties and Conservation Strategies
		a) Development and use of transgenic forest species
		b) Germplasm preservation strategies: short-, medium-, and long-term storage
	4	Ethical Considerations and Future Prospects
		a) Ethical concerns in genetic modification
		b) Biotechnological advancements in conservation forestry
5	**Teacher Specific Module (30 Hours)**	
	• *Visit to Tissue culture laboratories* • *Practical Training in Tree Breeding Methods – Plus tree selection, Provenance test, Hybridization and production* • *Visit to tree improvement centers, seed orchards, and clonal forestry sites* • *Hands-On Training in Tissue Culture Techniques - Explant collection and sterilization procedures, Preparation of culture media and inoculation techniques* • *Use of bioinformatics tools for analysis of genetic diversity*	
	Space to fill the selected area/ activity	

Essential Readings:

1. FAO. 1985. Forest Tree Improvement, FAO Pub.
2. Mandal AK & Gibson GL. (Eds.). 1997. Forest Genetics and Tree Breeding. CBS.
3. Surendran C, Sehgal RN and Parmathama M. (eds). 2003. A Text Book of Forest Tree Breeding. ICAR.
4. Zobel BJ and Talbert J. 1984. Applied Forest Tree Improvement. John Wiley & Sons.
5. Gupta, P.K. 2000. Molecular Biology and Genetic Engineering. Rastogi Publ. New Delhi
6. Kumar, S. and Singh, M.P. 2008. Plant Tissue Culture. APH Pub. New Delhi
7. Punia, M.S. 1998. Plant Biotechnology and Molecular Biology. Scientific Pub.

8. Bajaj YPS. (ed.). 1988. Biotechnology in Agriculture and Forestry. Springer Verlag.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**
Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define forest genetics.
2. What is the significance of anthesis in tree breeding?
3. Name two important tree breeding methods used in forestry.
4. What is provenance testing in tree improvement?
5. Mention any two vegetative propagation methods used in forestry.
6. Define somatic embryogenesis in plant tissue culture.
7. What is the role of recombinant DNA technology in forestry?
8. List any two applications of genetic engineering in tree improvement.
9. What are synthetic seeds, and how are they used in forestry?
10. Name two conservation strategies used for preserving forest genetic resources.

6 Marks Questions

1. Explain the role of genetic, environmental, and phenotypic factors in determining tree growth and adaptability.
2. Compare and contrast various tree breeding methods, including selection, hybridization, and introduction.
3. Analyze the importance of population viability analysis (PVA) in conservation planning for forest species.
4. Evaluate the significance of plant tissue culture in forestry, focusing on its advantages and limitations.
5. Assess the impact of genetic engineering on forest conservation and the development of transgenic tree varieties.
6. Propose a tissue culture method for rapid clonal propagation of economically important tree species.
7. Develop a forest genetic conservation model incorporating in-situ and ex-situ methods.

14 Mark Questions

1. Analyze the impact of genetic, environmental, and phenotypic expressions on tree growth and adaptability. How do these factors influence forest productivity and conservation?
2. Evaluate various tree breeding methods such as selection, hybridization, and introduction. Discuss their advantages, limitations, and applications in forestry improvement.
3. Analyze the role of plant tissue culture in forestry. Discuss its importance, challenges, and future potential in large-scale tree propagation and conservation.
4. Evaluate the significance of genetic engineering in forestry. How has recombinant DNA technology contributed to forest management, and what are the ethical concerns associated with it?

KU4VACFOR222 FIELD ETIQUETTES IN FORESTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	200-299	KU4VACFOR222	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course is designed to inculcate essential field etiquettes among forestry students and professionals. It emphasizes respectful behaviour, safety protocols, environmental ethics, and effective communication while working in forest ecosystems. The course prepares students for professional field conduct aligned with legal, ecological, and cultural sensitivities.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Recognize the importance of appropriate behaviour and discipline during forestry fieldwork.	***R***
2	Demonstrate adherence to safety measures and environmental ethics in various forest environments.	***A***
3	Analyse legal frameworks and their relevance to ethical field conduct and biodiversity conservation.	***An***
4	Develop professional documentation, communication, and stakeholder engagement skills for fieldwork.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2				✓			
CO 3		✓					✓
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO FIELD DISCIPLINE AND BEHAVIOUR (5 HOURS)**	
	1	Importance of Field Etiquette in Forestry
		a) Role in safety
		b) Essential Safety Gear for Forestry Operators
		c) Conservation and professionalism
	2	Respect for Nature and Local Communities
		a) Cultural sensitivity and awareness in tribal and rural landscapes
		b) Common ethical and behavioural guidelines
2	**MODULE TITLE: SAFETY PROTOCOLS AND PERSONAL CONDUCT (20 HOURS)**	

	1	Personal Safety Measures
		a) Personal Protective Equipment
		b) Protection of Legs and Feet
	2	First Aid Awareness
		a) Chemical hazards
		b) Biological hazards
	3	Forest fire management and control
	4	Ergonomics
	5	Wildlife Encounters and Risk Management
3	**MODULE TITLE: ENVIRONMENTAL ETHICS AND LEGAL COMPLIANCE (10 HOURS)**	
	1	Leave No Trace Principles
		d) Waste disposal, minimizing impact, avoiding disturbance
	2	Code of Conduct in Protected Areas
		d) Respecting boundaries, no collection zones, permits
4	**MODULE TITLE: SAFETY AND HEALTH IN FORESTRY (10 HOURS)**	
	1	Occupational Health and Safety Assessment Series
		a) Regulations concerning Safety and Health Standard
		b) OHSAS 18000
	2	Classification of Accidents
	3	Medical Supervision and Care
	4	First Aid

<table>
<tr><td rowspan="3">5</td><td>Teacher Specific Module</td></tr>
<tr><td><i>Directions: 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.</i></td></tr>
<tr><td>Space to fill the selected area/ activity</td></tr>
</table>

Essential Readings:

1. Apud E., Bostrand L., Mobbs I. & Strehlke B. 1989. Guidelines on ergonomic study in forestry. Geneva, Switzerland, International Labour Organization.
2. Apud, E. & Meyer, F. 2004. Ergonomics. In J. Burley, J. Evans & J.A., Youngquist, eds. Encyclopaedia of Forest Sciences, 2: 639–645.
3. Axelson, O. 1974. Heat stress in forest work: an attempt to evaluate the physical work capacity of forest workers as influenced by a hot climate. Rome, FAO Swedish Funds-in-Trust, No. 74. 31 pp.
4. FAO/ECE/ILO. 1999. Improving working conditions and increasing productivity in forestry. Seminar proceedings. Zvolen, Slovakia, Forest Research Institute.
5. FAO/ECE/ILO. 1996. Safety and health in forestry are possible. Seminar and workshop proceedings, Komolfingen, Switzerland. Bern, Federal Office of Environment, Forests and Landscape.
6. FAO & ILO. 1980. The chainsaw in tropical forest. Rome, FAO.
7. Poschen, P. 1993. Forestry, a healthy and safe profession. Unasylva, 44(172): 3–12. Rome, FAO.
8. Staal-Wasterlund, D. 1998. A review of heat stress research with application to forestry. Applied Ergonomics, 29(3): 179–183.

Reference Distribution:

Module	**Unit**	**Reference No.**
1	1	1
	2	2
	3	3
	4	4

2	1	5
	2	6
	3	6
3	1	7
	2	8
	3	9,10
4	1	11
	2	12

Suggested Readings:

1. International Labour Organization. 2011a. Forestry. In P. Poschen, ed. Encyclopaedia of Occupational Safety & Health, 68. (available at http://www.ilo.org/oshenc/part-x/forestry)

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Total	75

Sample questions to Test Outcome

2 Marks Questions (Short Answer Type)

1. What is the role of field etiquette in ensuring safety during forestry operations?
2. Define 'Leave No Trace' in the context of forestry fieldwork.
3. Mention any two essential personal protective equipment used in the field.
4. What is the significance of respecting local communities during field visits?
5. List any two chemical hazards commonly encountered during forestry surveys.
6. What do you mean by “No Collection Zones”?
7. State any two precautions to be taken while encountering wild animals during fieldwork.
8. What is OHSAS 18000?

6 Marks Questions

1. Explain the importance of cultural sensitivity while conducting fieldwork in tribal or rural areas.
2. Describe the major components of a personal safety protocol for forestry students.
3. Discuss the significance and proper use of first aid during field emergencies.
4. How can ergonomics reduce the risk of injury during forest surveys?
5. Describe the methods of fire control in forest areas and how a student should respond to a fire situation.
6. Outline the key principles of the ‘Leave No Trace’ approach and its relevance to sustainable forestry.
7. Discuss the ethical responsibilities of students working in protected areas.

14 Marks Questions

1. Elaborate on the various types of personal safety measures a forestry student must adopt during fieldwork. Illustrate with examples.
2. Discuss in detail the ethical, cultural, and professional aspects of field behavior in forestry, and how these contribute to conservation and community relationships.
3. Analyze the various risks and hazards involved in forestry fieldwork and explain the strategies to manage them effectively, including first aid, ergonomics, and wildlife encounters.
4. Explain the legal frameworks, field discipline norms, and safety standards applicable to forestry fieldwork. How do they ensure professional conduct and personal well-being?

KU4VACFOR223 TOWARDS ENVIRONMENTAL STEWARDSHIP

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	200-299	KU4VACFOR223	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course aims to instil an ethic of environmental responsibility among students by exploring ecological principles, the human-environment relationship, contemporary environmental challenges, and sustainable practices. It emphasizes personal and collective action towards conservation, climate resilience, and ecological justice.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand key concepts of ecology and environmental science	***U***
2	Develop a stewardship mindset through sustainable practices and community action	***A***
3	Analyze human impact on ecosystems and the biosphere	***An***
4	Critically evaluate global and local environmental challenges	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2				✓			
CO 3		✓					✓
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: FOUNDATIONS OF ENVIRONMENTAL UNDERSTANDING (5 HOURS)**
	1	Definition and scope of environmental stewardship
	2	Principles of ecology and ecosystems
	3	Biodiversity: significance and threats
	4	Indigenous knowledge and environmental ethics
2		**MODULE TITLE: ENVIRONMENTAL ISSUES AND HUMAN IMPACT (10 HOURS)**
	1	Pollution
		a) Types and Causes

		b) Mitigation Measures
	2	Climate change and global warming
	3	Deforestation, desertification, and habitat loss
	4	Urbanization and waste management
	5	Environmental disasters and their management
3	**MODULE TITLE: PATHWAYS TO SUSTAINABILITY (20 HOURS)**	
	1	Concept of sustainability
		a) Sustainability and development indicators
		b) Sustainable Development Goals
		c) Circular economy and green technologies
		d) Green Consumerism
	2	Renewable vs. non-renewable resources
	3	Certification of Sustainable Products
		a) Green Building: Indian Green Building Council (IGBC), LEED and GRIHA (Green Rating for Integrated Habitat Assessment) standards
		b) Forest Stewardship Council (FSC), Rainforest Alliance, Fairtrade International
		c) Ecomark (BIS Environmental Labelling Scheme)
	4	Requirements for sustainability: food security and agriculture
4	**MODULE TITLE: SUSTAINABLE LIFESTYLES AND CIVIC RESPONSIBILITY (10 HOURS)**	
	1	Carbon footprint: causes and reduction strategies

	2	Role of youth in sustainability movements
		a) Fridays for Future
		b) Sunrise Movement
		c) Climate Action Network
	3	Eco-leadership and environmental citizenship
	4	Community-based conservation and participatory governance
5	**Teacher Specific Module**	
	• *Campus audit for sustainability indicators* • *Debate* • *Visit to a certified green building (or virtual tour)* • *Prepare a personal sustainability plan* • *Designing a model eco-friendly home or classroom*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Franco, I.B. and Tracey, J. (2019), "Community capacity-building for sustainable
2. development: Effectively striving towards achieving local community sustainability
3. targets", International Journal of Sustainability in Higher Education, Vol. 20 No. 4, pp.
4. 691-725
5. Our Common Journey: A Transition Toward Sustainability. National Academy Press,
6. Washington D.C. Soubbotina, T. P. 2004.
7. Elliott, Jennifer. 2012. An Introduction to Sustainable Development. 4th Ed. Routledge,
8. London.
9. Rogers, Peter P., Kazi F. Jalal, and John A. Boyd. "An introduction to sustainable
10. development." (2012).

11. Sachs, J. D. 2015. The Age of Sustainable Development. Columbia University Press,
12. New York.
13. Soubbotina, Tatyana P. 2004. Beyond Economic Growth: An Introduction to Sustainable Development. WBI learning resources series. Washington DC ; World Bank.
14. Kerr, Julie. Introduction to energy and climate: Developing a sustainable environment.
15. CRC Press, 2017.
16. Saito, Osamu. Sharing Ecosystem Services. Springer Singapore, 2020.
17. Nhamo, Godwell, and Vuyo Mjimba. Sustainable Development Goals and institutions of higher education. Springer, 2020.

Suggested Readings:

1. Carson, Rachel – *Silent Spring*
2. UNEP – *Global Environment Outlook Reports*
3. Erach Bharucha – *Textbook of Environmental Studies*
4. IPCC Reports – *Climate Change Assessment Reports*
5. Vandana Shiva – *Soil Not Oil*
6. Ministry of Environment, Forest and Climate Change (MoEFCC) – Acts & Notifications

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Marks Questions

1. Define sustainability in one sentence.
2. What is the full form of LEED?
3. Mention any two principles of sustainable development.
4. Name two eco-labels used in India for sustainable products.
5. What is a green building?
6. State one objective of the GRIHA rating system.
7. What does FSC certification stand for?
8. Mention any two features of a sustainable lifestyle.
9. What is the purpose of the Ecomark?
10. Name any two Sustainable Development Goals (SDGs) related to the environment

6 Marks Questions

11. Explain the role of the Forest Stewardship Council (FSC) in promoting sustainability.
12. Differentiate between LEED and GRIHA certification systems.
13. Write a short note on eco-friendly materials used in green buildings.
14. Discuss how the Indian Green Building Council (IGBC) contributes to sustainable construction.
15. List and briefly describe three global agencies that certify sustainable products.
16. How do smart cities incorporate sustainable infrastructure?
17. What are the main environmental benefits of green buildings?
18. Describe the concept of carbon footprint and suggest ways to reduce it.

14 Marks Questions

1. Discuss in detail the importance of sustainable practices in modern society and the role of certification agencies in ensuring sustainability.
2. Explain the concept of green buildings with examples. Highlight their features, benefits, and certification standards.
3. “Sustainable development requires civic engagement.” Justify the statement with reference to youth movements, lifestyle changes, and policy advocacy.
4. Compare and contrast major sustainability certification systems (LEED, GRIHA, FSC, Ecomark) and discuss their relevance in the Indian context.
5. Examine the role of infrastructure and urban planning in promoting sustainability. Use examples of smart cities or eco-villages.
6. Write an essay on the United Nations Sustainable Development Goals (SDGs), focusing on their environmental dimensions and challenges in implementation.

KU4VACFOR224 CITIZEN SCIENCE IN CONSERVATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	200-299	KU4VACFOR224	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: The boundaries between science and society are becoming increasingly porous in today's rapidly evolving world. Citizen science, a collaborative approach that involves nonprofessional individuals in scientific research, is gaining prominence as a powerful tool for addressing complex and pressing challenges. At the same time, scientists are increasingly expected to engage with their communities and consider their work's broader ethical, social, and political implications. This interdisciplinary course explores the intersection of citizen science and the ethical obligations of scientists as responsible and engaged citizens.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe how citizen science contributes to biodiversity and conservation efforts.	***R***
2	Use citizen science platforms (e.g., iNaturalist, eBird) to gather biodiversity data and understand and apply basic methods for data validation and quality control.	***A***
3	Evaluate the strengths and limitations of citizen science in various ecological and social contexts.	***E***

4	Develop a basic citizen science project plan focused on a conservation issue.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2	✓			✓			
CO 3	✓		✓	✓			✓
CO 4	✓	✓				✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: INTRODUCTION TO CITIZEN SCIENCE AND CONSERVATION (15 HOURS)**
	1	Citizen Science
		a) Definition and history of citizen science
		b) Scope of citizen Science
		c) Types of citizen science (contributory, collaborative, co-created)
	2	Definition and scope of conservation biology

	3	Principles of conservation biology
		Biodiversity patterns and values
		Threats to biodiversity
		Conservation strategies
2	**MODULE TITLE: CITIZEN SCIENCE IN CONSERVATION (10 HOURS)**	
	1	The role of citizen science in conservation
	2	Case studies of successful citizen science projects a) Biodiversity monitoring b) Environmental monitoring c) Community-based monitoring
	3	Applications of citizen science in biodiversity and mapping
3	**MODULE TITLE: PRACTICAL APPLICATIONS OF CITIZEN SCIENCE(10 HOURS)**	
	1	Data collection and analysis
	2	Project design and implementation
	3	Communication and engagement
	4	Technology and tools
4	**MODULE TITLE: TOOLS AND PLATFORMS (5 HOURS)**	
	1	Mobile apps
	2	Web platforms
	3	Sensors and Devices
5	**TEACHER SPECIFIC MODULE (5 HOURS)**	

	Directions: 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.
	Space to fill the selected area/ activity

Essential Readings:

1. Christopher A Lepczyk. 2020. Handbook of Citizen Science in Ecology anD Conservation
2. Hunter L Malcom. 1996. Conservation Biology. Blackwell Science. Chicago
3. Kumar and Asija. Biodiversity – Principles and conservation. UpdeshPurohit, Agrobios, Jodhpur
4. Negi, S.S. 1993. Biodiversity and its Conservation in India. India Publishing company, New
5. Caren Cooper., 2016. Citizen Science: How Ordinary People are Changing the Face of Discovery.
6. Darlene Cavalier. 2020. The Field Guide to Citizen Science: How You can Contribute to Scientific Research and Make a Difference.
7. Loree Griffin Burns. 2012. Citizen Scientists: Be a Part of Scientific Discovery from Your Own Backyard.
8. Mary Ellen Hannibal. 2016. Citizen Scientist: Searching for Heroes and Hope in an Age of Extinction
9. Simon Worthington. 2021. Citizen Science Skilling for Library Staff, Researchers and the Public
10. Kristin Frontichiaro. 2017. Citizen Science
11. Alan Irwin. 1995. Citizen Science: A Study of People, Expertise and Sustainable Development.

Suggested Readings:

1. Chandra K Clarke. 2014. Be the Change: Saving the World with Citizen Science.
2. Anna Forrester. 2016. Bat Count: A Citizen Science Story.
3. Heidi E Y Stemple. 2018. Counting Birds: The Idea That Helped Save Our Feathered Friends.
4. Susan Edwards Richmond. 2019. Bird Count.
5. Akiko Busch., 2013. The Incidental Steward: Reflections on Citizen Science.
6. Kathryn Hulick. 2019. Citizen Science: How Anyone can Contribute to Discovery.

7. Grey Landgraf. 2013. Citizen Science for Families: Taking Part in Real Science.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Which biodiversity data collection tool is app-based and uses photographs for species identification?
2. List two benefits of citizen science for conservation researchers.
3. Summarize the main threats to global biodiversity identified by conservation biologists.
4. Discuss how invasive species can disrupt native ecosystems and lead to biodiversity loss.
5. Why is communication important between scientists and citizen participants?
6. Describe the role of local communities in citizen science
7. Summarize the challenges faced by citizen science in conservation.
8. Give an example of a successful citizen science project and describe its conservation impact.
9. Discuss the importance of data validation in citizen science projects.
10. How can citizen science help in managing invasive species or tracking endangered species?
11. Explain how citizen science helps in conserving biodiversity.

6 Mark Questions

1. Compare and contrast traditional scientific research with citizen science in conservation.
2. Distinguish between in-situ and ex-situ citizen science approaches.
3. Identify strengths and weaknesses of citizen-collected data.
4. Design a basic citizen science project to document urban wildlife.
5. Identify strengths and weaknesses of citizen-collected data.
6. Imagine you are organizing a local citizen science project to monitor bird species in your area. What steps would you take to ensure reliable data collection?
7. Propose a campaign to increase youth involvement in conservation through citizen science.

14 Mark Questions

1. Compare and contrast the roles of professional scientists and citizen scientists in conservation research.
2. Analyze the potential risks and benefits of relying on citizen-collected data in scientific studies.
3. Do you think citizen science is a reliable method for gathering conservation data? Support your answer with examples.
4. Evaluate the impact of citizen science on public awareness and policy-making in conservation.
5. Design a new citizen science initiative to track invasive plant species in your region. What tools, methods, and community engagement strategies would you use?

KU4VACFOR225 BIOETHICS AND IPR

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	VAC	200-299	KU4VACFOR225	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course introduces students to the ethical, legal, and social implications of advances in the biological sciences. It explores fundamental issues in bioethics, such as genetic engineering, cloning, and stem cell research, while equipping students with a foundational understanding of intellectual property rights (IPR) as they pertain to biotechnology, biodiversity, and innovation. Through case studies, discussions, and legal frameworks, the course aims to prepare responsible scientists, researchers, and citizens.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	To understand the ethical dimensions of biotechnological research and applications	***U***
2	To promote awareness of the importance of responsible innovation and fair access to biological resources	***A***
3	To analyze contemporary bioethical issues including those involving human, animal, and environmental welfare	***An***

4	Identify complex situations that frequently present legal issues to the stakeholders of intellectual property rights	*E*

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2				✓			
CO 3		✓					✓
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO BIOETHICS (5 HOURS)**	
	1	Definition, scope, and importance of bioethics
	2	Ethical theories and principles
		a) autonomy
		b) beneficence
		c) non-maleficence
		d) justice

	3	Human dignity and rights
	4	Animal ethics and welfare
2	**MODULE TITLE: CODES AND GUIDELINES (10 HOURS)**	
	1	Principles of Bioethics and Application
		a) Belmont Report
		b) Nuremberg code
	2	CIOMS guidelines
	3	Indian codes of ethics
		a) ICMR Ethical Guidelines
		b) General and Specific Principles
		c) Indian Medical Council Act
		d) Schedule Y
		e) Indian Good Clinical Practice Guidelines
	4	Clinical Trial Registry of India
	5	Ranjith Roy Choudhry report
3	**MODULE TITLE: INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS (15 HOURS)**	
	1	Introduction to IPR
		a) Meaning of property; Origin & Nature
		b) Meaning of Intellectual Property Rights
	2	Kinds of Intellectual property rights
		a) Copy Right, Patent, Trade Mark

		b) Trade Secret and trade dress
		c) Design & Layout Design
		d) Geographical Indication
		e) Plant Varieties and Traditional Knowledge
	3	Patent Rights
		a) Indian Patent Act
		b) Criteria for patentability: novelty, utility, and non-obviousness
		c) Registration Procedure and Documentation
	4	Copy Rights
		a) Definition &Types of Copy Right,
		b) Registration Procedure and Documentation
		c) Piracy & Infringement
4	**MODULE TITLE: IPR AND BIODIVERSITY (10 HOURS)**	
	1	International treaties and conventions:
		a) TRIPS (WTO)
		b) Convention on Biological Diversity (CBD)
		c) International Union for the Protection of New Varieties of Plants
		d) Nagoya Protocol on Access and Benefit Sharing
	2	Indian laws and policies:
		a) Protection of Plant Varieties and Farmers' Rights Act (PPV&FR)
		b) Biological Diversity Act (2002)
	3	Traditional knowledge and IPR

	4	Bio piracy
5	**TEACHER SPECIFIC MODULE (5 HOURS)**	
	- *Patent review of a biotech product* - *Ethical analysis of a gene-editing technology* - *Case study on biopiracy involving Indian traditional knowledge* - *Analysis of IPR protection in local plant varieties* - *GI products of Kerala*	
	Space to fill the selected area/ activity	

Essential Readings:

1. ALEXANDRA GEORGE-CONSTRUCTING INTELLECTUAL PROEPRTY(CUP2012)
2. UN SUBCOMMISSION ON THE PROMOTION AND PROTECTIONOF HUMAN RIGHTS RESOLUTION 200/7 INTELLECTUAL PROPERTY AND HUMAN RIGHTS UN DOC.e/CN.4. SUB 2/RES/2000/7; 17TH AUGUST 2000.
3. Prabuddha Ganguli, (2001): Intellectual Property Rights. Tata McGraw Hill.
4. W.R. Cornish, (2013): Intellectual Property: Patents, Copyright, Trade Marks and Allied Rights. Sweet and Max Well London
5. Blakeney, (1996), Trade Related Aspects of Intellectual Property Rights: A Concise
6. Guide to the TRIPS Agreement. Sweet and Max Well London
7. Beauchamp TL, Childress JF [2011]. Principles of Biomedical Ethics. Edition 5. Oxford
8. University Press, New York.
9. Timms O [2016]. Biomedical Ethics. Edition 1. Elsevier
10. Ethical Guidelines for Biomedical Research on Human Research, ICMR, 2006
11. International Ethical Guidelines for Biomedical Research Involving Human Subjects,
12. CIOMS, 2002
13. United States. (1978). The Belmont report: Ethical principles and guidelines for the
14. protection of human subjects of research. Bethesda, Md.: The Commission.
15. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310[20]:2191-4.
16. The Nuremberg Code (1947) In: Mitscherlich A, Mielke F. Doctors of infamy: the story of the Nazi medical crimes. New York: Schuman, 1949

17. Drug and Cosmetic rules, Schedule Y, 2005
18. [http://cdsco.nic.in/html/D&C_Rules_Schedule_Y.pdf]
19. Indian Good Clinical Practice Guidelines [http://www.cdsco.nic.in/html/GCP1.html}
20. Report of the Prof. Ranjit Roy Chaudhury Expert Committee. 2013
21. [http://www.cdsco.nic.in/writereaddata/Report_of_Dr_Ranjit_Roy.pdf]

Suggested Readings:

1. Beauchamp & Childress – *Principles of Biomedical Ethics*
2. Krishna Veni – *Bioethics and Biosafety*
3. Subbaram N.R. – *Intellectual Property Rights*
4. B. D. Singh – *Biotechnology: Expanding Horizons*
5. S.B. Rao – *Bioethics and Biosafety*

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Marks Questions

1. Define bioethics.
2. What is the principle of autonomy in bioethics?
3. Name any two ethical issues related to genetic engineering.
4. What is a patent?
5. Mention any one international treaty related to biodiversity.

6. Define biopiracy.
7. What are the 3Rs in animal research ethics?
8. State one function of the World Intellectual Property Organization (WIPO).
9. What is the Biological Diversity Act (2002) in India?
10. What does TRIPS stand for?

6 Marks Questions

1. Explain the difference between animal rights and animal welfare.
2. Discuss the ethical concerns related to cloning.
3. Describe the patentability criteria for biotechnological inventions.
4. What are the key objectives of the Convention on Biological Diversity (CBD)?
5. Explain the role of ethics committees in biomedical research.
6. Briefly describe the Nagoya Protocol and its significance.
7. Discuss the ethical implications of gene editing technologies like CRISPR-Cas9.
8. Write a short note on traditional knowledge and IPR.

14 Marks Questions

1. Discuss the principles of bioethics and their application in contemporary biomedical research.
2. Examine the role of intellectual property rights in promoting innovation and protecting biodiversity.
3. Analyze the ethical and legal challenges posed by cloning and stem cell research.
4. Discuss the importance of international treaties like TRIPS and CBD in regulating biotechnology and biodiversity conservation.
5. Explain the concept of biopiracy with relevant examples, and suggest measures to prevent it.
6. Evaluate the impact of patent laws on farmers' rights and access to genetic resources in India.
7. Write an essay on the ethical considerations and legal frameworks governing the use of animals in research.

KU4SECFOR230 DENDROLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	SEC	200-299	KU4SECFOR230	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course provides an introduction to the study of trees and the basic principles of plant classification and nomenclature. Students will learn about different systems of plant classification including artificial, natural, and phylogenetic systems, with a focus on the Bentham and Hooker classification. The course also covers the objectives and principles of plant nomenclature under the International Code of Botanical Nomenclature (ICBN). Practical skills such as the use of identification keys, preparation of herbaria, and the role of vegetative morphology in tree identification will be developed. Major angiosperm families important in forestry, and ecology will be studied, including their diagnostic features, floral formula, and economic significance.

Course Prerequisite

- Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the definition, scope, and importance of dendrology and State the principles and objectives of plant nomenclature (ICBN).	***U***

2	Use identification keys (indented and bracketed) to identify tree species, Prepare and maintain a herbarium specimen correctly, Identify trees using vegetative morphological characters such as bole, bark, leaves, and exudations.	***A***
3	Differentiate between artificial, natural, and phylogenetic classification systems, Analyze the diagnostic features and systematic positions of major angiosperm families, Interpret floral formulas and their significance in plant identification.	***An***
4	Analyze the diagnostic features and systematic positions of major angiosperm families, Interpret floral formulas and their significance in plant identification.	***An***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create ©

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓		✓			
CO 2							
CO 3	✓	✓			✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF DENDROLOGY AND PLANT CLASSIFICATION (10 HOURS)**	
	1	Definition, scope, and importance of Dendrology

		a) Artificial classification
		b) Natural classification
		c) Phylogenetic classification
	2	Bentham and Hooker classification system
2	**MODULE TITLE: NOMENCLATURE AND IDENTIFICATION TECHNIQUES (10 HOURS)**	
	1	Plant nomenclature: Objectives and principles of ICBN (International Code of Botanical Nomenclature)
	2	Identification keys
		a) Indented keys
		b) Bracketed keys
	3	Herbaria: Preparation, labelling, and significance
3	**MODULE TITLE: VEGETATIVE MORPHOLOGY IN TREE IDENTIFICATION (10 HOURS)**	
	1	Role of vegetative characters in identification
		a) Bark
		b) Blaze
		c) Exudations
		d) Leaves
		e) Glands
4	**MODULE TITLE: SYSTEMATICS OF MAJOR ANGIOSPERM FAMILIES (10 HOURS)**	
	1	Systematic position, diagnostic features, floral formula, economic importance, and key members of the following families

		a) Annonaceae
		b) Dipterocarpaceae
		c) Tiliaceae
		d) Meliaceae
		e) Rutaceae
		f) Anacardiaceae
		g) Myrtaceae
		h) Leguminosae (Fabaceae, Caesalpiniaceae, Mimosaceae)
		i) Rhizophoraceae
		j) Apocynaceae
		k) Bignoniaceae
		l) Verbenaceae
		m) Casuarinaceae
5	**Teacher Specific Module (5 Hours)**	
	Directions: 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.	
	5.17 Field visit to study the morphological characteristics and develop indented and bracketed keys for a selected group of plants 5.18 Identify and record vegetative characters (bole, bark, blaze, leaves, exudates, glands) of 5–10 trees 5.19 Collection, pressing, drying, mounting, and labelling of at least 5 plant specimens 5.20 Preparation of Keys for the trees of campus/botanical garden 5.21 Invited lecture from a taxonomist fill the selected area/ activity	

Essential Readings:

1. Sambamurthy, A. V. S. S. 2005. Taxonomy of Angiosperms. I.K International Pvt. Ltd. 892 p.
2. Jeffrey, C. 1982. An Introduction to plant taxonomy. Allied publishers. 154p
3. Henry, A. N. and Chandrabose, M. 1980. An Aid to the International Code of Botanical Nomenclature. Today and Tomorrow printers and publishers. 100p.
4. Johri, R. M and SnehLata. 2005. Taxonomy- 1 (Systematics and Morphology). SonaliPublications. 340 p
5. Johri, R. M and SnehLata. 2005. Taxonomy- 2 (Polypetalae). Sonali Publications. 300 p
6. Johri, R. M and SnehLata. 2005. Taxonomy- 3 (Gamopetalae). Sonali Publications. 190p

Reference Distribution:

Module	Unit	Reference No.
1	1	1
	2	2
2	1	3
	2	3
	3	3
3	1	4
4	1	5,6

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10

c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define dendrology and explain its scope in plant science.
2. State the main objectives of the International Code of Botanical Nomenclature (ICBN).
3. List the major vegetative characters used in tree identification.
4. Explain the structure and purpose of indented and bracketed keys.
5. Describe the process of herbarium specimen preparation.

Mark Questions

1. Compare artificial, natural, and phylogenetic systems of classification with suitable examples.
2. Differentiate between indented and bracketed keys in terms of structure and application.
3. Compare the vegetative and floral features of the families Annonaceae and Apocynaceae.

14 Mark Questions

1. Analyze the diagnostic features of the family Fabaceae and explain how they aid in its identification.
2. Interpret the floral formula of a member of the Rutaceae family and relate it to its floral structure.
3. Examine the vegetative characters (bole, bark, exudate, leaves) of two local trees and discuss their significance in field identification.

KU4SECFOR231 ORNITHOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	SEC	200-299	KU4SECFOR231	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0	-	25	50	75	1.5

Course Description: This course explores the biology, ecology, and conservation of birds, covering anatomy, physiology, behaviour, taxonomy, and their roles in ecosystems. Fieldwork includes bird identification, survey techniques, and habitat assessment.

Course Prerequisite:

- Basic knowledge of Ecology
- Ability to conduct fieldwork

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe avian anatomy, physiology, and adaptations.	U
2	Analyze bird behavior and communication strategies.	An
3	Apply field techniques for bird identification and surveys.	A
4	Evaluate conservation challenges and strategies for avian species.	E

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓		✓			✓
CO 2	✓	✓		✓		✓	✓
CO 3	✓	✓	✓	✓	✓		✓
CO 4	✓	✓	✓	✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE 1: AVIAN BIOLOGY & ADAPTATIONS (5 HOURS)**	
	1	Ornithology
		a) Characteristics and adaptations of birds
		b) Renowned ornithologists and their contribution
	2	Feathers & Flight Mechanics
		a) Types of feathers
		b) Molting
		c) Types of flights
2	**BIRD IDENTIFICATION TECHNIQUES (10 HOURS)**	
	1	Bird identification features

		a) Visual Identification
		b) Auditory identification
	2	Techniques for bird watching
		a) Principles of Bird Watching
		b) Bird Watching Equipment and Tools
		c) Techniques for Effective Bird Watching
3	**MODULE 3: TAXONOMY OF BIRDS (15 HOURS)**	
	1	Bird Classification
		a) Major orders and families
	2	Survey Methods
		a) Point counts
		b) transects
		c) banding techniques
4	**MODULE 4: CONSERVATION & HUMAN IMPACTS (10 HOURS)**	
	1	Threats to Birds
		1. Habitat loss
		a) climate change
		b) pollution
	2	Conservation Strategies
		a) Protected areas
		b) captive breeding
		c) citizen science (e.g., eBird)

	3	Birds in Culture & Economy
5	**Teacher Specific Module (5 Hours)**	

Essential Readings:

1. Williams, T.D., 2012. *Physiological adaptations for breeding in birds*. Princeton University Press.
2. Birkhead, T.R. and Charmantier, I., 2009. History of ornithology. *eLS*.
3. Bostwick, K., 2016. Feathers and plumages. *Handbook of Bird Biology.–3rd ed.–Wiley*, pp.101-148.
4. Henderson, C.L., 2008. *Birds in flight: the art and science of how birds fly*. Voyageur Press.
5. Praveen, J., Jayapal, R. and Pittie, A., 2020. Taxonomic updates to the checklists of birds of India, and the South Asian region—2020. *Indian Birds*, *16*(1), pp.12-19.
6. Buff, S., 2010. *Birding for Beginners: A Comprehensive Introduction to the Art of Birdwatching*. Rowman & Littlefield.
7. Wetmore, A., 1960. A classification for the birds of the world. *Smithsonian Miscellaneous Collections*.
8. Gregory, R.D., Gibbons, D.W. and Donald, P.F., 2004. Bird census and survey techniques. *Bird ecology and conservation*, pp.17-56.
9. Lees, A.C., Haskell, L., Allinson, T., Bezeng, S.B., Burfield, I.J., Renjifo, L.M., Rosenberg, K.V., Viswanathan, A. and Butchart, S.H., 2022. State of the world's birds. *Annual Review of Environment and Resources*, *47*(1), pp.231-260.
10. Hundal, S.S., 2004, March. Wildlife conservation strategies and management in India: an overview. In *Proceedings of the species at risk 2004 pathways to recovery conference, Victoria conference centre, BC, Canada* (pp. 2-6).

11. Khadher, R. and Aiyadurai, A., Human-bird Relations: Religious and Cultural Significance in India.

Reference Distribution:

Module	Unit	Reference No.
1	1	1,2
	2	3,4
2	1	5
	2	6
3	1	7
	2	8
4	1	9
	2	10
	3	11

Suggested Readings:

1. Morrison, M.L., Rodewald, A.D., Voelker, G., Colón, M.R. and Prather, J.F. eds., 2018. *Ornithology: foundation, analysis, and application*. JHU Press.
2. Mainwaring, M.C., 2017. Why birds matter: avian ecological function and ecosystem services. *The Condor: Ornithological Applications*, *119*(2), pp.354-355.
3. Dunne, P., 2012. *The Art of Bird Identification: A Straightforward Approach to Putting a Name to the Bird*. Stackpole Books.
4. Dunne, P., 2003. *Pete Dunne on bird watching: The how-to, where-to, and when-to of birding*. Houghton Mifflin Harcourt.
5. Fuller, R.J. ed., 2012. *Birds and habitat: relationships in changing landscapes*. Cambridge University Press.
6. Wallace GJ and HD Mahan. 20015. An introduction to ornithology. Mc Million Publishing Company, New York.
7. Collias, N.E. and Collias, E.C., 2014. *Nest building and bird behavior* (Vol.857). Princeton University Press.

8. Newton, I., 2023. *The migration ecology of birds*. Elsevier.
9. Ali, S., 1979. Bird study in India: its history and its importance. *India International Centre Quarterly*, *6*(2), pp.127-139.
10. Shyamal, L., 2007. Opinion: Taking indian ornithology into the information age. *Indian Birds*, *3*(4), pp.122-137.
11. Chandler, M., See, L., Copas, K., Bonde, A.M., López, B.C., Danielsen, F., Legind, J.K., Masinde, S., Miller-Rushing, A.J., Newman, G. and Rosemartin, A., 2017. Contribution of citizen science towards international biodiversity monitoring. *Biological conservation*, *213*, pp.280-294.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. List any two key characteristics that distinguish birds from mammals.
2. What are flight feathers? Mention their types.
3. Explain the role of feathers in bird thermoregulation.
4. Name two renowned ornithologists and their contributions.
5. What is molting in birds?
6. List any two purposes of bird calls.
7. Differentiate between song and call in birds
8. Name any two bird behaviors observed during courtship.
9. What is mimicry in birds? Name a bird known for this behavior.

10. Mention two ways birds use visual signals for communication.

6 Mark Questions

1. Describe how you would conduct a birdwatching field trip in a forested area. What key preparations and tools would you use?
2. Explain the steps involved in identifying a bird using both visual and auditory features during a survey.
3. Design a simple checklist for bird observation during a transect walk.
4. Analyze how environmental factors like light and noise pollution can affect bird communication.
5. Interpret the courtship and territorial behaviors in birds and explain how they relate to species survival.
6. Examine flocking behavior in birds and explain the possible ecological benefits.
7. Analyze bird migration patterns and discuss the role of navigation cues such as the sun, stars, and magnetic fields.

14 Mark Questions

1. Design a bird conservation plan for your local area or campus. Include survey methods, community engagement, and monitoring tools.
2. Create a proposal for a public awareness campaign on bird conservation using social media, education, and citizen science.
3. Develop a conservation strategy that integrates indigenous knowledge systems with modern ecological approaches to protect a specific bird species.
4. Create a model for an eco-tourism initiative centered around birdwatching that balances conservation and livelihood goals.

KU4SECFOR232 HERPETOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	SEC	200-299	KU4SECFOR232	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course provides an in-depth study of amphibians and reptiles, collectively known as herpetofauna. Students will explore the taxonomy, anatomy, physiology, behavior, ecology, evolution, and conservation of these ectothermic vertebrates. Through lectures, discussions, and (if applicable) hands-on laboratory or fieldwork, students will develop skills in species identification, ecological monitoring, and data analysis. Emphasis is placed on understanding the ecological roles of herpetofauna, their adaptations to diverse environments, and current challenges they face due to habitat loss, climate change, and disease. The course also covers global and regional diversity, with examples from local ecosystems where possible.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify major groups of amphibians and reptiles and describe their evolutionary relationships	***R***
2	Analyze herpetological data and interpret ecological patterns	***An***
3	Evaluate the significance of herpetofauna in ecosystems and conservation biology.	***E***
4	Create knowledge and conduct basic field or laboratory techniques used in herpetological research.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓						
CO 2	✓	✓					
CO 3		✓	✓		✓		
CO 4			✓	✓	✓	✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE 1: INTRODUCTION TO HERPETOLOGY (10 HOURS)**	
	1	Evolution of Reptiles and Amphibians
	2	Systematics and biogeography of herpetofauna
	3	Major Reptiles and Amphibians of India with reference to Western ghats
	4	Characteristic features of Reptile and Amphibians
2	**MODULE 2: REPRODUCTION AND BEHAVIOUR OF HEPETOFAUNA (10 HOURS)**	
	1	Reproduction in Herpetofauna
		a) Breeding biology of Reptiles and Amphibia
		b) Role of temperature in sex determination of Reptiles

	2	Behaviour of Herpetofauna
		a) Reproductive behaviour
		b) Defensive mechanism
		c) Thermoregulation
		d) Adaptative mechanism
3	**MODULE 3: SNAKES OF INDIA (5 HOURS)**	
	1	Identification of venomous and non- venomous snakes in India
	2	Snake bite
		a) Venom
		b) Anti venom
		c) First aid and management of snake bite cases
4	**MODULE 4: CONSERVATION BIOLOGY OF HERPETOFAUNA (15 HOURS)**	
	1	Endemism
		a) Rarity and extinction of species of herpetofauna
		b) Threats and causes of extinction
	2	Conservation and management of Indian herpetofauna
		a) Major Ex-situ conservation in India
		b) Captive breeding of herpetofauna
	3	Population surveys and census techniques for herpetofauna
	4	Conservation problems and challenges of herpetofauna in Indian subcontinent
5	**Teacher Specific Module (5 Hours)**	

	Directions: Describe the ecological roles and importance of herpetofauna. Practice the ethical field observation and data collection method. Discuss threats to reptiles and amphibians including habitat destruction and climate change

Essential Readings

1. Zug, G. R., Vitt, L. J., & Caldwell, J. P. (2001).
   Herpetology: An Introductory Biology of Amphibians and Reptiles (2nd or 3rd Ed.).
2. Pough, F. H., Andrews, R. M., Cadle, J. E., Crump, M. L., Savitzky, A. H., & Wells, K. D. (2015).
   Herpetology (4th Ed.).
3. Whitaker, R., & Captain, A. (2004).
   Snakes of India: The Field Guide.
4. Daniel, J. C. (2002).
   The Book of Indian Reptiles and Amphibians.
   Bombay Natural History Society (BNHS).
5. Dinesh, K. P., Radhakrishnan, C., et al. (2013).
   Amphibians of India: Updated Checklist and Distribution.
6. IUCN SSC Amphibian and Reptile Specialist Group Publication Species status reports, Red List assessments, and habitat conservation guidelines.
7. Heatwole, H., & Wilkinson, J. W. (2009).
   Amphibian Biology (multi-volume series).
8. Murthy, T. S. N. (1990).
   A Field Guide to the Amphibians and Reptiles of the Western Ghats.
   Zoological Survey of India (ZSI).
9. Dash, M. C., & Mahanta, L. (1993).
   Ecology, Distribution and Conservation of Amphibians and Reptiles in India.
   Environment and Ecology.

Reference Distribution:

Module	**Unit**	**Reference No.**
1	1	1
	2	5
	3	8
	4	1,2,4

2	1	1,2
	2	2
3	1	3
	2	3
4	1	6
	2	9
	3	6
	4	9

Suggested Readings:

- Herpetology – *Laurie J. Vitt & Janalee P. Caldwell*
- Biology of Amphibians – *William E. Duellman & Linda Trueb*
- Reptile Ecology and Conservation – *Edited by C. Kenneth Dodd Jr.*
- Amphibians of Peninsular India – *R. Biju et al.*
- Snakes of India: The Field Guide – *Romulus Whitaker & Ashok Captain*
- A Photographic Guide to Snakes and Other Reptiles of India – *Indraneil Das*

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10

c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define ectothermy and explain how it affects reptilian behavior.
2. What are the major distinguishing features between amphibians and reptiles?
3. List any three families of Indian amphibians and give one example species from each.
4. Describe the structure and function of amphibian skin.
5. What is tail autotomy? Which groups of reptiles use this defense mechanism

6 Mark Questions

1. Describe the role of herpetofauna in forest ecosystems and their significance in ecological balance.
2. Explain the reproductive strategies of frogs and compare them with those of snakes
3. Analyze the impacts of deforestation and forest fragmentation on herpetofaunal diversity.
4. Explain how temperature-dependent sex determination works in reptiles, with examples.
5. Differentiate venomous and non- venomous snakes of India with examples

14 Mark Questions

1. Describe the major taxonomic groups of reptiles and amphibians found in India. Highlight distinguishing characteristics and give two examples from each group.
2. Explain the physiological and ecological adaptations of amphibians and reptiles that enable them to survive in forest ecosystems. Illustrate with examples from Indian species.
3. Design a year-long community-based conservation program for the protection of amphibians and reptiles in a forest area facing biodiversity loss. Include objectives, methods, stakeholder involvement, and evaluation tools.

KU4SECFOR233 FOREST BIOMETRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
4	SEC	200-299	KU4SECFOR233	3	45

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: Forest Biometry involves the application of statistical and mathematical principles to the measurement and analysis of forest resources. This course enables students to understand, measure, analyse, and model forest stand parameters such as tree diameter, height, volume, and biomass. It also covers growth and yield modelling and the use of statistical tools in forest inventory and data interpretation.

Course Prerequisite:

Ability to write examinations in English.

Course Outcomes:

CO No	Expected Outcome	Learning Domains
1	To understand the concepts and importance of forest measurement	***U***
2	To make forest inventory reports that support specific multiple land management objectives	***A***
3	To analyse forest inventory data to project future stand conditions	***An***
4	Develop skills in the measurement of tree and stand attributes	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓				
CO 2				✓			
CO 3		✓					✓
CO 4				✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: INTRODUCTION TO FOREST BIOMETRY (10 HOURS)**
	1	Definition, scope, and importance of forest biometry
	2	Measurement of tree dimensions
		a) diameter
		b) height
		c) Tree form; Metgerz's Theory
		d) bark thickness
	3	Instruments used
		a) calipers

		b) diameter tape
		c) clinometer
		d) relascope
		e) hypsometer
	4	Measurement errors and precision
		a) sources and types of errors
		b) Concepts of accuracy
2	**MODULE TITLE: DETERMINATION OF TREE PARAMETERS (10 HOURS)**	
	1	Measurement of Volume of Trees
		a) Quarter girth formula
		b) Volume Table
	2	Solid volume of firewood
		a) Xylometric method
		b) Specific gravity method
		c) Measurement of Branch wood
		d) Biomass Estimation
	3	Dendrochronology
	4	Age determination
		a) Stem analysis
		b) Stump analysis
		c) Increment boring
3	**MODULE TITLE: EVALUATION OF SITE QUALITY (10 HOURS)**	

	1	Site Quality
		a) Site quality determination by evaluation of site factors
		b) Site quality determination by evaluation of vegetative factors
		c) Site quality determination by evaluation of site factors
		d) Evaluation of site quality by using tree characteristics:
	2	Fractional quality
	3	Importance of site quality
	4	Determination of site index
4	**MODULE TITLE: FOREST INVENTORY (10 HOURS)**	
	1	Forest Inventory; Definition and Scope
	2	Forest Enumeration
		a) Total or complete enumeration
		b) Partial enumeration
		c) Factors deciding the choice of kind enumeration
	3	Sampling
		a) advantages of sampling
		b) kinds of sampling
		c) Sampling units
		d) Laying out of sampling plot
		e) Sampling intensity
	4	Point sampling
		a) Horizontal point sampling; concept and instruments used

		b) Vertical point sampling; concept and instruments used
5	**Teacher Specific Module (5 HOURS)**	
	- *Calculations of volume of felled as well as standing trees;* - *Volume table preparation;* - *Application of different sampling methods;* - *Preparation of yield and stand table;* - *Quantification of regeneration and stand establishment;* - *Measurement of crown density and crown ratios;* - *Crown profiling of trees and stand;* - *Dendrochronological studies.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Chaturvedi AN and Khanna LS. 1994. Forest Mensuration. International Book Distributor.
2. Ram Parkash 1983. Forest Surveying. International Book Distributor.
3. Sharpe GW, Hendee CW and Sharpe WE. 1986. Introduction to Forestry.
4. McGraw-Hill. Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh Mahender Pal Singh, Dehradun

Suggested Readings:

1. Husch, B., Beers, T.W., & Kershaw, J.A. – *Forest Mensuration*
2. Philip, M.S. – *Measuring Trees and Forests*
3. Avery, T.E., & Burkhart, H.E. – *Forest Measurements*
4. Gregoire, T.G., & Valentine, H.T. – *Sampling Strategies for Natural Resources and the Environment*
5. FAO Manuals on Forest Inventory and Biomass Estimation

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Marks Questions

1. Define forest biometry.
2. What is the difference between precision and accuracy?
3. Name two instruments used for measuring tree height.
4. Define form factor.
5. What is a volume table?
6. Explain the term “sampling intensity.”
7. What is mean annual increment (MAI)?
8. Mention any two types of sampling methods used in forest inventory.
9. Write the formula for calculating the volume of a cylinder.
10. What is a site index?

6 Marks Questions

1. Explain the sources and types of errors in forest measurements.
2. Describe the construction and use of local volume tables.
3. Differentiate between systematic and stratified sampling with examples.
4. Write a short note on destructive and non-destructive biomass estimation methods.
5. Explain current annual increment (CAI) and its significance in forest management.

6. Discuss the Bitterlich method of angle count sampling.
7. Describe the various types of plots used in forest inventory.
8. What are the differences between empirical and process-based growth models?

14 Marks Questions

1. Explain the different methods used for measuring tree volume. Discuss the advantages and limitations of each.
2. Describe in detail the process of conducting a forest inventory using systematic sampling.
3. Elaborate on the various growth and yield models used in forestry. How are these models used for forest management planning?
4. Explain the role of forest biometry in sustainable forest resource management. Include tools, methods, and data interpretation techniques.
5. Discuss in detail the procedure and importance of biomass estimation in forest ecosystems. Include examples of allometric equations.
6. Write an essay on forest measurement errors. How can these be minimized or corrected during field surveys?

KU5DSEFOR301 FOREST MENSURATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCFOR301	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: Forest Mensuration deals with the science of measurement of trees, forests, and forest produce. This course covers concepts and methods for measuring tree dimensions such as diameter, girth, height, bark thickness, and volume. It also focuses on understanding tree form, increment, yield, and principles of forest management. Emphasis is placed on developing skills in using instruments, data analysis, and applying measurement techniques to sustainable forest management.

Course Prerequisite: Basic knowledge of dendrology, taxonomy, and environmental science at the undergraduate level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the concepts, objectives, and scope of forest mensuration.	***U***

2	Demonstrate skills in measuring diameter, girth, height, and volume of trees using standard instruments.	***A***
3	Analyze tree form, increment, yield, and prepare volume tables for forest stands.	***An***
4	Evaluate forest management concepts like rotation, yield regulation, and growing stock estimation.	***E***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓	✓					
CO 2	✓	✓	✓	✓			
CO 3	✓	✓	✓	✓	✓		
CO 4	✓	✓	✓	✓	✓	✓	✓

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**	**HOURS**
	MODULE TITLE: DIAMETER AND GIRTH MEASUREMENT OF TREES (10 Hours)		
1	1	Forest Mensuration - definition, objectives, scope.	
	2	Units of measurement.	
	3	Breast height measurement-advantages and standard rules.	

	4	Measurement of diameter and girth	
		a) instruments used, merits and demerits	
		b) measurement of upper stem diameter	
	5	Bark thickness-instrument used	
		a) conversion of GOB to GUB	
		b) conversion of DOB to DUB	

2	**MODULE TITLE: TREE HEIGHT MEASUREMENT (20 Hours)**		
	1	Definitions	
		a) total height, bole height, commercial bole height	
		b) crown point, crown height, crown length.	
	2	Methods of height measurement	
		a) Ocular estimation	
		b) non-instrumental methods	
		c) Instrumental methods based on geometric principles	
		d) Instrumental methods based on trigonometric principles	
	3	Measurement of cross-sectional area, basal area, and leaf area.	
	4	Tree stem form	
		a) Metzger's theory	
		b) form factor - types	
		c) form height	
		d) form quotient	

		e) form class	

3	**MODULE TITLE: TREE VOLUME MEASUREMENT (20 Hours)**		
	1	Definitions	
		a) Commercial volume	
		b) standard stem timber volume	
		c) small timber volume	
	2	Calculation of volume of felled trees	
		a) Smalian's formula	
		b) Huber's formula	
		c) Prismoidal/Newton's formula	
		d) Quarter girth formula	
	3	Volume of standing trees	
		a) Ocular and partly ocular methods	
		b) direct and indirect methods	
		c) Volume tables – classification and preparation	
		d) Measurement of branch wood and root wood – solid volume and stacked volume	
	4	Increment-classification, relationship between CAI and MAI	
		a) Determination of tree age	
		b) Stump analysis and stem analysis	
		c) Measurement of tree crops: crop diameter, crop height, crop age, crop volume.	

4	**MODULE TITLE: FOREST MANAGEMENT (20 Hours)**		
	1	Definition, scope, objectives, and principles of forest management	
		a) Forest management as an art and science	
		b) Forest management in relation to industrial and agricultural management	
		c) Organization and control of forest property and personnel	
	2	Rotation – types, factors determining length and choice of rotation	
	3	Concepts of yield and Growing stock	
		a) sustained yield and progressive yield	
		b) Normal forest – definition and concept	
		c) Causes of abnormality in forests	
	4	Yield regulation – definition, objectives, methods	
		a) area-based	
		b) volume-based	
		c) area and volume-based	
		d) Increment percent	
5	**Teacher Specific Module (5 Hours)**		
	Directions: Teachers may choose themes relevant to the course, such as local case studies, recent innovations, applied practices, or entrepreneurship opportunities. The teaching approach should emphasize experiential learning, creativity, and project-based activities (e.g., assignments, group discussions, mini-projects, field-based tasks). Assessment may include class tests, assignments, project reports, or presentations.		

	Space to fill the selected area/ activity	5

Essential Readings:

1. Chaturvedi, A.N and Khanna,L.S (1982) Forest Mensuration , International Book Distributors, Dehra Dun
2. Husch, B, Bers, T.W and Kershaw, J (2003). Forest Mensuration, John Wiley & Sons. INC, USA.
3. Husch,B,Miller,C and Bers, (1972) Forest Mensuration, Ronald Press company, New York
4. Philip, M.S, (1994). Measuring tree and forests, CAB International, UKRamprakash. 2001.
5. Forest management. International Book Distributors. Dehradun 256p
6. Negi, S.S. 1984. Scientific management of forest. Bishen Singh Mahendra Pal Singh,
7. Dehradun. 123 p. Avery, T.E. & Burkhart, H.E. (2015). *Forest Measurements*. McGraw Hill.
8. Philip, M.S. (1994). *Measuring Trees and Forests*. CAB International.
9. Husch, B., Beers, T.W., & Kershaw, J.A. (2002). *Forest Mensuration*. John Wiley & Sons.
10. FAO (1998). *Manual of Forest Inventory*. FAO, Rome.

Suggested Readings:

1. Prodan, M. (1968). *Forest Biometrics*. Pergamon Press.
2. Van Laar, A. & Akça, A. (2007). *Forest Mensuration*. Springer.
3. West, P.W. (2015). *Tree and Forest Measurement*. Springer.
4. Alder, D. (1980). *Forest Volume Estimation and Yield Prediction*. FAO, Rome.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks (Short Answer Type)

1. Define forest mensuration.
2. What is breast height? State its advantages.
3. Differentiate between GOB and GUB.
4. Name two instruments used for measuring tree diameter.
5. Define crown height.
6. What is bole height?
7. Mention two ocular methods of tree height measurement.
8. Define form factor.
9. What is Smalian’s formula?
10. Define Commercial volume.
11. Write short notes on stump analysis.
12. Differentiate between CAI and MAI.
13. What is a normal forest?
14. State the concept of sustained yield.
15. Write any two causes of abnormality in forests.

6 Marks (Medium Answer Type)

1. Explain the objectives and scope of forest mensuration.
2. Describe the standard rules for measuring breast height.
3. Discuss the instruments used for upper stem diameter measurement.
4. Explain the geometric principles of tree height measurement.
5. Differentiate between total height, crown height, and crown length with diagrams.
6. Describe the concept of form quotient and form class.
7. Explain Huber’s formula and Prismoidal formula for volume calculation.
8. What are volume tables? Explain their classification.
9. Describe the methods of determining tree age.
10. Discuss the relationship between CAI and MAI.
11. Explain the concept of rotation and the factors influencing its length.
12. Differentiate between sustained yield and progressive yield.
13. Explain yield regulation based on area.
14. Write short notes on organization and control of forest property.
15. Discuss the importance of growing stock assessment.

14 Marks (Long Answer / Essay Type)

1. Discuss in detail the methods of measuring tree diameter and girth, including instruments, merits, and demerits.
2. Explain the instrumental methods of tree height measurement based on trigonometric principles. Illustrate with diagrams.
3. Describe Metzger's theory of stem form and explain different types of form factors.
4. Explain the methods of calculating volume of felled trees with suitable formulas.
5. Describe the methods of measuring the volume of standing trees.
6. Discuss increment studies in detail, with emphasis on stump analysis and stem analysis.
7. Explain the principles of forest management and its scope in modern forestry.
8. Describe the concept of rotation. Explain different types and the factors determining rotation length.
9. Explain the concepts of sustained yield and progressive yield. How is yield regulated based on area and volume?
10. Write an essay on causes of abnormality in forests and their management implications.

KU5DSCFOR302 FOREST HEALTH AND PROTECTION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCFOR302	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	1.5
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course provides an understanding of forest health and protection, covering both natural and human-induced threats to forest ecosystems. Students will study injurious agencies, forest fires, resource removal, encroachment, poaching, grazing, invasive species, and legal aspects of forest protection. Emphasis is given to prevention, management strategies, and community participation in protecting forests. The course integrates modern technologies with traditional knowledge for effective forest health management.

Course Prerequisite:

Basic knowledge of forestry, ecology, and environmental science at undergraduate level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the importance of forest protection in Indian forestry and classify injurious agencies.	***R***
2	Identify causes, types, and impacts of forest fires and apply appropriate fire management strategies.	***A***

3	Assess forest health indicators and propose strategies for sustainable management.	***An***
4	Evaluate the impacts of human activities (resource removal, encroachment, poaching, grazing) on forests.	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X		X	X			
CO 2	X			X			
CO 3	X	X					X
CO 4	X			X		X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO FOREST HEALTH AND PROTECTION (20 HOURS)**	
	1	Importance of forest protection in Indian forestry.
		Classification of injurious agencies

	2	a) Biotic & abiotic
		b) Anthropogenic: Illegal felling, Encroachment, Shifting cultivation
	3	Concept of forest health
		a) Indicators and significance
		b) Preventive vs. curative measures.
		c) Role of silvicultural practices in forest health maintenance.
		d) Integrated pest management in forestry.
	4	Tools and Techniques for Forest Health Monitoring
		a) Ground-based surveys
		b) Remote sensing and GIS applications
		c) Use of bioindicators for forest ecosystem health assessment
2	**MODULE TITLE: THREATS TO FORESTS (20 HOURS)**	
	1	Hazards
		a) Wildlife poaching – gravity, case studies, prevention strategies in India and abroad
		b) Grazing and browsing; Impact of grazing on forest ecosystems
		c) Carrying capacity concept
	2	Forest Pests
		a) Defoliators
		b) Bark and wood borers
		c) Sap-sucking insects
		d) Seed and cone pests
	3	Forest Diseases

		a) Fungal diseases **–** root rot, damping-off, rusts, and leaf spots.
		b) Bacterial diseases – gummosis, blights.
		c) Viral diseases – mosaic, stunting.
		d) Mycoplasma-like organisms (MLOs) – wilt diseases.
	4	Invasive and Parasitic Threats
		a) Parasitic plants, weeds, and invasive alien species
		b) Control strategies and effectiveness.
		c) Case studies of invasive species in Indian forests
3	**MODULE TITLE: FOREST FIRES (15 HOURS)**	
	1	Definition and characteristics of forest fires
	2	Causes & classification
	3	Impact of fire on forest ecosystems: Positive and Negative
	4	Fire management
		a) Prevention, suppression, and control strategies
		b) Tools for fire-fighting and extension activities
		c) Fire-fighting in other countries: Case Studies
		d) Modern methods of fire control
4	**MODULE TITLE: LEGAL AND INSTITUTIONAL ASPECTS OF PROTECTION (15 HOURS)**	
	1	Forest protection laws in India
		Historical background of forest laws in India
		Constitutional provisions related to forest protection

	2	Major Forest Protection Laws in India
		a) Indian Forest Act, 1927
		b) Wildlife (Protection) Act, 1972; Amendments and recent legal developments
		c) Forest (Conservation) Act, 1980
		d) Biological Diversity Act, 2002
	3	International Conventions and Agreements
5	**Teacher Specific Module (5 Hours)**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Varghese, M.I. *Treatise on Forest Laws in Kerala*. Swamy Law House.
2. MoEF&CC publications on forest policy and legal frameworks.
3. Indian Forest Act, 1927; Forest (Conservation) Act, 1980; Wildlife (Protection) Act, 1972.
4. Supreme Court and NGT judgments related to forest protection.
5. Tainter, F.H. & Baker, F.A. *Principles of Forest Pathology*. Wiley.
6. FAO. *Forest Health and Biosecurity*. FAO Forestry Paper.
7. Ciesla, W.M. *Forest Entomology: A Global Perspective*. Wiley.
8. Manion, P.D. *Tree Disease Concepts*. Prentice Hall.

Suggested Readings:

1. Schowalter, T.D. *Insect Ecology: An Ecosystem Approach*. Academic Press.
2. Singh, B., & Kumar, P. *Forest Entomology*. IBDC Publishers.
3. Goldammer, J.G. *Forest Fires and Climate Change*. Kluwer.
4. FAO. *Forest Health Monitoring: An Overview*.
5. Ciesla, W.M. *Forest Health Management*.
6. Lovett, G.M., et al. *Forest Health Indicators*. Springer.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define injurious agencies in forestry.
2. List the major causes of forest fires.
3. What is shifting cultivation?

6 Mark Questions

1. Explain the impact of grazing on forest ecosystems.
2. Describe two modern methods of fire control.
3. Discuss the role of invasive alien species in forest degradation.

14 Mark Questions

1. Evaluate the strategies for prevention of wildlife poaching in India.
2. Explain fire management strategies with special reference to community participation.
3. Discuss the role of laws and commissions in forest protection.

KU5DSCFOR303 AGROFORESTRY, SOCIAL FORESTRY AND HUMAN DIMENSION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSC	300-399	KU5DSCFOR303	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0		30	70	100	2

Course Description: This course provides an integrated understanding of agroforestry, social forestry, forestry extension, and human dimensions in forestry. Students will learn about various agroforestry systems, management practices, and their socio-economic and ecological benefits. The course emphasizes community participation, forestry extension methods, tribal-forest relationships, and policy frameworks aimed at sustainable forest resource use and rural development.

Course Prerequisite:

Basic knowledge of silviculture, ecology, and rural development concepts at undergraduate level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the concepts, systems, and classifications of agroforestry and social forestry.	***R***
2	Apply management techniques to optimize tree-crop interactions in agroforestry systems.	***A***
3	Analyze the role of forestry extension, community participation, and policies in sustainable forestry.	***An***
4	Evaluate the socio-economic and cultural relationships between forest-dependent communities and forests, with reference to legal frameworks.	***E***

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X	X	X			
CO 2	X			X			
CO 3	X	X					X
CO 4	X	X		X		X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO AGROFORESTRY (20 HOURS)**	
	1	Indian agriculture: structure, constraints, and land use planning.
	2	Agroforestry – definition, objectives, importance.
	3	Classification
		a) Structural and functional
		b) socio-economic and ecological
	4	Agroforestry Systems

		a) Silvoagriculture systems: shifting cultivation, Taungya, crops with commercial trees, plantation agriculture and forestry.
		b) Agrosilviculture systems: alley cropping, trees in fields, farm boundaries, commercial crops under tree shade.
		c) Pastoral silvicultural systems: grassland and tree management in humid, arid, and semi-arid zones.
		d) Silvopastoral systems – protein banks.
		e) Agrosilvopastoral systems – home gardens, shelter belts, windbreaks, multipurpose tree gardens.
2	**MODULE TITLE: MANAGEMENT OF AGROFORESTRY SYSTEMS (20 HOURS)**	
	1	Tree-crop interactions:
		a) Positive: complementarity, compatibility, mutualism, commensalism.
		b) Negative: allelopathy, competition.
	2	Interaction management – aboveground and belowground.
		a) Manipulation of density, space, crown, and roots.
		b) Tree management: architecture, canopy management, lopping, pruning, pollarding, hedging.
		c) Practices to minimize negative interactions – coppicing, thinning
		d) Crop planning and management – crop selection, nutrient, water, and weed management.
		e) Multipurpose tree species – desirable traits.
	3	National Agroforestry Policy 2014
	4	National and international organizations in agroforestry.
3	**MODULE TITLE SOCIAL FORESTRY AND FORESTRY EXTENSION (15 HOURS)**	
		Social forestry

	1	a) Definition, concept, objectives
		b) Social forestry in National Forest Policies
		c) Classification: farm forestry, extension forestry, village forestry
	2	Role of social forestry in meeting demands for timber, firewood, fodder, and fibre.
		a) Species suitable for social forestry – examples from Kerala
		b) Organizations involved in social forestry programme
	3	Forestry Extension- concept, scope, and principles
		a) People's participation – community forestry, participatory forestry
		b) Participatory Rural Appraisal (PRA) techniques
		c) Joint Forest Management (JFM) – concept, benefits, impact
	4	Village Forest Council – formation and functions
4	**MODULE TITLE: HUMAN DIMENSIONS IN FORESTRY (15 HOURS)**	
	1	Ethnobiology – definition, ethnobotany, ethnozoology.
	2	Primitive tribes in India and Kerala
		a) Economy, occupations, and forest dependence.
		b) Role of NWFPs in tribal livelihoods
		c) Tribes and forest policies – rights, concessions, and legal provisions.
	3	Forest Rights Act 2006
	4	Ecodevelopment and tribal development
		a) case study: Periyar Tiger Reserve

		b) Problems of tribes – exploitation, land alienation
5	**Teacher Specific Module (5 Hours)**	
	Directions: 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.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Nair, P.K.R. *An Introduction to Agroforestry*. Springer.
2. Pathak, P.S., & Roy, M.M. *Agroforestry Systems and Practices*. Scientific Publishers.
3. Lal, P. *Social Forestry in India*. Indian Social Institute.
4. FAO. *Agroforestry for Sustainable Land Use*.

Reference Distribution:

Module	**Unit**	**Reference No.**
1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6
	3	6
3	1	7
	2	8

	3	9,10
4	1	11
	2	12

Suggested Readings:

1. National Agroforestry Policy 2014 – MoEF&CC, Govt. of India.
2. Chambers, R. *Participatory Rural Appraisal: Principles and Practices*
3. Gadgil, M., & Guha, R. *This Fissured Land: An Ecological History of India*

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define agroforestry and mention two of its objectives.
2. List any three classifications of agroforestry systems.
3. What is the Taungya system? Give one example.
4. Name any three multipurpose tree species used in agroforestry.
5. State two advantages and one disadvantage of agroforestry systems.
6. Differentiate between farm forestry and village forestry.

7. Mention three PRA techniques used in forestry extension.
8. Define ethnobotany and give two examples.
9. State two features of the Forest Rights Act, 2006.
10. What is a shelter belt? Give one function.

6 Mark Questions

1. Explain the structural classification of agroforestry systems with examples.
2. Describe aboveground and belowground interactions in agroforestry.
3. Discuss the role of the National Agroforestry Policy 2014 in promoting agroforestry in India.
4. Differentiate between social forestry and community forestry.
5. Explain the concept and benefits of Joint Forest Management (JFM).
6. Discuss the role of NWFPs in the economy of forest-dependent tribes.
7. Describe the functions of a Village Forest Council.
8. Explain two silvicultural practices used to manage tree architecture in agroforestry systems.

14 Mark Questions

1. Discuss in detail the various agroforestry systems practiced in India, giving suitable examples.
2. Explain the positive and negative interactions in agroforestry and the management practices to optimize them.
3. Describe the scope, objectives, and types of social forestry with examples from Kerala.
4. Elaborate on the principles, techniques, and importance of Participatory Rural Appraisal in forestry.
5. Evaluate the role of tribal communities in forest conservation and the legal provisions safeguarding their rights.
6. Write detailed notes on multipurpose tree species in agroforestry, their desirable traits, and their uses.
7. Discuss the problems faced by tribes in India and suggest strategies for ecodevelopment through forestry programmes.

KU5DSEFOR304 WILDLIFE MONITORING TECHNIQUES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEFOR304	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: Wildlife Monitoring Techniques is a DSE Course exploring the methods and technologies used to study and understand the behavior, population dynamics, and habitat requirements of various wildlife species. This course covers a wide range of topics, from traditional field observation techniques to cutting-edge technologies such as remote sensing, camera traps, and DNA analysis.

Course Prerequisite: Basic Understanding in wildlife science and wildlife management.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Demonstrate a comprehensive understanding of the principles, methodologies, and technologies used in wildlife monitoring.	***U***
2	Apply various wildlife monitoring techniques to effectively observe, document, and analyze wildlife behavior and population dynamics.	***A***
3	Design and implement wildlife monitoring programs, incorporating appropriate sampling methods, data collection protocols, and analytical tools.	***C***
4	Interpret and communicate wildlife monitoring data accurately and effectively to diverse stakeholders, including scientists, policymakers, and the general public.	***An***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X			X			X
CO 2			X			X	
CO 3		X	X			X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO WILDLIFE MONITORING (15 Hours)**	
	1	Wildlife census
		a) Purpose and techniques.
		b) Importance of wildlife monitoring
	2	Principles of wildlife population monitoring
	3	Assessment techniques in estimating wildlife populations
		a) Study designs and analytical tools

2	**MODULE TITLE: WILDLIFE CENSUS TECHNIQUES (20 Hours)**	
	1	Planning census

		a) Basic concepts and applications
		b) Total counts and Sample counts
	2	Direct count methods
		e) Block count
		f) Transect methods
		g) Road side counts
		h) Visual encounter survey
		i) Waterhole survey
	3	Indirect count methods
		a) Strip transects for indirect evidences of tracks and signs
		b) Dung count method for Elephants and Gaur
		c) Pug mark census
	4	Mark capture-recapture methods
	5	Use of Sherman traps, mist nets, harp traps, drones etc

3	**MODULE TITLE: CAMERA TRAPPING AND ACOUSTIC MONITORING (10 Hours)**	
	1	Use of camera trap in wildlife monitoring
		a) Types and functions of a camera trap
		b) Deployment and setting up of camera traps
		c) Data management and analysis
	2	Bio Acoustics

		e) Basics of bio-acoustics
		f) Tools and methods in bio-acoustics
		g) Deployment and analysis of acoustic recorders
		h) Applications in ecology, conservation, and animal behavior.
	3	Software tools in wildlife monitoring

4	**MODULE TITLE: DATA ANALYSIS AND EMERGING TECHNOLOGIES (15 Hours)**	
	1	Statistical Methods for Analyzing Wildlife Data
		a) Distance sampling and estimating animal densities and abundance
		b) Designing occupancy surveys and data collection
		c) Estimating species occurrence and detection probabilities.
	2	Mapping Wildlife Habitats and Movement Patterns
	3	Genetic Sampling and Analysis; eDNA
	4	Radio telemetry and tracking studies
		e) Visual tagging
		f) PIT tags
		g) Ringing in birds
5	**Teacher Specific Module (15 Hours)**	
	Directions: Teachers may choose themes relevant to the course, such as local case studies, recent innovations, applied practices, or entrepreneurship opportunities. The teaching approach should emphasize experiential learning, creativity, and project-based activities (e.g., assignments, group discussions, mini-projects, field-based tasks). Assessment may include class tests, assignments, project reports, or presentations.	

Space to fill the selected area/ activity

Essential Readings:

1. Sutherland, W.J. and Krebs, C.J., 1997. Ecological census techniques. Trends in Ecology and Evolution, 12(2).
2. Pollock, K. H., Nichols, J. D., Simons, T. R., Farnsworth, G. L., Bailey, L. L., & Sauer, J. R. (2002). Large scale wildlife monitoring studies: statistical methods for design and analysis. Environmetrics: The official journal of the International Environmetrics Society, 13(2).
3. Silvy, N. J. (Ed.). (2020). The Wildlife Techniques Manual: Volume 1: Research. Volume 2: Management. JHU Press.
4. Singh, L. A. K. 2000. Tracking Tigers: Guidelines for estimating wild tiger populations using the 'Pugmark Technique': Revised Edition. WWF Tiger Conservation Programme.
5. Donnelly, M.A., Guyer, C., Juterbock, E.J. and Alford, R.A., 1994. Techniques for marking amphibians. Measuring and monitoring biological diversity: standard methods for amphibians
6. Swann, D. E., & Perkins, N. (2014). Camera trapping for animal monitoring and management: a review of applications. Camera trapping: Wildlife management and research.
7. Penar, Weronika, Angelika Magiera, and Czesław Klocek. "Applications of bioacoustics in animal ecology." Ecological complexity 43 (2020): 100847.
8. Lahoz-Monfort, José J., and Michael JL Magrath. "A comprehensive overview of technologies for species and habitat monitoring and conservation." BioScience 71.10 (2021).
9. Skalski, John R., Kristin E. Ryding, and Joshua Millspaugh. Wildlife demography: analysis of sex, age, and count data. Elsevier, 2010.

10. Fuller, Mark R., and Todd K. Fuller. "Radio-telemetry equipment and applications for carnivores." Carnivore ecology and conservation: a handbook of techniques 152 (2012).

Suggested Readings:

- Rajesh, G. 1989. Fundamentals of Wildlife Management. Justice Home, Allahabad.
- Sukumar, R., 1992. The Asian elephant: ecology and management. Cambridge University Press.
- Karanth, K.U. and Nichols, J.D. eds., 2002. Monitoring tigers and their prey: a manual for researchers, managers, and conservationists in tropical Asia. Centre for Wildlife Studies.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define wildlife monitoring.
2. State two purposes of wildlife census.
3. Mention two principles of wildlife population monitoring.

4. What is total count in wildlife census?
5. Write short notes on block count.
6. Name two indirect census methods used in tropical forests.
7. Define mark–recapture method.
8. What is the function of a Sherman trap?
9. List two functions of camera traps.
10. Define bio-acoustics.
11. Name two software tools used in wildlife monitoring.
12. What is distance sampling?
13. Define eDNA with one application.
14. Write short notes on PIT tags.
15. Mention two uses of radio telemetry in wildlife research.

6-Mark Questions

1. Explain the importance of wildlife monitoring in conservation biology.
2. Describe the assessment techniques used for estimating wildlife populations.
3. Differentiate between total counts and sample counts in wildlife census.
4. Explain the transect method of wildlife census.
5. Discuss the role of dung count methods in estimating populations of elephants and gaur.
6. Describe the planning process of a wildlife census.
7. Explain the use of mist nets and harp traps in wildlife monitoring.
8. Describe the types and deployment strategies of camera traps.
9. Explain the basics of bio-acoustics and its applications in conservation.
10. Discuss the role of data management in camera trap studies.
11. Explain how statistical methods are applied in estimating wildlife abundance.
12. Describe the design of occupancy surveys in wildlife monitoring.
13. Discuss the importance of mapping wildlife habitats and movement patterns.
14. Explain the role of genetic sampling and eDNA in wildlife monitoring.
15. Describe the advantages and limitations of radio telemetry in wildlife studies.

14-Mark Questions

1. Discuss the principles of wildlife population monitoring and their applications in field studies.
2. Explain in detail the planning and execution of wildlife census, highlighting total and sample count techniques.

3. Discuss the direct count methods used in wildlife monitoring with suitable examples.
4. Explain indirect count methods of wildlife census and evaluate their effectiveness in dense tropical forests.
5. Describe the mark–recapture method of wildlife census and its applications.
6. Explain the use of advanced trapping techniques (Sherman traps, mist nets, harp traps, drones) in wildlife monitoring.
7. Discuss the role of camera trapping in wildlife research, covering deployment, data analysis, and conservation applications.
8. Explain bio-acoustic monitoring methods and their applications in ecology, animal behavior, and conservation.
9. Describe the use of statistical methods (distance sampling, occupancy models) in analyzing wildlife data.
10. Discuss the role of modern technologies (eDNA, genetic sampling, PIT tags, radio telemetry) in wildlife monitoring.
11. Evaluate the importance of integrating traditional census techniques with emerging technologies in wildlife conservation.

KU5DSEFOR305 VEGETATION ANALYSIS AND BIODIVERSITY ASSESSMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEFOR305	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: This course provides a comprehensive understanding of vegetation analysis and biodiversity assessment techniques essential for ecological studies and forest management. Students will learn various methods of quantitative and qualitative vegetation analysis, biodiversity indices, conservation assessment approaches, and the application of modern tools such as GIS, remote sensing, and molecular techniques in biodiversity research.

Course Prerequisite: Basic knowledge of ecology, taxonomy, and environmental science at the undergraduate level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the concepts, scope, and importance of vegetation analysis and biodiversity assessment.	***U***
2	Apply standard field techniques for vegetation sampling and biodiversity surveys.	***A***
3	Analyze vegetation data using ecological indices and statistical tools.	***An***
4	Evaluate conservation priorities and biodiversity status using global and national frameworks.	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X				X	X	
CO 2	X		X				
CO 3	X	X			X		
CO 4	X		X			X	X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: CONCEPTS OF VEGETATION ANALYSIS AND BIODIVERSITY (10 Hours)**	
	1	Definition, objectives, and scope of vegetation analysis.
	2	Concepts of biodiversity
		a) genetic, species, and ecosystem diversity
		b) Levels and patterns of biodiversity – global, national, and regional perspectives
		c) Biodiversity hotspots of India
	3	Importance of biodiversity assessment in forestry and conservation

2	**MODULE TITLE: VEGETATION SAMPLING AND ANALYSIS (20 Hours)**	
	1	Methods of vegetation sampling
		a) quadrats

		b) transects
		c) point-centered quarter method
	2	Measurement of vegetation parameters
		a) frequency
		b) density
		c) abundance
		d) cover
		e) basal area
	3	Structural attributes
		a) stratification
		b) canopy cover
		c) importance value index (IVI)

3	**MODULE TITLE: BIODIVERSITY ASSESSMENT METHODS (20 Hours)**	
	1	Qualitative and quantitative assessment methods
	2	Diversity indices
		a) Shannon-Weiner
		b) Simpson
		c) Margalef
		d) Evenness indices
	3	Species–area relationship.
	4	Rarefaction and species accumulation curves

4		**MODULE TITLE: MODERN APPROACHES IN VEGETATION AND BIODIVERSITY STUDIES (20 Hours)**
	1	Remote sensing and GIS applications in vegetation and biodiversity mapping
		a) Classification of land cover (forest, grassland, cropland, wetlands)
		b) NDVI, EVI, SAVI
		c) Land Use Land Cover change mapping
	2	Molecular tools for biodiversity assessment (DNA barcoding, eDNA)
	3	Ecological modelling
		a) Species Distribution Models (SDMs) / Ecological Niche Models (ENMs)
		b) Population Models
		c) Community Model
	4	Community-based biodiversity conservation and People’s Biodiversity Registers (PBRs)
5		**Teacher Specific Module (5 Hours)**
		Directions: Teachers may choose themes relevant to the course, such as local case studies, recent innovations, applied practices, or entrepreneurship opportunities. The teaching approach should emphasize experiential learning, creativity, and project-based activities (e.g., assignments, group discussions, mini-projects, field-based tasks). Assessment may include class tests, assignments, project reports, or presentations.
		Space to fill the selected area/ activity

Essential Readings:

1. Misra, R. *Ecology Workbook*. Oxford & IBH.
2. Magurran, A.E. *Measuring Biological Diversity*. Blackwell.
3. Krebs, C.J. *Ecological Methodology*. Harper & Row.
4. Choudhury, A. & Singh, J.S. *Biodiversity and Conservation*.

Suggested Readings:

- Odum, E.P. Fundamentals of Ecology. Saunders.
- Colwell, R.K. *Biodiversity: Concepts, Patterns and Measurement*.
- Pielou, E.C. *Ecological Diversity*. Wiley.
- **Gotelli, N.J. (2008).** *A Primer of Ecology*. Sinauer Associates.
- **Krebs, C.J. (2014).** *Ecology: The Experimental Analysis of Distribution and Abundance*. Pearson.
- **Clark, J.S. (2007).** *Models for Ecological Data: An Introduction*. Princeton University Press.

Assessment Rubrics:

Evaluation Type	**Marks**
End Semester Evaluation	**70**
Continuous Evaluation	**30**
a) Test Paper- 1	10
b) Test Paper-2	10
c) Assignment	5
d) Seminar	2
e) Book/ Article Review	3
Total	**100**

Sample questions to Test Outcome

3 Marks

1. Define biodiversity and mention its levels.
2. What is a quadrat method?
3. Write short notes on the biological spectrum.
4. Define IVI and state its importance.
5. What is an IUCN Red List?

6 Marks

1. Explain the importance of vegetation analysis in forest management.
2. Differentiate between quadrat and transect methods of sampling.
3. Describe the Shannon-Weiner index of diversity.
4. Explain the role of ex-situ and in-situ methods in biodiversity conservation.

14 Marks

1. Discuss various methods of vegetation sampling and analysis, with examples.
2. Describe the biodiversity assessment methods using ecological indices and their applications.
3. Explain the role of modern tools like remote sensing, GIS, and DNA barcoding in biodiversity assessment.
4. Evaluate the biodiversity conservation strategies in India with special reference to NBAP and PBRs.

KU5DSCFOR306 SOIL SCIENCE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEFOR306	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: This course provides a comprehensive understanding of soil, its physical and chemical properties, formation, classification, and fertility. Students will explore soil types in India and Kerala, techniques of soil survey, and principles of watershed management. The practical component focuses on soil analysis, enabling students to relate theoretical concepts to real-world applications in forestry and environmental management.

Course Prerequisite:

Basic understanding of biology and environmental science at higher secondary level. Ability to conduct laboratory-based soil analysis and write examinations in English.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify and explain physical and chemical properties of soil	***R***
2	Recognize and classify different soil types of India and Kerala	***A***
3	Analyze soil-related data for interpretation and management planning.	***An***
4	Evaluate soil problems and suggest reclamation measures	***E***

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	✓		✓	✓			
CO 2	✓			✓			

CO 3	✓	✓					✓
CO 4	✓			✓		✓	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: PROPERTIES OF SOIL (10 Hours)**	
	1	Definition and components of soil
	2	Soil profile and difference between soil and subsoil
	3	Physical properties and their role in fertility
		a) Texture and structure
		b) Density and porosity
		c) Colour
		d) Temperature
	4	Chemical properties
		a) Electrical Conductivity
		b) Cation Exchange Capacity
		c) Soil pH
2	**MODULE TITLE: SOIL FORMATION (10 Hours)**	
	1	Definitions and concepts of Pedogenesis

	2	Processes in Soil Formation
		a) Weathering: Physical, chemical, and biological weathering processes
		b) Horizon development: Formation of soil horizons from parent material
		c) Transformation, translocation, and addition of materials in soil profiles
	3	Factors Influencing Soil Formation
		a) Parent material**:** Rock type, mineral composition.
		b) Climate: Temperature, precipitation, seasonal variations.
		c) Topography: Slope, aspect, elevation effects.
		d) Role of vegetation, animals, and microorganisms.
3	**MODULE TITLE: SOIL FERTILITY (10 Hours)**	
	1	Soil fertility and productivity
	2	Essential elements –
		a) functions, forms, availability, critical limits
		b) Deficiency and toxicity symptoms
		c) Mechanisms of nutrient absorption
		d) Nutrient cycles: Carbon, Nitrogen, Phosphorus, Sulphur
	3	Soil organic matter
		a) Role of micro-organisms: bacteria, fungi, actinomycetes
		b) Role of macro-organisms: earthworms, termites, ants
	4	Soil fertility evaluation
4	**MODULE TITLE: SOIL TYPES AND SOIL SURVEY (15 Hours)**	

	1	Forest soil and Agricultural Soil
	2	Soils of India and Kerala
	3	Soil Erosion
		a) Types, cause
		b) Universal soil loss equation
		c) Conservation measures
	4	Wastelands and Land use capability classification
		a) definition, extent, classification
		b) Reclamation and suitable species for problem soils
		c) Afforestation in different ecological system
	5	Soil survey – objectives and types
5	**Teacher Specific Module (30 Hours)**	
	To be designed by the course instructor to complement modules 1–4 through case studies, fieldwork, data analysis, or seminars.	
	Space to fill the selected area/ activity	

Essential Readings:

- Brady, N.C. & Weil, R.R. *The Nature and Properties of Soils*. Pearson.
- Lal, R. *Soil and Water Conservation*. CRC Press.
- Miller, R.W. & Donahue, R.L. *Soils in Our Environment*. Pearson.
- Sehgal, J.L. *Soils of India*. IARI, New Delhi.

Reference Distribution:

Module	Unit	Reference No.

1	1	1
	2	2
	3	3
	4	4
2	1	5
	2	6
	3	6
3	1	7
	2	8
	3	9,10
4	1	11
	2	12

Suggested Readings:

- FAO. *Guidelines for Soil Description*. FAO, Rome.
- Indian Council of Agricultural Research. *Handbook of Agriculture*.
- Schwab, G.O., Fangmeier, D.D., Elliot, W.J. & Frevert, R.K. *Soil and Water Management*. Wiley.

Assessment Rubrics:

Evaluation Type	Marks

End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define soil texture and explain its importance.
2. List three chemical properties of soil.
3. What is the Universal Soil Loss Equation?

6 Mark Questions

1. Differentiate between soil and subsoil.
2. Explain the role of organic matter in soil fertility.
3. Name two tree species suitable for saline soils.

14 Mark Questions

1. Describe the nitrogen cycle and its role in soil fertility.
2. Discuss factors influencing soil formation.
3. Explain principles of watershed management.

KU5DSEFOR307 FOREST BIOTECHNOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	DSE	300-399	KU5DSEFOR307	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	0	30	70	100	2

Course Description: Forest Biotechnology is a multidisciplinary field integrating plant biotechnology, tissue culture, genetic engineering, and molecular breeding to improve forest tree species. This course covers in vitro techniques, somaclonal variation, protoplast fusion, genetic engineering, transgenic plant production, molecular markers, and bio-safety regulations. Students will gain practical exposure to tissue culture and genetic analysis techniques, and understand applications in forest tree improvement, conservation, and sustainable forestry.

Course Prerequisite: Basic knowledge of plant physiology, genetics, and molecular biology at the undergraduate level.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe the scope and history of plant biotechnology with special reference to forestry	***U***
2	Demonstrate knowledge of tissue culture techniques, somatic embryogenesis, and synthetic seed production	***A***
3	Apply genetic engineering tools (vectors, enzymes, gene transfer methods) in forest biotechnology.	***A***

4	Analyze molecular marker techniques and evaluate their role in tree breeding and genetic diversity studies.	***An***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						X
CO 2		X			X		
CO 3		X					
CO 4				X		X	X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FOREST BIOTECHNOLOGY (20 Hours)**	
	1	Introduction to plant biotechnology
		a) scope in tree improvement
		b) history and development
	2	Methods of plant tissue culture
		a) Scope in agriculture and forestry
		b) micropropagation
		c) Haploid plant production – pollen, anther, ovule culture

	3	Overcoming incompatibility and distant hybridization
		a) In vitro fertilization and embryo culture.
		b) Somaclonal variation – definition, reasons, applications; in vitro mutagenesis.
		c) Protoplast isolation, culture, fusion, and cybrid production
		d) Secondary metabolite production under in vitro conditions
	4	Somatic embryogenesis, synthetic seed production and applications
		a) Germplasm conservation through tissue culture
		b) Factors affecting in vitro culture

2	**MODULE TITLE: PLANT GENETIC ENGINEERING (10 Hours)**	
	1	Principles and general strategy of plant genetic engineering
		a) Restriction enzymes and their mode of action
		b) Artificial synthesis of gene, gene library, cDNA library
	2	Gene cloning – general strategies and enzymes.
		a) Cloning vectors in recombinant DNA technology: plasmids, phages, cosmids, ssDNA phages, BACs, YACs.
	3	Gene transfer methods in plants:
		a) Direct methods (microinjection, electroporation, gene gun, PEG-mediated)
		b) Indirect methods – *Agrobacterium tumefaciens*, Ti plasmid, T-DNA transfer and integration

3	**MODULE TITLE: TRANSGENIC PLANTS AND MOLECULAR TOOLS (20 Hours)**	
	1	Production of transgenic plants

	2	Screening of transformants
		a) GUS assay
		b) PCR
		c) RT-PCR
		d) Southern blotting
		e) Northern blotting
		f) electrophoresis
		g) autoradiography
	3	Genetic fingerprinting
		a) RAPD, RFLP, AFLP, SSR, VNTRs, CAPS, SNPs, ESTs, DNA probes
		b) Marker-assisted selection, QTL mapping, and molecular breeding
	4	Achievements and future prospects in forest biotechnology
		a) Scope of biotechnology in forest tree improvement

4	**MODULE TITLE: BIO-SAFETY AND LEGAL ASPECTS (10 Hours)**	
	1	Bio-safety rules and regulations
		a) research, development, field trials, and commercial cultivation of GM crops
	2	Intellectual Property Rights (IPR)
		a) concepts, TRIPS, WTO, WIPO, GATT
		b) IPR in international trade
		c) gene patenting
	3	Protection of plant and animal genetic resources, biological materials, and biodiversity

5	**Teacher Specific Module (15 Hours)**
	Directions: Teachers may choose themes relevant to the course, such as local case studies, recent innovations, applied practices, or entrepreneurship opportunities. The teaching approach should emphasize experiential learning, creativity, and project-based activities (e.g., assignments, group discussions, mini-projects, field-based tasks). Assessment may include class tests, assignments, project reports, or presentations.
	Space to fill the selected area/ activity

Essential Readings

1. Bhojwani, S.S. & Razdan, M.K. (1996). *Plant Tissue Culture: Theory and Practice*. Elsevier.
2. Brown, T.A. (2016). *Gene Cloning and DNA Analysis*. Wiley-Blackwell.
3. Singh, B.D. (2015). *Biotechnology: Expanding Horizons*. Kalyani Publishers.
4. Glick, B.R., Pasternak, J.J., & Patten, C.L. (2010). *Molecular Biotechnology: Principles and Applications of Recombinant DNA*. ASM Press.

Suggested Readings

1. Reinert, J. & Bajaj, Y.P.S. (1999). *Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture*. Springer.
2. Gupta, P.K. (2018). *Elements of Biotechnology*. Rastogi Publications.
3. Primrose, S.B. & Twyman, R.M. (2014). *Principles of Gene Manipulation and Genomics*. Wiley.
4. Henry, R.J. (2001). *Plant Genotyping: The DNA Fingerprinting of Plants*. CABI.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10

b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Marks (Short Answer Type)

1. Define plant biotechnology. Mention its scope in forestry.
2. What is totipotency?
3. Differentiate between differentiation and dedifferentiation.
4. What is somaclonal variation?
5. Give two examples of secondary metabolites produced in vitro.
6. Mention two applications of synthetic seeds.
7. What is a restriction enzyme?
8. Define plasmid.
9. Give two direct methods of gene transfer in plants.
10. What is a Ti plasmid?
11. Mention two techniques used to screen transgenic plants.
12. Define RAPD.
13. What is marker-assisted selection?
14. What is biosafety in biotechnology?
15. Expand: TRIPS, WIPO

6 Marks (Medium Answer Type)

1. Write a short note on the history and development of plant tissue culture.
2. Explain nutritional requirements for in vitro culture.
3. Describe haploid plant production through anther and pollen culture.
4. Explain the process of protoplast isolation and fusion.
5. What is somatic embryogenesis? Mention its applications.
6. Explain the principle of recombinant DNA technology.
7. Describe the structure and role of BACs and YACs in gene cloning.
8. Write short notes on gene gun and electroporation methods.

9. Explain the role of *Agrobacterium tumefaciens* in genetic transformation.
10. Write short notes on RAPD and RFLP techniques.
11. Differentiate between PCR and RT-PCR.
12. Explain the concept of QTL mapping.
13. Discuss the role of biosafety measures in GM crop cultivation.
14. What is gene patenting?
15. Explain the objectives of WTO and TRIPS in biotechnology.

14 Marks (Long Answer / Essay Type)

1. Discuss the principles of plant tissue culture and explain different routes of micropropagation.
2. Explain in detail the methods of overcoming incompatibility in plants through in vitro techniques.
3. Describe somaclonal variation. Discuss its causes, detection, and applications in forestry.
4. Explain different methods of plant gene transfer – direct and indirect – with examples.
5. Describe in detail the production of transgenic plants and methods for screening transformants.
6. Discuss the principles, methodology, and applications of genetic fingerprinting techniques (RAPD, AFLP, SSR, SNP).
7. Explain marker-assisted selection and molecular breeding. Discuss achievements in forestry.
8. Write an essay on the scope of biotechnology in forest tree improvement with examples.
9. Explain biosafety regulations related to research, development, field trials, and commercial cultivation of GM crops.
10. Discuss the concept of Intellectual Property Rights (IPR) in biotechnology. Explain the role of TRIPS, WIPO, and gene patenting.

KU5SECFOR330 INTRODUCTION TO IT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	SEC	100-199	KU5SECFOR330	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course introduces the fundamentals of Information Technology (IT) with an emphasis on practical applications relevant to students in forestry and allied sciences. It covers the basics of computer systems, operating systems, productivity tools, networking, internet applications, and data management. Special focus is given to the use of IT tools for academic and professional purposes, including word processing, spreadsheets, presentations, and online collaboration platforms.

Course Prerequisite:

No formal prerequisites. Basic familiarity with computers is desirable

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of computer systems, hardware, and software	***R***
2	Use productivity tools (Word, Excel, PowerPoint) effectively for academic and professional tasks	***U***
3	Apply IT skills for internet browsing, online communication, and cloud-based collaboration.	***A***

4	Develop basic data handling and presentation skills using spreadsheets and visualization tools.	***An***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X		X			
CO 3							X
CO 4		X					X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: FUNDAMENTALS OF COMPUTERS (5 Hours)**
	1	Introduction to computers – history, evolution, and applications
	2	Basic components: hardware, software, input/output devices, storage
	3	Number systems – binary, decimal, hexadecimal
	4	Operating systems – Windows and Linux basics
2		**MODULE TITLE: OFFICE PRODUCTIVITY TOOLS (10 Hours)**
	1	MS Word / LibreOffice Writer: document formatting, tables, citations, mail merge.

	2	MS Excel / LibreOffice Calc: formulas, functions, charts, pivot tables, data analysis basics.
	3	MS PowerPoint / LibreOffice Impress: slide creation, themes, animations, presentations.
3	**MODULE TITLE: INTERNET AND COMMUNICATION TECHNOLOGIES (10 Hours)**	
	1	Internet basics – browsers, search engines, email etiquette.
	2	Online collaboration tools – Google Workspace, MS Teams, Zoom
	3	Cybersecurity fundamentals – safe browsing, passwords, phishing
	4	Cloud storage – Google Drive, OneDrive, Dropbox
4	**MODULE TITLE: DATA MANAGEMENT AND IT APPLICATIONS IN FORESTRY (10 Hours)**	
	1	Introduction to databases and data organization
	2	Introduction to data visualization (graphs, charts, dashboards)
	3	Future trends – AI, IoT, and Big Data in environmental sciences
5	**Teacher Specific Module (10 Hours)**	
	Directions: Teachers may choose themes relevant to the course, such as local case studies, recent innovations, applied practices, or entrepreneurship opportunities. The teaching approach should emphasize experiential learning, creativity, and project-based activities (e.g., assignments, group discussions, mini-projects, field-based tasks). Assessment may include class tests, assignments, project reports, or presentations.	
	Space to fill the selected area/ activity	

Essential Readings

1. Norton, P. (2019). *Introduction to Computers*. McGraw-Hill.

2. Goel, A. (2021). *Computer Fundamentals*. Pearson.
3. Microsoft Office Tutorials (Official documentation).
4. Free and open-source software manuals (LibreOffice, Google Workspace).

Suggested Readings

1. Balagurusamy, E. (2017). *Fundamentals of Information Technology*. Tata McGraw Hill.
2. Rajaraman, V. (2018). *Fundamentals of Computers*. PHI Learning.
3. Online resources: Coursera, NPTEL, Microsoft Learn, Google Skillshop.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define Information Technology.
2. Name any four input and output devices.
3. What is the difference between hardware and software?
4. Write two advantages of using cloud storage.
5. Define operating system with one example.
6. What is phishing? Give one example.
7. Name any two online collaboration tools.

8. Write two applications of MS Word in forestry.
9. Define binary number system with one example.
10. What is a database?

6 Mark Questions

1. Explain the role of IT in forestry and environmental sciences.
2. Discuss the basic components of a computer system.
3. Write a note on the applications of MS Excel in data analysis.
4. Explain the importance of presentations in academic and professional work.
5. Differentiate between Windows and Linux operating systems.
6. Describe the uses of cloud-based collaboration tools in higher education.
7. What is cybersecurity? Explain three basic safety measures.
8. Explain the importance of email etiquette in professional communication.
9. Write a short note on databases and their applications in ecological data management.
10. Explain the role of internet search engines in research.

14 Mark Questions

1. Explain the evolution of computers and their applications in modern society.
2. Discuss in detail the productivity tools (Word, Excel, PowerPoint) and their academic applications with examples.
3. Write an essay on the importance of internet and IT applications in forestry research, conservation, and e-governance.
4. Describe the process of preparing and analyzing ecological/forestry datasets using spreadsheets.
5. Explain databases and data visualization. How can IT help in biodiversity assessment and management?
6. Discuss the future trends in IT (AI, IoT, Big Data) and their scope in environmental and forestry studies.
7. Compare and contrast the features of MS Office and LibreOffice with respect to their utility in academic institutions.
8. Write an essay on cybersecurity threats and measures for safe internet usage.

KU5SECFOR331 INDOOR PLANTSCAPING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	SEC	100-199	KU5SECFOR331	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This foundational course introduces students to the basic concepts and practices of indoor plantscaping, focusing on the selection, care, and arrangement of plants in indoor spaces. Students will learn how plants enhance living and working environments, the basics of plant care, and simple design ideas for homes, classrooms, and offices. The course emphasizes hands-on learning and is designed for beginners.

Course Prerequisite:

No formal prerequisites.

Course Outcomes:

CO No.	**Expected Outcome**	**Learning Domains**
1	Explain the importance and benefits of indoor plants.	***R***
2	Identify common indoor plants and their requirements.	***U***
3	Demonstrate basic plant care practices (watering, potting, pruning)	***A***
4	Create simple indoor plant arrangements such as pots, dish gardens, and terrariums	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X		X			
CO 3							X
CO 4		X					X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO INDOOR PLANTSCAPING (10 Hours)**	
	1	Definition and importance
	2	Benefits of indoor plants – aesthetic, health, and psychological
	3	Role of greenery in homes, classrooms, and offices
	4	History and trends in indoor gardening and green interiors
2	**MODULE TITLE: INDOOR PLANTS AND THEIR REQUIREMENTS (10 Hours)**	
	1	Classification of indoor plants – foliage plants, flowering plants, climbers, cacti, succulents, palms, ferns
	2	Environmental requirements – light, temperature, humidity, ventilation
	3	Potting media – types and preparation

		Containers and planters – materials, styles, and suitability
3	**MODULE TITLE: DESIGN PRINCIPLES AND TECHNIQUES (10 Hours)**	
	1	Principles of design – balance, proportion, harmony, rhythm, focal point
	2	Plantscaping styles – table-top arrangements, terrariums, hanging baskets, dish gardens, bottle gardens, vertical gardens
	3	Interior plant placement – homes, offices, malls, institutions
		a) Case studies of indoor plant design
4	**MODULE TITLE: MAINTENANCE AND EMERGING TRENDS (10 Hours)**	
	1	Watering, fertilization, pruning, staking, repotting
	2	Integrated pest management for indoor plants
	3	Propagation methods – cuttings, division, tissue culture
	4	Emerging trends: biophilic design, hydroponics, moss walls, smart indoor gardens.
5	**Teacher Specific Module (5 Hours)**	
	Directions: Teachers may choose themes such as native indoor plants of Kerala, low-cost indoor gardening with recycled materials, cultural and aesthetic aspects of plants in traditional homes, emerging trends like hydroponics and vertical gardening, entrepreneurship opportunities, or case studies of successful indoor plantscaping projects.	
	Space to fill the selected area/ activity	

Essential Readings

1. Hessayon, D.G. (2013). *The House Plant Expert*. Expert Books.
2. Chen, J. & Henny, R.J. (2008). *Ornamental Plant Propagation in the Tropics*. Springer.

3. Nelson, P.V. (2011). *Greenhouse Operation and Management*. Pearson**.**

Suggested Readings

1. Thomas, B. & Vince-Prue, D. (1997). *Photoperiodism in Plants*. Academic Press.
2. DelPrince, J. (2020). *Interior Plantscaping: Principles and Practices*. Delmar, Cengage Learning.
3. Online resources: NASA Clean Air Study (plants for indoor air purification), horticultural extension bulletins.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

11. List three health benefits of keeping indoor plants.
12. Write two differences between foliage plants and flowering plants.
13. Mention two advantages of using terrariums for indoor decoration.
14. Define repotting. When is it necessary?
15. List any three common indoor plant pests.

6 Mark Questions

11. Explain the care requirements (light, water, and soil) for indoor succulents.

12. Describe the process of preparing a potting mixture for indoor plants.
13. What are the principles of harmony and proportion in indoor plant arrangements?
14. Discuss the role of indoor plants in improving psychological well-being.
15. Write a short note on the use of recycled materials in indoor plantscaping.

14 Mark Questions

1. Discuss in detail the different types of indoor plant arrangements (potted plants, hanging baskets, dish gardens, terrariums). Give suitable examples.
2. Explain step by step the process of designing and maintaining a terrarium. Mention common mistakes to avoid.
3. “Indoor plants are both aesthetic and functional.” Justify this statement with examples.
4. Describe the routine maintenance practices for indoor plants (watering, pruning, pest control, repotting). How do these practices ensure plant longevity?
5. Imagine you are designing an indoor plantscape for a college library. Prepare a plan mentioning plant selection, placement, and expected benefits.

KU5SECFOR332 URBAN GREENSCAPING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	SEC	100-199	KU5SECFOR332	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course provides students with applied skills in planning, designing, and managing urban greenscapes. Emphasis is given to the ecological and social benefits of urban greenery, techniques for establishing green infrastructure, and sustainable practices such as vertical gardening, rooftop greening, and community-based projects. Students will gain practical experience through hands-on activities and small-scale green scaping projects suitable for Indian urban contexts.

Course Prerequisite:

No formal prerequisites.

Course Outcomes:

CO No.	**Expected Outcome**	**Learning Domains**
1	Understand the importance of greenscapes in enhancing urban ecosystems.	***U***
2	Classify and select plant species suitable for different urban greenscapes	***R***
3	Apply techniques for establishing and maintaining urban green projects	***A***

4	Design a small-scale greenscaping model/project with ecological and social considerations	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X		X			
CO 3							X
CO 4		X					X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO URBAN GREENSCAPING (5 Hours)**	
	1	Concept, scope, and objectives of urban greenscaping
	2	Importance of green spaces in urban ecosystems
	3	The concept of Urban Green Islands
	4	Benefits: ecological services, climate regulation, health, aesthetics, and social value
2	**MODULE TITLE: ELEMENTS OF URBAN GREEN DESIGN (10 Hours)**	
	1	Types of urban green spaces: parks, avenues, institutional greens, home gardens, vertical gardens, rooftop gardens

	2	Plant selection: shade trees, ornamentals, flowering shrubs, grasses, climbers
	3	Design principles: balance, proportion, rhythm, color, harmony, sustainability.
3	**MODULE TITLE: TECHNIQUES AND PRACTICES (10 Hours)**	
	1	Urban tree planting and aftercare
	2	Basics of vertical gardens and rooftop gardening
	3	Sustainable irrigation methods: drip, sprinkler, greywater use
	4	Green Building
4	**MODULE TITLE: URBAN GREEN MANAGEMENT AND PROJECTS (10 Hours)**	
	1	Maintenance routines: watering, pruning, pest control
	2	Role of community participation in greenscaping
	3	Case studies of successful Indian and international urban greenscaping models
	4	Emerging trends
5	**Teacher Specific Module (10 Hours)**	
	Directions: Teachers may choose themes such as native urban trees, cultural aspects of green landscapes, smart city greening projects, or entrepreneurship opportunities (urban nurseries, rooftop garden consultancies). The teaching approach should emphasize experiential learning, creativity, and project-based activities.	
	Space to fill the selected area/ activity	

Essential Readings

1. Randhawa, G.S. & Mukhopadhyay, A. (2017). *Floriculture in India*. Allied Publishers.
2. Bhattacharjee, S.K. (2010). *Urban Horticulture*. Pointer Publishers.

Suggested Readings

1. DelPrince, J. (2020). *Interior and Exterior Plantscaping: Principles and Practices*. Cengage Learning.
2. FAO (2016). *Green Cities Initiative*. FAO Publications.
3. Kerala Agricultural University Extension Bulletins on urban gardening.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

3 Mark Questions

1. List any three ecological benefits of urban greenspaces.
2. Define vertical gardening. Mention two examples.
3. Name three plants suitable for rooftop gardens.
4. What is the role of compost in urban greenscaping?
5. Mention two differences between avenue trees and ornamental shrubs.

6 Mark Questions

16. Explain the importance of plant selection in designing urban greenscapes.
17. Describe the process of preparing soil/compost for rooftop gardening.
18. Discuss how sustainable irrigation methods can support urban greenscapes.
19. What role can community participation play in urban greening initiatives? Give examples.
20. Explain the design principles of balance and proportion in greenscape planning.

14 Mark Questions

1. Discuss in detail the types of urban green spaces (parks, avenues, rooftops, vertical gardens, institutional greens). Give examples from Indian cities.
2. Design a rooftop garden plan for a residential building. Include plant selection, soil preparation, irrigation methods, and expected benefits.
3. Evaluate the ecological and social role of urban greenscapes in mitigating urban challenges such as heat islands, pollution, and stress.
4. Describe the steps and challenges in establishing a vertical garden. Suggest strategies for sustainable maintenance.
5. Imagine you are part of a city greening project. Prepare a proposal for converting a vacant urban plot into a small community park. Discuss layout, plants, facilities, and community involvement.

KU5SECFOR333 COMMERCIAL BEE KEEPING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
5	SEC	100-199	KU5SECFOR333	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course introduces the principles and practices of apiculture, with a special focus on commercial beekeeping. Students will gain knowledge of bee biology, hive management, honey harvesting, and value-added bee products. Emphasis is given to the role of bees in pollination, biodiversity conservation, and entrepreneurship opportunities in beekeeping. Practical sessions provide hands-on experience in hive handling and honey extraction, preparing students for self-employment and allied sector jobs

Course Prerequisite:

No formal prerequisites.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the importance of bees in ecology, agriculture, and economy	***U***
2	Identify major honey bee species and their characteristics	***R***
3	Demonstrate skills in hive management, colony care, and honey extraction	***A***

4	Develop a basic business plan for small-scale commercial beekeeping	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X		X			
CO 3							X
CO 4		X					X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: INTRODUCTION TO APICULTURE (5 Hours)**
	1	History and scope of beekeeping
	2	Importance of bees in pollination and agriculture
	3	Role of beekeeping in rural economy and biodiversity conservation
2		**MODULE TITLE: HONEY BEE BIOLOGY AND SPECIES (10 Hours)**
	1	Morphology, anatomy, and life cycle of honey bees
	2	Types of bees in a colony: queen, workers, drones – division of labour

	3	Important honey bee species (Apis dorsata, A. cerana indica, A. mellifera, stingless bees) and their economic importance
3	**MODULE TITLE: HIVE MANAGEMENT (10 Hours)**	
	1	Types of hives (traditional and modern box hives)
	2	Apiary site selection and seasonal management
	3	Handling of colonies – feeding, shifting, combining and dividing colonies
	4	Hive products: honey, beeswax, royal jelly, pollen, propolis
4	**MODULE TITLE: BEE PESTS, DISEASES AND HONEY HARVESTING (10 Hours)**	
	1	Common bee enemies (wax moth, wasps, ants, birds)
	2	Diseases: brood diseases, Nosema, Varroa mites – symptoms and management.
	3	Honey harvesting – methods of extraction, processing, and storage
	4	Quality control and standards in honey production
5	**Teacher Specific Module (10 Hours)**	
	*Directions: This flexible module allows the teacher to adapt based on expertise, student interest, and local context. Possible themes: advanced pollination services, stingless beekeeping, entrepreneurship models, honey value addition, or local case studies. The focus should be on **applied learning and project work**, encouraging students to connect theory with field realities. Assessment may include assignments, presentations, or project reports.*	
	Space to fill the selected area/ activity	

Essential Readings

1. Singh, S. (2019). *Beekeeping in India*. Indian Council of Agricultural Research.
2. Abrol, D.P. (2013). *Pollination Biology: Biodiversity Conservation and Agricultural Production*. Springer.

Suggested Readings

1. Crane, E. (1999). *The World History of Beekeeping and Honey Hunting*. Routledge.
2. Mishra, R.C. (1995). *Honey Bees and Their Management in India*. ICAR.
3. FAO Manuals on Apiculture.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

3 Mark Questions

1. List three ecological services provided by honey bees.
2. Name any two species of honey bees commonly reared in India.
3. Differentiate between a worker bee and a drone.
4. Write two important qualities of a good apiary site.
5. Mention two major products obtained from beekeeping apart from honey

6 Mark Questions

1. Explain the role of bees in crop pollination with suitable examples.
2. Describe the seasonal management practices in an apiary.
3. Write a short note on Apis mellifera and its importance in commercial beekeeping.
4. Discuss two common enemies of bees and their control measures.
5. Explain the process of honey extraction using a honey extractor.

14 Mark Questions

1. Describe the organization of a honey bee colony. Explain the roles of queen, worker, and drone in colony maintenance.
2. Discuss in detail the common bee diseases and pests. Suggest strategies for their prevention and control.
3. Explain the methods of hive management in commercial beekeeping. How do these practices ensure colony strength and productivity?
4. “Beekeeping is both an ecological service and a source of livelihood.” Evaluate this statement with reference to India.
5. Imagine you are starting a small-scale commercial beekeeping unit. Prepare a business plan outlining site selection, equipment, colony management, products, and market potential.

KU5DSEFOR309 FORESTRY SURVEY AND GEOINFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCFOR309	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">1.5</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides a foundation in surveying, remote sensing, GPS, and GIS as applied to forestry. Students will learn basic principles of forest surveying, levelling, and mapping, as well as modern geoinformatics techniques. Emphasis is placed on the use of remote sensing data, satellite imagery, GPS, and GIS tools for forest management, vegetation mapping, and natural resource monitoring.

Course Prerequisite: Basic knowledge of forest mensuration and mapping. Familiarity with fundamental principles of mathematics and geometry. Introductory knowledge of ecology and forestry resource management.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the objectives, methods, and tools of forest surveying and levelling.	***R***

2	Apply remote sensing principles and aerial photography interpretation in forestry.	***A***
3	Demonstrate knowledge of GPS technology and its applications in forestry and wildlife studies.	***An***
4	Evaluate the use of GIS for spatial data integration, thematic mapping, and decision-making in forest management.	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X					
CO 2		X	X	X			
CO 3			X		X	X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FOREST SURVEYING AND LEVELLING (30 Hours)**	
	1	Forest surveying – definition, objectives, classification.
	2	Chain survey –
		a) types, procedures

		b) Traversing and triangulation
		c) survey stations, baseline, check and tie lines
		d) ranging, offsets.
	3	Obstacles in Chaining
		a) Obstacles can be chained across but not seen across
		b) Obstacles can be seen across but not chained across
		c) Obstacles cannot be seen across and not chained across
		d) Obstacles can be seen across but chained around
	4	Compass surveying
		a) Principle and types of Compasses
		b) Earth magnetism; Magnetic North and True North
		c) Bearings of a Line; Forward Bearing and Backward bearing
		d) Whole circle Bearing System and Quadrantal Bearing systems; conversions
		e) Procedure
	5	Plain table survey
		a) scope, methods, procedures, advantages and disadvantages, forestry applications.
		b) Topographical survey.
		c) Levelling – terms, types of levels, uses of theodolite.
		d) Contour surveying – principles and methods.
	6	Maps and map reading
		a) importance and types of maps used in forestry

2	**MODULE TITLE: REMOTE SENSING (15 Hours)**	
	1	Remote sensing – definition, principles, scope, history.
	2	Electromagnetic spectrum
		a) surface reflectance properties
		b) True colour and False colour composites
		c) Active and passive remote sensing
		d) Applications of remote sensing in forestry – vegetation mapping, forest cover monitoring.
	3	Satellite systems and sensors.
	4	Aerial photography
		a) classification, platforms, sensors.
		b) Aerial photo interpretation.
		c) Digital image processing

3	**MODULE TITLE: GEOGRAPHIC INFORMATION SYSTEM (10 Hours)**	
	1	GIS – definition, principles, and components
		a) Applications of GIS in forestry – habitat mapping, resource inventory, and management planning.
	2	Components of GIS: Hardware, Software, Liveware and Data
		a) Spatial and non-spatial data.
		b) Raster and vector data models.
		c) Integration of attribute data with spatial data.
	3	Georeferencing and coordinate systems.
	4	Thematic overlays and map analysis.

4	**MODULE TITLE: GLOBAL POSITIONING SYSTEM (GPS) (10 Hours)**	
	1	GPS – working principle.
	2	Space segment, control segment, user segment.
	3	Applications of GPS in forestry and wildlife studies.
	4	GNSS, RNSS, GAGAN
5	**Teacher Specific Module (10 Hours)**	
	Directions: This module is to be designed by the instructor handling the course. *Suggested topics:* - *Case studies of remote sensing and GIS in Indian forestry.* - *Advanced GNSS applications.* - *Use of drones and UAVs for forest surveys.* - *GIS-based decision support systems in forest management.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Punnia, B.G. 1987. Surveying. Laxmi Publishers, New Delhi
2. Sahani, P.B. 1979. Text book of surveying Vol. I & II. Oxford and IBH., New Delhi
3. Sharma, M. K. 2001. Remote sensing and Forest surveys. IBD, Dehra Dun
4. Bhatt, A.B. 1994.Aerial photography and remote sensing. Oxford University press
5. Furrows et. al. Introduction to GIS. Oxford University press
6. Patel, A.N. and Singh, S. 1999. Principles of remote sensing. Oxford University press

Suggested Readings:

1. Campbell, J.B. (2002). Introduction to Remote Sensing -Third edition. Taylor and Francis, London.
2. Environment System Research Institute, (1999). GIS for Everyone. Redlands, CA:ESRI.
3. Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6- 7): 1343-1351p.
4. Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press.
5. Lillesand, T.M. and Kiefer,W.R. (1994).Remote sensing and Image Interpretation,
6. Fourth edition. John Wiley & Sons, Inc., USA.
7. Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil
8. Landscape Modelling. NBSS & LUP, Nagpur.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**
Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**

a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Mark Questions

1. Define forest surveying and state its objectives.
2. Differentiate between chain survey and compass survey.
3. What is the electromagnetic spectrum in remote sensing?
4. List the components of GPS.
5. What is georeferencing in GIS?

6-Mark Questions

1. Explain the procedure of chaining across obstacles in forest survey.
2. Discuss the applications of remote sensing in vegetation mapping.
3. Write a short note on aerial photo interpretation.
4. Explain raster and vector data models in GIS.
5. Describe the importance of contour maps in forestry.

14-Mark Questions

1. Discuss the principles, methods, and applications of plain table survey in forestry.
2. Explain the principles of remote sensing, satellite systems, and their applications in forestry.
3. Describe the working of GPS and its applications in forestry and wildlife studies.
4. Evaluate the applications of GIS in forestry resource management and decision-making.

KU6DSCFOR310 FOREST ECONOMICS AND ELEMENTARY STATISTICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCFOR310	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	1.5
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course introduces students to the fundamentals of forest economics and elementary statistics, equipping them with tools to analyze forestry-related production, demand, and supply functions along with statistical methods for research and data interpretation. It covers demand and supply concepts, production economics, valuation of forest goods and services, statistical measures, sampling, correlation, regression, hypothesis testing, and experimental designs with forestry applications.

Course Prerequisite:

Basic knowledge of economics, Familiarity with forestry principles and forest resource use, Fundamental mathematical skills, including algebra and ratio analysis, Ability to interpret simple quantitative data and graphs.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the basic concepts of forest economics, demand, supply, and valuation of forest goods and services	***R***
2	Apply production economics principles and cost–benefit analysis in forestry contexts	***A***

3	Use statistical tools for data collection, presentation, and analysis in forestry studies	***An***
4	Create hypotheses and apply experimental designs to forestry research problems	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X		X	X			
CO 2	X			X			
CO 3	X	X					X
CO 4	X			X		X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FOREST ECONOMICS (20 Hours)**	
	1	Definition, scope and basic concepts of forest economics.
	2	Concepts of Demand
		a) theory of demand; law of demand; determinants of demand
		b) Elasticity of demand – price, cross, income, advertising

		c) Factors affecting demand function; market demand and demand for forest products.
	3	Supply
		a) law of supply; elasticity
		b) factors affecting supply; supply of forest products
		c) Applications of demand and supply in forestry
	4	Valuation of forest goods and services
		a) market-based and non-market-based
		b) use and non-use values
		c) valuation methods – Contingent Valuation Method (CVM)
		d) Travel Cost Method (TCM)
2	**MODULE TITLE: PRODUCTION ECONOMICS (10 Hours)**	
	1	Production economics – basic concepts
		a) product, resources, production
		b) Factors of production
	2	Physical efficiency measures
		a) TPP
		b) APP
		c) MPP
	3	Cost concepts: fixed, variable, MC, AC, TC
		a) Cost–Benefit Analysis (CBA) and applications in forestry
		b) Factor–factor and product–product relationships
	4	Project cycle

		a) identification, formulation, appraisal, implementation, monitoring and evaluation
3	**MODULE TITLE: FOREST STATISTICS (15 Hours)**	
	1	Statistics – definition, scope, and importance in forestry research
		a) Data – Types and Classifictaion
		b) Data collection
		c) tabulation
		d) graphical representation
	2	Measures of central tendency
		a) mean
		b) median
		c) mode
		d) geometric mean
		e) harmonic mean
	3	Measures of dispersion
		a) range
		b) quartile deviation
		c) mean deviation
		d) variance
		e) standard deviation
	4	Sampling theory
		a) parameter, statistic, standard error, confidence interval
		b) Sampling errors vs. non-sampling errors.

		c) Types of sampling – simple random, stratified, systematic, cluster, multi-stage sampling
	5	Correlation – types, scatter diagram, coefficient of correlation
	6	Regression – regression coefficients, simple linear regression equations
4	**MODULE TITLE: HYPOTHESIS TESTING AND EXPERIMENTAL DESIGNS (15 Hours)**	
	1	Theoretical distributions – binomial, Poisson, normal
	2	Hypothesis testing- concepts
		a) Z test
		b) t-test
		c) Chi-square test
		d) F test
	3	Experimental designs - terms and principles (randomization, replication, local control).
		a) Completely Randomized Design (CRD) – advantages, limitations
		b) Randomized Block Design (RBD) – advantages, limitations
		c) Latin Square Design (LSD) – advantages, limitations
		d) Factorial experiments – advantages, limitations
	4	Analysis of Variance (ANOVA) – one-way and two-way ANOVA; layout, analysis, assumptions.
5	**Teacher Specific Module (15 Hours)**	
	Teachers may introduce topics related to recent advances in forest economics or modern statistical applications in forestry, such as ecosystem service valuation techniques, economic modelling, or use of statistical software for forestry data analysis.	

	Space to fill the selected area/ activity

Essential Readings:

1. Muraleedharan, P. K., K. K Subramanian, P. K Pillai. 1998. Basic Readings in Forest Economics. KFRI. 176 p.
2. Pant, M .M. 1984. Forest Economics and Valuation- Principles of economics applied to forest management and utilization. Madhavi publishers. 612p
3. Johl, S. S and T. R Kapur. 1973. Fundamentals of Farm business management. Kalyani publishers. 475 p
4. Johl, S. S and T. R Kapur. 2012. Fundamentals of Farm business management. Kalyani publishers. 415 p
5. Jayaraman, K. 2001. A handbook on Statistical analysis in forestry research. KFRI. 203p
6. Banerjee, P. K. 2013. Introduction to Biostatistics. S Chand Publications. 208p
7. Sharma, A. K. 2005. Text book of Biostatistics I. Discovery Publishing House. 480p
8. Sharma, A. K. 2005. Text book of Biostatistics II. Discovery Publishing House. 464 p
9. Rangaswamy, R. A. A text book of Agricultural statistics. New age International (P) Limited Publishers. 500p

Suggested Readings:

1. Dewett, K.K., Verma. (2005). Elementary Economic Theory, S.Chand, New Delhi
2. Reddy, S.S., RaghuRam, P., Neelakanta Sastry, T.V., Bhavani, D.I. (2009). Agricultural Economics.Oxford and IBH Publishers, New Delhi.
3. Anderson, R.L. and Bancroft, T.A. (1952).StatisticalTheoryinResearch. Mc.Graw Hill BookCo.,NewYork.
4. Cochran, W. GandCox, G.M.(1958).Experimental designs. Wiley, NewYork
5. Das, M.N. and Giri, N.C. (1986). Design and analysis of Experiments. Wiley EasternLtd., NewDelhi.
6. Federer, W.T. (1955). Experimental Design. Macmillan, NewYork.

Assessment Rubrics:

Evaluation Type – Theory	**Marks**
End Semester Evaluation	**50**
Continuous Evaluation	**25**

a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

2 Mark Questions

1. Define elasticity of demand.
2. Distinguish between fixed cost and variable cost.
3. What is sampling error?
4. Write the principles of experimental design.
5. Mention any two valuation methods for forest goods.

6 Mark Questions

1. Explain the determinants of demand for forest products.
2. Write a note on Cost–Benefit Analysis in forestry projects.
3. Compare mean, median, and mode with forestry examples.
4. Explain stratified and systematic sampling with examples.

5. Describe the layout and advantages of RBD.

14 Mark Questions

1. Discuss the law of demand and supply. Explain their applications in forestry with examples.
2. Describe hypothesis testing procedures in detail. Illustrate with t-test and Chi-square test.
3. Explain the various valuation methods of forest goods and services. How are non-market values assessed?
4. Write in detail about correlation and regression analysis and their applications in forestry.

KU6DSCFOR311 FOREST MANAGEMENT AND PLANTATION FORESTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSC	300-399	KU6DSCFOR311	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides a comprehensive understanding of forest management principles and the role of plantation forestry in sustainable forest resource development. It covers classical and modern tools of forest management, sustained yield, working plans, joint forest management, and community forestry approaches. In addition, it emphasizes the planning, establishment, and maintenance of plantations, plantation silviculture, industrial plantations, and their contribution to rural development, biodiversity conservation, and climate change mitigation.

Course Prerequisite:

A basic knowledge of forestry and silvicultural practices. Familiarity with the role of forests in rural development and environmental sustainability. Introductory exposure to ecology, biodiversity, and social forestry concepts.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the principles, scope, and objectives of forest management and sustainable forest management	***R***
2	Apply the concepts of working plans, sustained yield, and community forestry to manage forest resources	***A***
3	Demonstrate knowledge of plantation forestry including species choice, establishment, maintenance, and productivity assessment	***An***

4	Evaluate the role of plantation forestry in rural development, industrial needs, and environmental services such as carbon sequestration	***E***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X		X	X			
CO 2	X			X			
CO 3	X	X					X
CO 4	X			X		X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FOREST MANAGEMENT (20 Hours)**	
	1	Forest management – definition, scope, objectives and principles
	2	Sustainable Forest Management (SFM)-criteria and indicators;
		a) sustained yield – definition, principles and limitations.
		b) increasing and progressive yields.
		c) Normal forest – definitions, factors of normality
		d) Rotation – definitions, types, length and choice of rotation

		e) Factors influencing yield and growth of stands
	3	Working plan
		a) preparation, objectives, uses
		b) NWPC 2014
		c) forest maps; Different types – methods of preparation and uses
	4	Joint Forest Management (JFM) – concept, principles, and role of communities.
2	**MODULE TITLE: COMMUNITY AND SOCIAL FORESTRY (15 Hours)**	
	1	Community forest management and development
		a) socio-economic and environmental aspects; role of NGOs, civil societies, citizen groups
		b) Social forestry for fodder, fuelwood, leaf manure, timber production
	2	People’s participation in forest conservation
		a) National Forest Policy 1988
		b) NCA report 1976
	3	Gender dimensions in forest management
	4	Introduction to multiple-use forest management.
3	**MODULE TITLE: PLANTATION FORESTRY (20 Hours)**	
	1	Plantation forestry – definition, scope, history, development, organization, and structure.
		a) Plantation records, Plantation Journals and maps.
		b) Choice of species – exotics vs. indigenous; concept of fast growth

		c) Plantation establishment Site preparation– boundary demarcation- ground preparation- levelling- contour terracing- alignment and staking
		d) plantation characteristics; species composition; age-class distribution
	2	Planting
		a) planting stock preparation, planting layout, planting pattern
		b) spacing
		c) general planting rules, protection of newly planted seedlings
	3	Plantation maintenance
		a) tending operations (weeding, cleaning, thinning, pruning, climber control)
		b) tending vs. cultural operations
		c) seedling mortality
		d) singling
		e) re-spacing
	4	Planning plantation enterprise-
		a) National and regional planning
		b) Project appraisal and project implementation
4	**MODULE TITLE: PLANTATION SILVICULTURE AND INDUSTRIAL PLANTATIONS (15 Hours)**	
	1	Dynamics of stand growth
		a) pattern of growth of individual trees;
		b) physiological and silvicultural basis of stand development
		c) CCF, MCA, stand density management, thinning regimes

		d) Site quality evaluation plantation productivity assessment
		e) stand basal area, site index concepts in plantation forestry
		f) growing stock assessment- MAI of different plantations
		g) Factors influencing forest product quality and value. Effects of rotation length on product quality
	2	Stand density management in plantations
		a) Thinning- concept of thinning;
		b) thinning schedules; kinds of thinning
		c) silvicultural regimes
		d) software tools for modelling thinning regimes.
		e) Pruning- need for pruning, timing and intensity of pruning
	3	Industrial plantations and Energy plantations
		a) paper and pulp, matchwood, plywood, MFP plantations.
		b) NTFP-yielding plantations- tannin, resin and turpentine plantations
		c) high-density short rotation plantations; petro crops, TBOs.
		d) Avenue plantations, roadside, railway and canal strip plantations
		e) Clonal plantations
		f) fast growing plantations-myths and reality
		g) Second rotation decline mensurational evidence of the productivity of successive tree crops
	4	Plantations as carbon sinks - concepts of Sequestration
		a) C Substitution and C Conservation functions
		b) LULUCF and REDD concepts

		c) AR-CDM concepts
	5	Final crop stocking
		a) Effects of final crop stocking on crop dimensions
		b) Site occupancy and biomass production.
5	**Teacher Specific Module (5 Hours)**	
	Teachers may introduce topics related to ***emerging trends in forest and plantation management****, such as carbon credit mechanisms, certification systems (FSC, PEFC), climate-smart forestry, or advanced modelling tools for plantation productivity. This ensures contextualization to local/regional issues, current research, or practical field problems.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Bowen, G.D., E. K. S. Nambiar, E.K.S (1984). Nutrition on Plantation Forests. Academic Press, Nature - 516 pages
2. Evans, J. and Turnbull, J.W. (2004). Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP Oxford, 467p.
3. Krishnapillay, B. (2000). Silviculture and Management of teak plantations. Unasylva. 201 (51): 14-21p
4. Nambiar, E.K.S., Cossalter, C and Tiarks.A. (1998). Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.
5. Nambiar, E.K.S. and Brown, A.G. (1997). Management of Soil, Nutrients and Water in Tropical PlantationForests. Australian Centre for Internat. Agricultural Research. 571p.
6. Nyland, R.D. (2016). Silviculture: Concepts and Applications, Third Edition. Waveland Press, 680 pages
7. Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. (2006). Plantation Forestry in the Tropics. Springer Tokyo
8. Balakathiresan, S. (1986).Essentials of Forest Management, Nataraj Publishers, Dehra Dun.

9. Bhattacharya, P., Kandya, A.K. and Krishnakumar (2008). Joint Forest Management in India, Aavishkar Publisher, Jaipur.
10. Desai,V.(1991).Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay.
11. Edmunds, D and Wollenberg, E. (2003). Essentials of Forest Management, Natraj Publishers, Dehra Dun.
12. National Working Plan Code (2014). MoEF, NewDelhi.
13. Osmaston, F.C. (1984). The management of Forests, International Book distributors, Dehra Dun, India, 384 p.
14. Prakash, R. (1986).Forest Management, International Book distributors, Dehra Dun, India, 256p.
15. Recknagel, A.B. and Bentley, J. (1985). Forest Management. International Book distributors ,Dehra Dun, India, 269p.

Suggested Readings:

1. Westoby, J. *Introduction to World Forestry: People and Their Trees*. Basil Blackwell.
2. Tiwari, K.M. *Social Forestry in India*.
3. Kozlowski, T.T. *Growth and Development of Trees*. Academic Press.
4. Parthiban, K.T. *Textbook of Plantation Silviculture*.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define sustained yield in forest management.
2. List two criteria of Sustainable Forest Management (SFM).
3. What is a working plan in forestry?
4. Differentiate between exotics and indigenous species in plantation forestry.

5. What is the purpose of a plantation journal?

6 Mark Questions

1. Explain the scope and necessity of community forestry.
2. Discuss the role of National Forest Policy 1988 in forest conservation.
3. Write a short note on tending operations in plantation forestry.
4. Describe the importance of gender dimensions in forest management.
5. What are the advantages of clonal plantations?

14 Mark Questions

1. Discuss the principles and limitations of sustained yield management with forestry applications.
2. Explain the concept, objectives, and importance of Social Forestry in India.
3. Describe the planning, establishment, and maintenance of plantation forestry in detail.
4. Analyze the role of plantation forestry in industrial development, rural livelihoods, and climate change mitigation.

KU5DSEFOR312 WOOD DEFECTS, DEGRADATION AND PRESERVATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU5DSEFOR312	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides a comprehensive understanding of wood defects, causes and processes of degradation by biological and abiotic agents, and methods of prevention and preservation. It covers insect and fungal pests, weathering, bacterial decay, and modern preservation technologies including eco-friendly treatments. The course enables students to evaluate wood quality, assess deterioration, and apply preservation techniques relevant to forestry and wood-based industries.

Course Prerequisite: Basic knowledge of wood science and forest biology.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the causes of wood degradation by insects, fungi, and other agents	***U***
2	Analyze the types and symptoms of wood defects and evaluate their impact on wood properties.	***An***
3	Apply principles and methods of seasoning and preservation for different wood species	***A***
4	Evaluate the effectiveness and sustainability of modern wood preservatives and protection methods.	***E***

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X			X			X
CO 2			X			X	
CO 3		X	X			X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: WOOD DEGRADATION AND WOOD SEASONING (15 Hours)**	
	1	Biodegradation of wood in use
		a) Types of wood decay
		b) gross characters of decay
	2	Wood–water relationship
		a) shrinkage, swelling, movement
		b) fibre saturation, equilibrium moisture content
	3	Wood Seasoning
		e) principles, merits, methods (air, kiln, chemical)
		f) kiln schedules

		g) refractory classes
	4	Seasoning defects and control measures

2	**MODULE TITLE: DEGRADATION DUE TO INSECTS (20 Hours)**	
	1	Insect pest
		a) natural and plantation forestry
		b) standing and felled trees
		c) timber in storage and fabricated wood
	2	Wood-boring insects:
		a) biology, life history, extent of damage, nature of injury, control
		b) Termites: identification, distribution, importance in forestry, life history, and control measures
	3	Principles of pest management in forestry
		a) natural, nutritional
		b) biotic, silvicultural
		c) mechanical, physical, and chemical methods
	4	Plant protection and quarantine laws
		a) phytosanitary certification
		b) phytosanitary certification

3	**MODULE TITLE: WOOD DETERIORATION BY FUNGI AND OTHER AGENTS (10 Hours)**	
	1	Fungal degradation

		a) white rot, brown rot, soft rot
		b) sapstain, moulds,
		c) blemishes and defects
	2	Biology and life cycle of decay fungi
		a) conditions for fungal survival
	3	Detection of decay
		a) destructive and non-destructive methods
		b) Symptoms, physical, chemical, and microscopic effects of decay and stains
		c) Heart rot in standing trees: management
		d) Decay by bacteria; biochemistry of decay-Ecology of microbial invasion of wood
		e) Abiotic agents: Wind, rain, temperature, (weathering) effects Fire, grazing, logging and other wood working tools, Creep (failure in service life due to aging)
	4	Natural decay resistance of timbers
		a) causes, evaluation, and testing
		b) Graveyard tests, decay-resistant woods

4	**MODULE TITLE: WOOD PRESERVATION (15 Hours)**	
	1	Importance of wood preservation
		a) Principles and processes
		b) Naturaldurability of heart wood and sapwood.
		c) Causes for natural durability
		d) Classification of timbers based on durability

		e) Methodsofdeterminationofnaturaldurability Includingaccelerated methods
	2	Wood preservatives
		a) Preservatives/ preservative materials toxic to various biodegrading agents – their toxicity level
		b) Biodegradable preservatives
		c) Preservation under marine condition
		d) Requirement of an ideal preservative
		e) Types of wood preservative: water soluble, oil-based, organic solvent type
		f) Merits/ de—merits of different preservative compositions in relation to end use.
		g) Recommended preservatives and their retention and penetration for various end uses
	3	Methods of treatment
		a) Non-pressure methods – brushing, spraying, soaking, steeping, hot and cold bath, sap displacement, diffusion, Boucherie, osmosis.
		b) Pressure methods – full-cell, empty-cell (Lowry, Rueping), oscillatory treatments.
		c) Miscellaneous treatments – prophylactic, remedial, bamboo/thatch preservation.
		d) CTPs: design, operation, inspection, economics.
		e) Environmental health and safety measure
		f) Economics of preservative treatment

		g) I S specifications governing preservatives
		h) Chemical modification of wood for bioresistance
	4	Fire protection of timbers
		a) General principles of combustibility
		b) Application of fire-retardant chemicals
		c) Methods of testing fire resistance
5	**Teacher Specific Module (15 Hours)**	
	Directions: Teachers may choose themes relevant to the course, such as Emerging technologies in wood preservation (e.g., nanotechnology, biodegradable preservatives). Field visits to timber depots/seasoning plants. Analysis of IS standards for preservatives.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Khanna, L.S. 1984. Forest Protection, KhannaBandhu, Dehra Dun.
2. Eaton RA and Hale MDC. 1993. Wood: Decay, Pests and Protection. Chapman and Hall.
3. Findlay WPK. 1985. Preservation of Timber in the Tropics. MartinusNijhoff
4. FAO Wood Preservation Manual. 1986. (FAO Forestry Paper No. 76).
5. Richardson BA. 1993. Wood Preservation. E and FN SPON.
6. Franze F.P Kollman and Wilfred A Coles. Principles of wood science and Technology Vol 1 & II Springer Verlag, Berlin.
7. Barry A Rishardson . Wood preservation. Construction press London

Suggested Readings:

1. UngerA,Schnienied,UngerW,(2001),ConservationofWoodArtifacts,Germany:Springer VerlayBerlinHeidelberg 19
2. Thompson,R.,(1991),TheChemistryOfWoodPreservation,Cambridge,TheRoyalSocietyOf Chemistry.
3. Townsend,T.G.,Solo-gabriele,H.,(2006),EnvironmentalImpactsofTreatedWood,NewYork, Taylor&Francis

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define sapstain and its impact on timber.
2. Mention any two differences between heartwood and sapwood in terms of natural durability.
3. What is the Boucherie process of wood preservation?

6-Mark Questions

1. Explain the biology and importance of termites in forestry.
2. Describe different seasoning defects in wood and their control.
3. Write a short note on eco-friendly wood preservatives.

14-Mark Questions

1. Discuss in detail the various methods of wood preservation, highlighting their merits and demerits.
2. Explain the types of fungal degradation of wood, with their biological requirements and management strategies.

KU5DSEFOR313 CERTIFICATION OF FOREST PRODUCTS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU5DSEFOR313	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course introduces the concept and practice of forest certification as a tool for ensuring sustainable forest management and responsible sourcing of forest products. It covers international and national certification schemes, key organizations and legislations, and methods for tracing illegal logging and verifying timber origin. Students will gain insights into the challenges and opportunities of certification in India and its role in international trade and conservation.

Course Prerequisite: Basic knowledge of forestry, forest management principles, and sustainable development concepts.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the principles, processes, and motivations behind forest certification	***U***
2	Analyze the role of certification in global timber trade, sustainable forest management, and prevention of illegal logging.	***An***
3	Apply knowledge of timber tracing methods, including genetic tools and stable isotope analysis, in the context of forest product verification.	***A***

4	Evaluate international and Indian certification schemes and their applications.	***E***

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X			X			X
CO 2			X			X	
CO 3		X	X			X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF FOREST CERTIFICATION (10 Hours)**	
	1	Definition of forest certification
	2	Principal stages in the certification process:
	3	Producer’s motivation for supplying certified products
	4	Key aspects of certification:
		a) Forest Management Unit (FMU)
		b) Chain of Custody (CoC)

2	**MODULE TITLE: PRINCIPLES, ORIGINS, AND ORGANIZATIONS (20 Hours)**	
	1	Principles of sustainable forest management
	2	Origin of certification and historical background.
	3	International organizations responsible: UNECE, ITTO, CIFOR (certification tool kit).
	4	Legislations and policies of importance – Lacey Act, FLEGT.

3	**MODULE TITLE: CERTIFICATION SCHEMES AND INDIAN CONTEXT (10 Hours)**	
	1	Certification schemes in operation:
		a) Forest Stewardship Council (FSC) – principles and initiatives in India.
		b) Programme for Endorsement of Forest Certification Schemes (PEFC).
		c) Other schemes: ATFS, CSA, MTCC, etc.
		d) Indian scenario in certification – SFM Cell of MoEF
	2	Responsible sourcing of wood – significance in global forestry.
		a) International trade in tropical logs and sawn wood.
		b) India's share in the world timber trade.
	3	Potential for certifying forests and forest products of India.
	4	Pros and cons of certification.
		a) Case studies in forest certification.

4	**MODULE TITLE: TIMBER TRACING AND EMERGING TECHNOLOGIES (20 Hours)**	
	1	Tracing illegal logging – technologies and practices.

		a) Timber tracing through genetic methods.
	2	Identification of species and region of origin.
	3	Analysis of stable isotope ratios for origin determination.
	4	Application of CIFOR certification toolkit.
5	**Teacher Specific Module (15 Hours)**	
	Directions: This module is to be designed by the course teacher depending on expertise and latest developments. It may include: • *Emerging national and regional certification practices.* • *Field-based case studies of certified forests/products in India.* • *Industry perspectives on certification.* • *Interactive sessions with certification bodies or NGOs.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Cashore, B., Gale, F., Meidinger, E., & Newsom, D. (2006). *Confronting Sustainability: Forest Certification in Developing and Transitioning Countries*. Yale University Press.
2. Rametsteiner, E., & Simula, M. (2003). *Forest certification—an instrument to promote sustainable forest management?* Journal of Environmental Management.
3. Bass, S., Thornber, K., Markopoulos, M., Roberts, S., & Grieg-Gran, M. (2001). *Certification's Impacts on Forests, Stakeholders, and Supply Chains*. IIED, London.

Suggested Readings:

1. FAO (2011). *Forest certification: A review of impacts and assessment frameworks*. FAO Forestry Paper.
2. CIFOR. *Forest Certification Toolkit*.

3. Azhar Ali, A., Sneha, C., Anoop, E.V. (2025). Timber Tracing: The Drive for Greener Supply Chains. In: Elias, A.A., Ramasamy, Y. (eds) Genomics Based Approaches for Tropical Tree Improvement and Conservation. Springer, Singapore. https://doi.org/10.1007/978-981-96-4616-6_12

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define forest certification.
2. What is meant by “responsible sourcing of wood”?
3. State two motivations for producers to supply certified products.
4. What is the Chain of Custody (CoC) certification?
5. Mention two key features of the Bhopal India process.
6. Expand FSC and PEFC.
7. What is the Lacey Act?
8. Give two advantages of certification in forestry.
9. Write two differences between FMU certification and CoC certification.
10. Mention any two certification bodies active in India.

6-Mark Questions

1. Explain the principal stages in the process of certification.
2. Describe the importance of the Working Plan Code in India’s SFM initiatives.
3. Write a short note on the Forest Stewardship Council (FSC) and its role in India.
4. Discuss the pros and cons of certification for forest producers.
5. Explain the concept of “timber tracing” and its role in preventing illegal logging.

14-Mark Questions

1. Discuss the principles of Sustainable Forest Management (SFM). How does certification help in achieving SFM?
2. Trace the origin of forest certification and evaluate the roles of UNECE, ITTO, and CIFOR in its development.
3. Compare FSC and PEFC certification schemes. How suitable are they for India’s forestry sector?
4. Explain in detail the Indian scenario of forest certification, including challenges and opportunities.
5. Describe the technologies available for tracing illegal logging and determining timber origin. How effective are genetic methods and stable isotope analysis?

KU5DSEFOR314 SILVICULTURE OF INDIAN TREES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU5DSEFOR314	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides detailed knowledge of the silvicultural characteristics, ecological requirements, regeneration methods, and management practices of important Indian tree species. Emphasis is placed on both indigenous and exotic species, their ecological roles, economic importance, nursery techniques, and responses to biotic and abiotic factors. The course also examines the challenges posed by pests and diseases and highlights sustainable management practices for maximizing productivity.

Course Prerequisite: Basic understanding of forest ecology and silviculture principles. Familiarity with Indian forest types and distribution of tree species. Introductory knowledge of nursery practices and regeneration methods.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe the silvicultural characteristics, ecological requirements, and phenology of major Indian tree species.	***R***
2	Apply knowledge of natural and artificial regeneration techniques for sustainable management of Indian trees.	***A***
3	Assess the economic importance, industrial utility, and ecological services of Indian trees.	***E***

4	Evaluate the problems of pests, diseases, and biotic interference and suggest management practices.	***C***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X		X			X
CO 2		X	X			X	
CO 3			X		X	X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION AND INDIGENOUS SPECIES I (20 Hours)**	
	1	Silviculture: definition, scope, and significance.
	2	General silvicultural characteristics
		e) distribution
		f) climate & soil requirements
		g) phenology, growth & regeneration methods
	3	Teak (*Tectona grandis*)
		e) origin, distribution, ecological requirements

		f) natural regeneration, artificial regeneration
		g) nursery and plantation practices
		h) pests and diseases
	4A	Sal (*Shorea robusta*)
		f) ecological requirements
		g) regeneration methods
		h) silvicultural characteristics
	4B	Shisham (*Dalbergia sissoo*) and Rosewood (*Dalbergia latifolia*)
		a) silvicultural characteristics, management, pests and diseases.
		b) management, pests and diseases

2	**MODULE TITLE: INDIGENOUS SPECIES II (20 Hours)**	
	1	Sandalwood (*Santalum album*)
		a) Ecology & host requirements
		b) Regeneration & phenology
		c) nursery practices and
	2	Bamboo species (*Dendrocalamus strictus, Bambusa bambos etc*) –
		e) phenology
		f) natural and artificial regeneration
		g) management of bamboo plantations
		h) economic importance
	3	Acacia species (*Acacia nilotica, Acacia catechu*) – regeneration, management, uses.

	4	Terminalia species (*Terminalia arjuna, Terminalia tomentosa)* – silvicultural characteristics and economic importance.
	5	Mangroves (Rhizophora, Avicennia, Sonneratia) – ecology, silvicultural practices, role in coastal protection.

3	**MODULE TITLE: EXOTIC AND PLANTATION SPECIES (10 Hours)**	
	1	*Eucalyptus spp*., controversies and sustainability.
		a) introduction, distribution in India, ecological requirements,
		b) regeneration, productivity
		c) controversies and sustainability.
	2	*Casuarina equisetifolia* –
		a) silvicultural characters and regeneration
		b) role in coastal protection
	3	*Prosopis juliflora* – ecology, regeneration, utility and invasiveness.
	4	*Populus spp.* (Poplar) – silviculture, plantation practices, productivity.
		a) **Other exotic plantation species** – *Albizia, Gmelina arborea, Melia dubia* – importance, regeneration, management.

4	**MODULE TITLE: CONIFERS AND HIGH-ALTITUDE SPECIES (10 Hours)**	
	1	*Pinus roxburghii* (Chir pine) and *Pinus wallichiana* (Blue pine) – silvicultural characteristics, regeneration, management.
	2	*Cedrus deodara* (Deodar) – ecology, silviculture, regeneration issues
	3	Abies and Picea species – distribution, ecological requirements, regeneration.

	4	High-altitude silviculture – constraints, management of coniferous forests in Himalayas.
5	**Teacher Specific Module (15 Hours)**	
	Directions: This module is to be Prepared by the course instructor depending on specialization and regional context. Possible themes: • *Silviculture of locally important species not covered in modules I–IV.* • *Case studies on successful regeneration projects.* • *Role of Indian tree species in climate change mitigation and carbon sequestration.* • *Integration of traditional knowledge in silvicultural practices.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Bebarta. K.C. (1999). Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun
2. Champion, H.G. and Griffith, A.L.. (1989). Manual for General Silviculture for India, EBD Educational
3. ICFRE booklets on tree species
4. Kadambi, K. (1993). Silviculture and Management of teak. Nataraj Publishers, Dehra Dun. p. 137.
5. Lamprecht H (1989). Silviculture in the Tropics. GTZ, GmBH, FRG
6. Luna, R. K. (1996). Plantation trees. International Book Distributors, Dehradun 975p. 8. Smith, D.M., Forest
7. Renuka, C., Pandalai, R.C. and Mohanan, C. (2002) Nursery and silvicultural techniques for rattan, Kerala Forest research Institute.
8. Seethalakshmi, K.K. and Kumar, M. (1998). Bamboos of India- a compendium. BIC India, Kerala Forest Research Institute, Peechi and International Network for Bamboo and Rattan, New Delhi, India, 342 pp
9. Troup, R.S. (1975). Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun.

Suggested Readings:

1. FAO (1995). Silviculture of Dry Zone Trees. FAO Forestry Paper.
2. Kaushik, P. (2017). Silviculture of Indian Trees – Advances and Practices.
3. Puri, G.S. (1980). Indian Forest Ecology and Silviculture.
4. Selected ICFRE and State Forest Department manuals.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define silviculture and its scope in Indian forestry.
2. Mention two regeneration methods of teak.
3. List any two ecological requirements of sandalwood.
4. Name two mangrove species common in India.
5. What are the main uses of bamboo in forestry?

6-Mark Questions

1. Describe the silvicultural characteristics of sal (*Shorea robusta*).
2. Explain the regeneration and management practices of *Dalbergia sissoo*.
3. Discuss the silvicultural practices for bamboo species.

4. Write a short note on the silviculture of *Eucalyptus spp.* in India.
5. Describe the ecological role and management of mangrove species.

14-Mark Questions

1. Discuss the silvicultural characteristics, regeneration methods, and management practices of teak (*Tectona grandis*).
2. Explain the silviculture of sandalwood (*Santalum album*) and its economic importance.
3. Evaluate the ecological requirements, regeneration methods, and management practices of important Himalayan conifers.
4. Plantation silviculture of exotics in India has both opportunities and controversies. Discuss with suitable examples.

KU6DSEFOR315 FOREST SEED TECHNOLOGY AND NURSERY MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	DSE	300-399	KU5DSEFOR315	4	75

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides students with knowledge of forest seed biology, seed handling, seed technology, and nursery management. It covers seed development, maturation, dispersal, collection, storage, testing, and certification, alongside nursery establishment, techniques, and management practices. Emphasis is placed on ensuring seed quality, nursery efficiency, and successful regeneration in forestry practices, with insights into emerging trends in tropical seed technology and nursery management.

Course Prerequisite:

Basic knowledge of plant biology and botany. Ability to follow laboratory instructions and basic field methods related to seed handling and nursery work.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the biological processes of seed development, maturation, dispersal, and germination.	***R***
2	Apply knowledge of seed collection, processing, storage, and testing in forestry practices.	***A***
3	Analyze nursery establishment techniques, stock production systems, and management practices.	***An***
4	Evaluate emerging trends, quality standards, and legal aspects in seed technology and nursery management.	***E***

***Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)**

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X		X	X			
CO 2	X			X			
CO 3	X	X					X
CO 4	X			X		X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: FOREST SEED BIOLOGY AND DEVELOPMENT (18 Hours)**	
	1	Reproductive biology in plants
		a) Seed development
		b) maturation
		c) structure, and dispersal
	2	Seed germination
		a) types, steps, factors affecting germination
		b) stimulators, and inhibitors.
		c) Seed classes: orthodox and recalcitrant

	3	Seed collection
		a) indices of maturity
		b) seed production areas
		c) seed orchards
		d) seed-bearing years
	4	Handling of fruits and seeds
		a) extraction and drying
		b) viability maintenance
		c) precautions for recalcitrant seeds
2	**MODULE TITLE: SEED PROCESSING, STORAGE, AND TESTING (18 Hours)**	
	1	Seed processing – principles, objectives, cleaning, grading, and drying methods.
	2	Seed treatments
		a) presowing
		b) prestorage
		c) mid-storage treatments
		d) pelleting
	3	Seed storage
		a) Harrington’s rule of thumb
		b) storage conditions
		c) methods and containers
		d) Seed dormancy – types and treatments for breaking dormancy
	4	Seed testing and certification

		b) ISTA rules, sampling methods, instruments, purity, germination, viability, and vigour testing
		c) Seed certification, Seed Act, and seed law enforcement
3	**MODULE TITLE: FOREST NURSERY (20 Hours)**	
	1	Nursery technology – scope and planning
		a) Site selection, layout, and types of nurseries
	2	Bare-root nursery techniques
		a) nursery beds, fumigation, sowing, watering, shading, pruning, root culturing, grading, packaging, and transport
		b) Advantages and disadvantages of bare-root system
	3	Containerized nursery techniques
		a) containers, rooting media, root trainer systems, acclimation, and planting methods
		b) Advantages and disadvantages of containerized systems
	4	Target seedling concept
		a) factors affecting seedling quality
4	**MODULE TITLE: NURSERY MANAGEMENT, PESTS, AND DISEASES (13 Hours)**	
	1	Management of nursery pests and diseases
		a) Common Nursery Pests - Defoliators, Borers – shoot borers, stem borers, and root borers, Sap suckers, Cutworms & termites b) Common Nursery Diseases - Fungal Diseases, Bacterial Diseases, Viral Diseases, Physiological/Abiotic Disorders
	2	Integrated Pest and Disease Management (IPDM) in Nurseries
		a) Preventive measures
		b) Cultural practices: Sanitation, solarization, fumigation, or steam

		c) Biological control
		d) Chemical measures
	3	Nursery practices for important tree species
	4	Emerging trends in tropical forest nursery management
5	**Teacher Specific Module (30 Hours)**	
	This flexible module is to be developed by the teacher handling the course. It may include local case studies, practical demonstrations, advanced seed technology, nursery automation, climate-resilient nursery practices, or value-addition opportunities. Teachers are encouraged to tailor this module to link classroom theory with regional forestry practices.	
	Space to fill the selected area/ activity	

Essential Readings:

1. Agrawal, R.L. (1996) Seed Technology. Oxford - IBH Publishing Co. New Delhi Agrobios
2. Ahuja PS, Mathur J, Lai N, Mathur A, Kukreja AK (1989). Towards developing artificial seeds by shoot bud encapsulation. In: Kukreja AK, Mthur A, Ahuja PS and Thakur RS (eds), Tissue culture and Biotechnology of medicinal and aromatic plants. Lucknow. India. CIMAP pp. 20- 78
3. Carol C. Baskin and Jerry M. Baskin. 2000. Seeds: Ecology, Biogeography, and Evolution of Dormancy and Germination. Academic Press; New edition
4. Chacko KC, Pandalai RC, Seethalakshmi KK, Mohanan C, Mathew G, Sasidharan N. (2002) Manual of seeds of Forest trees, Bamboos and Rattans. Kerala Forest Research Institute, Peechi, Thrissur, Kerala, India.
5. Chin, H.F. and Roberts, E.H. 1980. Recalcitrant crop seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia
6. Edwards, D. G. W. and Naithani)1999(. C .S Seed and nursery technology of forest trees.New Age International (P) Limited
7. Dharmaligam C., Sivasubramaniam K., Yadav Shiv K. **(**2007). A Dictionary of Seed technological Terms. Kalyani Publishers,
8. Dutta, M. and Saini, G.C. (2009). Forest tree improvement and seed technology International Book Distributors, Dehra Dun 302 p.
9. ISTA. (2016). International Rules for Seed Testing Rules., http://doi.org/10.15258/istarules.2016.i

10. Khullar, P., Thapliyal, R.C.;,Beniwal, B.S., Vashasya, R.K. and Sharma, A. (2003). Forest Seed. ICFRE Publication, Dehradun
11. Leadem, C.L. (1984) Quick tests for tree seed viability. BC Ministry of Forests, Reserach Branch. Land Management Handbook No. 18. 45 pp.
12. Ramamoorthy. K., K., Sivasubramaniam and A. Kannan (2006). Seed legislation in India, Agrobios
13. Schmidt, L. (2000) Guide to handling tropical and subtropical forest seed. Danida Schmidt. L. (2007) Tropical forest seed. Springer New York. 409 p.
14. Willan, R.L. (1985) A guide to forest seed handling. FAO Forestry Paper 20/

Suggested Readings:

1. Duryea ML, Landis TD (2004) Forest nursery manual: production of bareroot seedlings. Martinus Nijhoff/Dr W Junk Publ, The Hague. http://dx.doi.org/10.1007/978-94-009-6110-4
2. Evans J and Turnbull W.J. (2004) Plantation forestry in the tropics. Oxford University Press - Oxford. 482p.
3. Kumar, V. (2006) Nursery and plantation practices in forestry. Scientific publication. Jodhpur.
4. May, J.T., Belcher, Jr. E. W., Cordell, C.E., Filer, Jr. T. H., David South, and Lantz. C. W. (1985). Southern Pine Nursery Handbook, USDA Forest Service, Southern Region, Cooperative Forestry
5. Napier, I. and Robbins, M. (1989) Forest seed and nursery practice in Nepal. Nepal-UK Forestry Research Project, Kathmandu
6. Prakash, R. Chaudhari, D.C. and Negi, S.S. (1990) Propagation practices of important Indian trees. International Book Distributors, Dehra Dun.
7. Prakash, R. Chaudhari, D.C. and Negi, S.S. (1998) Plantation and NurseryTechniques of Forest Trees. International Book Distributors, Dehra Dun.
8. Singh V and Lavania S.K. (2003) Forest tree seeds and nursery management. Bishan Singh Mahendra Pal Singh , Dehra Dun
9. Wilkinson KM, Landis TD, Haase DL, Daley BF, Dumroese R.K. (2014). Tropical Nursery Manual: a Guide to Starting and Operating a Nursery for Native and Traditional Plants. Agric Handbk 732. US Dept Agric Forest Serv, Washington, DC

Assessment Rubrics:

Evaluation Type	Marks
End Semester Evaluation	**70**
Continuous Evaluation	**30**

a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define orthodox and recalcitrant seeds with one example each.
2. List three factors that affect seed germination.
3. What is the target seedling concept?
4. Mention two seed dormancy-breaking treatments.
5. Name any two common nursery pests.

6 Mark Questions

1. Explain the importance of proper seed collection in forestry.
2. Describe the Harrington’s Rule of Thumb in seed storage.
3. Compare bare-root nursery and containerized nursery techniques.
4. Write a short note on seed testing methods as per ISTA rules.
5. Discuss the role of mycorrhizae in nursery seedling growth.

14 Mark Questions

1. Explain the process of seed collection, processing, and storage in forestry. How do these influence seed quality?
2. Discuss the different types of seed dormancy and methods to overcome them.
3. Describe nursery establishment and management practices for containerized seedlings.
4. Evaluate the challenges of seed technology and nursery management in tropical forestry.
5. “Seed quality is the foundation of successful forest regeneration.” Discuss with reference to seed testing, certification, and legal aspects.

KU6SECFOR334 DRONE APPLICATION IN NATURAL RESOURCE MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECFOR334	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: The Application of Drones in Natural Resource Management is a Value-Added course designed to equip students with the knowledge and skills needed to effectively utilize unmanned aerial vehicles (UAVs) or drones for monitoring, assessment, and management of natural resources. Drones have emerged as powerful tools in various fields, and this course focuses on their applications in environmental conservation, forestry, agriculture, and other sectors related to natural resource management.

Course Prerequisite:

No formal prerequisites.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Demonstrate a comprehensive understanding of drone technology	***R***
2	Apply drone technology in tree health assessment, monitoring wildlife, ecosystems and fire detection	***A***
3	Comply with relevant regulations and legal frameworks governing drone operations in natural resource management	***An***

4	Safely and effectively deploy drones for various natural resource management tasks	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X		X			X	
CO 2		X	X			X	X
CO 3	X	X	X	X		X	X
CO 4		X			X	X	

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO DRONE TECHNOLOGY (10 HOURS)**	
	1	Unmanned Aerial Vehicles (UAVs)
		a) Types
		b) Functionalities
	2	Structural classification of drones
		a) Fixed wing
		b) Single-rotor

		c) Multi-rotor
	3	Classification of Drones based on size
		a) Micro Drones
		b) b) Mini Drones
		c) Consumer Drones
		d) Commercial Drones
	4	Evolution of drone technology in India
		a) Initial adoption and early uses
		b) Key milestones in the evolution of drone technology
		c) Role of drones in national security and surveillance

2	**MODULE TITLE: ESSENTIALS OF DRONE OPERATION (10 HOURS)**	
	1	Basic principles of safe drone operation
	2	Basic Controls in drone operations
		a) Pitching
		b) Rolling
		c) Yawing
	3	Key features of drone regulations
		a) Notification of final regulations for civil use
		b) No drone zones
		c) Enforcement actions

		d) Relevant sections of aircraft act-1934
	4	Rules, Regulations, Standards & Practices
	5	Ethical concerns in drone use

3	**MODULE TITLE: APPLICATIONS OF DRONES IN NATURAL RESOURCE MANAGEMENT (10 HOURS)**	
	1	Applications of drones in Natural Resource Management
		c) Tree health assessment
		d) Deforestation monitoring
		e) Crop monitoring and yield estimation
	2	Using drones for ecosystem and wildlife monitoring
	3	Disaster Management and risk assessment
	4	GIS and remote sensing with reference to drone technology

4	**MODULE TITLE: APPLICATION OF DRONES IN ENVIRONMENTAL CONSERVATION (10 HOURS)**	
	1	Water Resource Management
		a) Drones in watershed and water quality monitoring
		b) Applications in managing irrigation systems
	2	Soil and Land Management
		a) Soil health assessment using drone technology
		b) Drones in erosion control and land degradation monitoring

	3	Marine and Coastal Resource Management
		a) Monitoring coastal erosion and marine habitats
		b) Applications in tracking and protecting marine life

5	**Teacher Specific Module (5 HOURS)**
	Directions
	Space to fill the selected area/ activity

Essential Readings

1. Kale, Atharva Abhijeet. "Drone Technology and Its Applications." Available at SSRN 3922787 (2021).
2. Prasad, Rajat, and K. V. S. Pavan Kumar. "Regulatory Evolution for Civilian Use of Drones in India." Indian Journal of Science and Technology, 2020.
3. Ministry of Civil Aviation, Government of India. Drone Ecosystem Policy Roadmap. 2021. Download PDF.

Suggested Readings

1. Sanderson, J. "Drone Flight Training Manual: Basic Controls and Maneuvers." Drone Pilot Ground School, 2020.
2. Ministry of Civil Aviation, Government of India. Drone Rules, 2021
3. Colomina, Ismael, and Pere Molina. "Unmanned aerial systems for photogrammetry and remote sensing: A review." ISPRS Journal of photogrammetry and remote sensing 92 (2014): 79-97.
4. Nowak, Maciej & Bogawski, Paweł & Dziób, Katarzyna. (2019). Unmanned Aerial Vehicles (UAVs) in environmental biology: A review. European Journal of Ecology. 4. 56-74. 10.2478/eje-2018-0012.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define UAV and list its major types.
2. Differentiate between fixed-wing and multi-rotor drones.
3. Mention two key milestones in the evolution of drone technology in India.
4. What is a “no-drone zone”?
5. List two applications of drones in agriculture.

6 Mark Questions

1. Explain the basic principles of safe drone operation.
2. Discuss the role of drones in disaster management and risk assessment.
3. Describe tree health assessment using drones.
4. Write a short note on drone-based soil health assessment.
5. Explain ethical concerns associated with drone usage.

14 Mark Questions

1. Discuss the major applications of drones in forestry, agriculture, and wildlife monitoring.
2. Evaluate the role of drone technology in environmental conservation with reference to water, soil, and coastal resource management.

KU6SECFOR335 CONSERVATION PHOTOGRAPHY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECFOR335	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course introduces the principles and practices of conservation photography as a tool for environmental awareness and biodiversity protection. It blends fundamentals of photography with specialized approaches to documenting wildlife, habitats, landscapes, and human-nature interactions. The course emphasizes ethics, storytelling, technical skills, and the role of photography in conservation campaigns, research, and policy advocacy.

Course Prerequisite: Basic understanding of digital photography (camera operation, framing, exposure) is desirable. No advanced photography background required.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the concepts, scope, and ethics of conservation photography	***U***
2	Apply photographic techniques for documenting wildlife, habitats, and landscapes.	***A***
3	Critically evaluate and curate photographs for conservation campaigns, exhibitions, and outreach.	***E***

4	Demonstrate the use of photography in biodiversity documentation, conservation awareness, and policy advocacy.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X			X			
CO 2		X	X				
CO 3		X				X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO CONSERVATION PHOTOGRAPHY (10 HOURS)**	
	1	Conservation photography
		a) definition, scope, and relevance
		b) Differences from nature/wildlife photography
	2	Role in biodiversity conservation and public awareness
	3	Historical evolution and global pioneers
	4	Ethics and responsibilities in conservation photography

2	**MODULE TITLE: FUNDAMENTALS OF PHOTOGRAPHY FOR CONSERVATION (10 HOURS)**	
	1	Camera types, lenses, and accessories for fieldwork
	2	Exposure triangle: aperture, shutter speed, ISO
		a) Lighting techniques in natural environments
	3	Composition principles
		a) framing, perspective
		b) rule of thirds
		c) storytelling composition
	4	Basics of field craft and minimizing disturbance to species/habitats

3	**MODULE TITLE: TECHNIQUES AND APPLICATIONS (10 HOURS)**	
	1	Macro photography for plants, insects, and small fauna
	2	Telephoto techniques for wildlife documentation
	3	Landscape photography and habitat documentation
	4	Role of camera traps and remote photography

4	**MODULE TITLE: ADVANCED FIELD TECHNIQUES AND SKILLS (10 HOURS)**	
	1	Mastering manual settings for challenging conditions
		a) Techniques for capturing fast-moving subjects
		b) Low-light photography

	2	Introduction to post-processing software for wildlife photography
	3	Developing a narrative through a series of images
	4	Selecting and curating images for a cohesive wildlife photography portfolio

5	**Teacher Specific Module (5 HOURS)**
	To be developed by the course instructor. *Suggested directions:* • *Local biodiversity documentation projects (flora/fauna)* • *Field assignments with forest/nature departments* • *Student exhibition/competition on a conservation theme* • *Guest lectures by practicing photographers/conservationists*
	Space to fill the selected area/ activity

Essential Readings

1. Sahney, A. (2019). *Wildlife Photography: A Beginner's Guide*.
2. Gombart, J. (2018). *Conservation Photography Handbook*.
3. Choudhary, R. (2020). *Wildlife and Conservation Communication in India*.

Suggested Readings

1. Beehler, B. (2017). *A Field Guide to Conservation Photography*.
2. Freeman, M. (2021). *The Photographer's Storytelling Guide*.
3. National Geographic Learning Resources on Conservation and Photography.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define conservation photography and differentiate it from wildlife photography.
2. List three ethical guidelines in conservation photography.
3. What is the role of camera traps in biodiversity studies?
4. State the importance of composition in conservation photography.

6 Mark Questions

1. Explain how photography can support conservation campaigns.
2. Discuss techniques used for documenting endangered species.
3. What are the challenges of photographing in natural habitats?
4. Describe the role of drones in conservation photography.

14 Mark Questions

1. Critically evaluate the importance of ethics in conservation photography with examples.
2. Discuss the applications of conservation photography in biodiversity documentation, awareness creation, and policy advocacy.

KU6SECFOR336 IoT IN PLANT NURSERY AUTOMATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECFOR336	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: IoT in Plant Nursery Automation" is a skill enhancement course designed to provide students with comprehensive knowledge and practical skills in using Internet of Things (IoT) technologies to automate and optimize plant nurseries. The course covers the fundamentals of IoT, sensor integration, data analysis, and automation techniques tailored specifically for plant nursery management. Students will learn to implement IoT solutions to monitor and control environmental conditions, enhance plant health, and improve operational efficiency.

Course Prerequisite: Basic understanding of computer applications and network concepts. Familiarity with nursery management practices will be advantageous.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Understand the fundamentals of IoT and its applications in plant nursery automation	***U***
2	Implement and manage IoT systems to monitor and control nursery environments	***A***
3	Analyze data collected from IoT devices to make informed decisions for plant health and growth	***An***

4	Design and deploy automated irrigation and climate control systems using IoT technologies	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X	X				
CO 3						X	
CO 4		X					X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO IoT IN PLANT NURSERY AUTOMATION (10 HOURS)**	
	1	Fundamentals of IoT
		a) Definition and components
		b) IoT architecture
	2	Applications of IoT in Agriculture
		a) Benefits and challenges
		b) Case studies in plant nurseries

	3	Sensors and Actuators in Plant Nurseries
		a) Types of sensors (temperature, humidity, soil moisture, light)
		b) Integration and functionality

2	**MODULE TITLE: IoT SYSTEM IMPLEMENTATION (10 HOURS)**	
	1	Setting Up IoT Systems
		a) Hardware and software requirements
		b) Connectivity options (Wi-Fi, Bluetooth, Zigbee)
	2	Data Collection and Management
		a) Data acquisition
		b) Cloud storage and data processing
	3	Automation in Plant Nurseries
		a) Automated irrigation systems
		b) Climate control systems

3	**MODULE TITLE: DATA ANALYSIS AND DECISION MAKING (10 HOURS)**	
	1	Data Analytics in IoT
		a) Basic concepts of data analysis
		b) Tools and techniques
	2	Interpretation of Sensor Data

		a) Analyzing environmental data
		b) Predictive analytics for plant health
	3	Decision Support Systems
		a) Implementing DSS in nurseries

4	**MODULE TITLE: DESIGN AND DEPLOYMENT OF IOT SYSTEMS (10 HOURS)**	
	1	IoT System Design
		a) Principles of designing IoT solutions
		b) Prototyping and testing
	2	Deployment Strategies
		a) Installation and maintenance
		b) Scalability and security considerations
	3	Performance Evaluation and Optimization
		a) Metrics for assessing system performance
		b) Techniques for optimization
	4	Sustainability in Plant Nursery Automation
		a) Environmental impact
		b) Sustainable practices and solutions

5	**Teacher Specific Module (5 HOURS)**
	Directions: Teachers handling the course are encouraged to design a customized module focusing on local or advanced applications of IoT. Possible directions include:

	• *Demonstration of IoT devices in local nurseries.* • *Hands-on sessions with open-source IoT platforms (Arduino, Raspberry Pi).* • *Case studies on Indian nursery automation initiatives.* • *Ethical, economic, and policy aspects of IoT adoption in forestry.*
	Space to fill the selected area/ activity

Essential Readings

1. Singh, R., Gehlot, A., Akram, S.V., Thakur, A.K., Buddhi, D. and Das, P.K., 2022. Forest 4.0: Digitalization of forest using the Internet of Things (IoT). Journal of King Saud University-Computer and Information Sciences, 34(8).
2. Hersent, O., Boswarthick, D., & Elloumi, O. (Year). The Internet of Things: Key Applications and Protocols.
3. Reddy, C.S.D., Bagwari, S., Gehlot, A. and Singh, R., 2022. Crop Survival Analysis Using IoT and Machine Learning. In Internet of Things for Agriculture 4.0 (pp. 155-182). Apple Academic Press.
4. Singh, R., Gehlot, A., Thakur, A.K., Swain, M. and Akram, S.V., 2020. Wireless sensor network with power management system for water level regulation in paddy fields. Int. J. Innov. Technol. Explor. Eng.(IJITEE), 9, pp.1243-1246.

Suggested Readings

1. Arshdeep Bahga, Vijay Madisetti. *Internet of Things: A Hands-On Approach*. Universities Press.
2. M. R. Ramesh et al. *IoT in Agriculture and Forestry*. Springer.
3. Selected case studies and journal articles from *Computers and Electronics in Agriculture* and *IoT-based Smart Agriculture Systems*.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define IoT and list its main components.
2. Mention two challenges of using IoT in agriculture.
3. Name any two sensors commonly used in plant nurseries.
4. What is cloud storage in IoT?
5. List any two environmental impacts of IoT adoption in nurseries.

6 Mark Questions

1. Explain the benefits of IoT in plant nursery automation with examples.
2. Compare Wi-Fi and Zigbee as connectivity options in IoT systems.
3. Discuss how predictive analytics can improve plant health in nurseries.
4. Write a short note on performance evaluation metrics in IoT systems.

14 Mark Questions

1. Explain the process of designing and deploying an IoT system for nursery automation. Discuss the sustainability aspects.

2. Discuss in detail the role of sensors and actuators in automating irrigation and climate control in plant nurseries.

3. Critically analyze the challenges and prospects of adopting IoT in Indian nursery management with case examples.

KU6SECFOR337 WOOD WORKING AND FINISHING TECHNIQUES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	SEC	100-199	KU6SECFOR337	3	45

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	0		25	50	75	1.5

Course Description: This course introduces the fundamentals of woodworking and finishing, equipping students with knowledge and skills in converting timber to commercial forms, carpentry techniques, wood finishing processes, and applications of modern tools including CAD and advanced finishing technologies. Students will gain both theoretical understanding and hands-on experience through practical projects, enabling them to design, construct, and finish wooden products with functional and aesthetic value.

Course Prerequisite: Basic knowledge of wood as a material and its uses in furniture and construction industries.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Identify commercial timber forms, carpentry tools, machines, and hardware used in woodworking.	***U***
2	Apply woodworking techniques to construct basic joints and simple wooden products.	***A***
3	Integrate modern technologies (CAD, advanced finishes, ergonomics) in woodworking and finishing practices.	***E***

4	Demonstrate understanding of finishing processes, coatings, and surface preparation for wood.	***C***

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X					
CO 2		X	X				X
CO 3	X	X		X			
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: FUNDAMENTALS OF WOODWORKING (10 HOURS)**
	1	Conversion of logs into market forms: plank, scantling, log, balk, board, square, etc.
	2	Familiarization with carpentry tools, woodworking machines, and power tools
	3	Basic operations: marking, sawing, planning, and boring.
	4	Identification of hardware and fittings: nails, screws, hinges, etc.

2	**MODULE TITLE: CARPENTRY AND JOINERY PRACTICES (10 HOURS)**

	1	Construction of important joints: lengthening, widening, framing joints
		a) Strength properties and design of structural timber joints
		b) conventional vs new types.
		c) Fasteners strength in single, double and multiple shear
		d) Design of timber joints with nails, bolts, wooden disc dowels, dowel pins, steel ring connectors and adhesives with side members of timber, plywood & MS plates
		e) Scarf, finger and glued lap jointing for load and non-load bearing applications
	2	Design of linear structural components
		b) Beams, Ties, Purlins, Columns, Joints.
		c) Trusses & arches - Configuration, analysis of simply supported 2 hinged ,3 hinged types
	3	Introduction to CAD technology in furniture design;
		a) Learning the basics of making drawings using CAD

3	**MODULE TITLE: WOOD FINISHING TECHNIQUES (10 HOURS)**	
	1	Importance of wood finishing.
	2	Surface preparation: sanding, dust cleaning, wood putties.
	3	Types of finishes
		a) Shellac, lacquer, varnish, drying oils, synthetic resin binders.
		b) Opaque vs. clear finishes
		c) Penetrating vs. non-film forming finishes
	4	Filling and staining methods

		a) pigments, dyes, natural dyes, figure and colour upgrading.
		b) Advanced coatings: UV coating, powder coating, high solid coating, nanotechnology in coatings.

4	**MODULE TITLE: ADVANCED TOPICS IN WOODWORKING & FINISHING (10 HOURS)**	
	1	Ergonomic considerations in furniture design.
	2	Knock-down and bentwood furniture
	3	Advanced woodworking machines used in the industry
	4	Finishing qualities of Indian woods
		a) finish adaptability indices
		b) testing methods for finish properties

5	**Teacher Specific Module**
	To be developed by the course instructor. *Suggested directions:* • *Highlight traditional woodworking or finishing practices unique to Kerala/India (e.g., rosewood in Kerala architecture, bamboo craft, temple carpentry).* • *Introduce new or emerging tools/techniques not covered in the main syllabus (e.g., CNC woodworking, laser cutting, eco-friendly finishes).* • *Arrange **industrial visits** to furniture factories, plywood units, finishing workshops, or handicraft centers.*
	Space to fill the selected area/ activity

Essential Readings

1. Brown, R. (2011). *Encyclopedia of Furniture Making*.
2. Walker, J.C.F. (2006). *Primary Wood Processing: Principles and Practice*. Springer.
3. Collings, T. (2018). *Wood Finishing Techniques*.

Suggested Readings

1. Hoadley, R.B. (2000). *Understanding Wood: A Craftsman's Guide to Wood Technology*.
2. Peters, S. (2015). *Furniture Design*. Laurence King Publishing.
3. FAO (1992). *Wood as an Engineering Material*.

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Sample questions to Test Outcome

2 Mark Questions

1. Define plank, scantling, and board with examples.
2. List three common carpentry tools and their uses.
3. What is the importance of sanding before finishing?
4. Differentiate between opaque and clear wood finishes.
5. Name two advanced woodworking machines used in industry.

6 Mark Questions

1. Explain the steps involved in preparing a working drawing and cutting list for a wooden product.
2. Describe different types of wood joints and their applications.
3. Discuss the role of pigments and dyes in wood staining.
4. Explain ergonomic considerations in furniture design with examples.

14 Mark Questions

1. Discuss the various types of wood finishes and evaluate their suitability for Indian timbers.

2. Elaborate on the applications of CAD and modern woodworking machines in furniture manufacturing.

3. Explain the principles and methods of advanced coating techniques (UV, powder coating, nanotechnology) and their relevance in the wood industry.

KU6INTFOR317 INTERNSHIP, FOREST RANGE TRAINING PROGRAMME AND FORESTRY FIELD EXPERIENCE

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
6	INTERNSHIP	-	KU6INTFOR317	2	120

Learning Approach (Hours/ Week)			Marks Distribution			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
0		0	15	35	50	-

Course Description: This course is designed to provide forestry students with practical, hands-on exposure through internship in forest ranges, training with state forest departments, and a structured all-India study tour to various forestry institutions, industries, and to expose the students to various national /heritage monuments as part of national integration activity. The programme develops professional skills, situational awareness, and field competence required for forestry graduates. It aligns with the objectives of Student READY (Rural Entrepreneurship Awareness Development Yojana) scheme

Course Prerequisite: Successful completion of core forestry courses up to Semester V. Basic knowledge of forest management, silviculture, and forest policy. Physical fitness and willingness for field-oriented training and travel.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Demonstrate practical understanding of forest range operations, silvicultural practices, and forest protection measures	***U***
2	Gain exposure to forestry institutions, industries, NGOs, and community forestry models across India	***A***

3	Acquire skills in field data collection, forest inventory, wildlife observation, and ecological monitoring	***E***
4	Develop professional values, teamwork, leadership, and communication skills through experiential learning	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X					
CO 2		X	X				X
CO 3	X	X		X			
CO 4					X		X

MANDATORY COMPONENTS

1. Summer Internship/ Apprenticeship/ Industrial Placement or Forest Range Training Programme (A or B)

A) All students shall undergo **a Summer Internship/Apprenticeship** in a Firm, Industry, or Organization, or training in labs with faculty/researchers at Higher Education Institutions (HEIs)/Research Institutions.

- Attachment with Forest Based Industries like Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units including AMPRS, Odakkali, Oushadhi, Kottakkal, KAPL, Aluwa, Ayurdhara, etc.
- Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc.
- Works to be undertaken includes study the nature of industrial and business organization–structure, raw material–collection and processing of raw-material, hands on practicals, production and management process, marketing and financial management.

B) Each student shall undergo **Forest Range Training Programme,** a practical training and field work at different forest ranges of Kerala:

- Visit to modern forest nurseries, herbal gardens and watersheds, study the felling and logging operations, timber lots and important industrial products, study working plan, enumeration, volume and yield calculation & compartment history files, study the 'CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies).
- Use of forestry equipments/instruments, Study there generation and management of important forestry tree species, Sample plots, layout studies, stump analysis, preparation of local volume Tables. Study the working of other Forestry related organizations/industries.
- At the Wildlife Sanctuaries/National Parks / Tiger Reserves, the students are expected to learn about the aspects related with the preparation of the Management Plans/Conservation Plans, to undertake and familiarize the various wildlife population enumeration techniques and the biodiversity assessment techniques. To undertake

pilot studies on the man-animal conflict and other issues in the forest areas etc

2. **Forest Field Experience/ All India Study Tour**

   The Forest Field Experience/ All India Study Tour is designed to provide students with a unique opportunity to explore the ecological, silvicultural, and socio-economic diversity of India's forests and natural resources.

   - Through visits to State Agricultural Universities (SAUs), premier research institutions, forest-based industries, government and private organizations, and protected areas across the country, students gain first-hand exposure to contemporary forestry practices, biodiversity conservation initiatives, and forest enterprise management.
   - The tour also includes visits to national and heritage monuments as part of a national integration activity, instilling cultural appreciation and a holistic perspective of India's natural and historical wealth.
   - Students are required to maintain a detailed Tour Diary, document observations, and prepare a comprehensive Study Tour Report, which together form the basis for evaluation.
   - This experiential learning fosters professional competence, broadens environmental and cultural awareness, and builds confidence in applying classroom knowledge to real-world forestry challenges.

3. **Report writing and presentation**

   Each student shall maintain a field diary to record the observations. The student should submit the field diary for internal evaluation. Compilation of the work/experience detailing the objectives, places and persons visited, work done, experiences/skills gained and suggestions for improvement to training. Presentation of the report before faculty. The assessment will be based on Report evaluation, presentation and viva-voce.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**35**
Continuous Evaluation		**15**
a)	Report	5
b)	Viva-Voce	5
c)	Report	5
Total		**50**

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 *(Components and their relative weightage can be decided by the department council)*

KU7DCCFOR401 FOREST ENGINEERING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DCC	400-499	KU7DCCFOR401	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course introduces the fundamental concepts of forest engineering with emphasis on the planning, design, and construction of forest roads, bridges, culverts, retaining structures, and drainage systems. It aims to equip students with knowledge of engineering applications in forestry operations, sustainable infrastructure development in forested terrains, and soil and water conservation measures related to forest works.

Course Prerequisite: Students should have a foundational understanding of soil science, hydrology, and silvicultural operations, and must have completed introductory courses in forest management and mensuration.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains

1	Explain the classification, components, and design principles of forest roads and associated structures.	***R***
2	Understand the engineering principles behind the construction and maintenance of forest infrastructure..	***U***
3	Apply technical knowledge for site selection, alignment, and drainage design for roads and bridges.	***A***
4	Analyze various forest engineering structures like culverts, retaining walls, and check dams in terms of functionality and sustainability.	***An***

******Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X	X					
CO 2		X	X	X			
CO 3			X		X	X	
CO 4					X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: INTRODUCTION TO FOREST ENGINEERING AND BUILDING MATERIALS (15 HOURS)**	
	1	Definition, scope, and importance of forest engineering.
	2	Building materials:
		a) Types
		b) Characteristics, and strength
		c) Suitability in forest operations (stone, wood, cement, sand, steel, concrete).
	3	Site selection for forest buildings
		a) factors influencing selection: topography soil, drainage, accessibility, safety).
	4	Forest infrastructure planning roads, bridges, culverts, and water structures as part of forest management.
		a) roads, bridges, culverts, and water structures as part of forest management

2	**MODULE TITLE: FOREST ROADS (15 HOURS)**	
	1	Classification of forest roads – permanent, temporary, extraction roads, approach roads.
	2	Components and cross-section of roads:
		a) Sealing coat, outer coat & inner coat
		b) soling, sub-base & sub-grade,
		c) shoulders & camber
		d) gradient, and kinds of gradients.
	3	Road alignment and design
		a) principles

		b) horizontal and vertical alignment
		c) curves
	4	Drainage of forest roads
		a) surface and subsurface drainage methods
		b) Retaining and breast walls

3	**MODULE TITLE: BRIDGES AND CULVERTS (20 HOURS)**	
	1	Importance, site selection, and types of bridges –
		a) Ford & road dam
		b) Irish bridge & causeways
		c) simple wooden beam bridge
		d) cantilever bridge
		e) suspension bridge.
	2	Culverts: Functions, design, and classification
		a) pipe, box, arched, timber pole, and masonry arched culverts.
	3	Abutments and piers – types, structure, and functions (masonry abutments, timber abutments, pile and trestle piers).
	4	Bridge maintenance and safety – inspection, rehabilitation, and environmental considerations.

4	**MODULE TITLE: HYDROLOGICAL STRUCTURES IN FORESTRY (15 HOURS)**	
	1	Check dams, farm ponds, and earth dams – purpose, design, and maintenance.
	2	Erosion control structures and soil conservation engineering principles in forest areas

	3	Waterways – design and importance in preventing road and slope erosion.
	4	Sustainability and eco-engineering approaches in forest water management.
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Include case studies or field-based assignments on local forest engineering works.* • *Conduct a mini-project on designing a forest road segment or small bridge structure.* • *Arrange visits to nearby forest ranges, PWD sites, or forest road construction projects.* • *Integrate GIS or drone mapping applications in forest infrastructure planning.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Banjade, M.R. (2018). Forest Engineering: Principles and Practices. Himalayan Publications.
2. FAO (1992). Forest Roads and Environment. FAO Forestry Paper No. 107.
3. Sahay, R.R. (2010). Construction and Maintenance of Forest Roads. Scientific Publishers, India.
4. Ghosh, S.N. (2008). Forest Engineering and Road Construction. International Book Distributors.
5. Hudson, N.W. (1981). Soil Conservation. B.T. Batsford Ltd.
6. Ministry of Environment, Forest and Climate Change (2014). Manual on Forest Road Construction and Maintenance, Govt. of India.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Mark Questions

1. Define forest engineering and mention its scope.
2. What are the main types of forest roads?
3. List any three functions of a retaining wall.
4. What is camber and why is it important in road design?
5. Name different types of culverts used in forest areas.

6-Mark Questions

1. Explain the factors to be considered for site selection in forest construction projects.
2. Discuss the process of road alignment and the principles involved.
3. Describe the different types of gradients used in forest roads.
4. Compare the design and function of pipe and box culverts.
5. Explain the role of check dams in forest water management.

14-Mark Questions

1. Discuss in detail the components, design, and maintenance of a forest road.
2. Explain the different types of bridges used in forest engineering with neat sketches.
3. Describe the drainage system of forest roads and its importance for road longevity.
4. Evaluate the role of forest engineering in sustainable forest management with suitable examples.

KU7DCCFOR402 FOREST HYDROLOGY AND WATERSHED MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DCC	400-499	KU7DCCFOR402	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides an in-depth understanding of forest hydrology, emphasizing the hydrological cycle, soil erosion processes, and watershed dynamics. It focuses on forest–water interactions, watershed classification, water harvesting, and soil and water conservation measures essential for sustainable forest management. Students will gain insights into hydrological data analysis, land capability classification, and the role of forests in maintaining watershed stability and water quality.

Course Prerequisite: Students must have completed foundational courses in soil science, forest ecology, and environmental management. Basic knowledge of GIS and hydrological concepts is recommended.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Critically analyze the interrelationships between forest ecosystems and hydrological processes, and evaluate their implications for water balance and watershed sustainability.	***A***

2	Interpret and model hydrological data to quantify runoff, infiltration, and evapotranspiration for assessing water yield and watershed response.	***E***
3	Design and evaluate soil and water conservation measures based on erosion assessment models (USLE, RUSLE) and terrain characteristics.	***C***
4	Formulate integrated watershed management plans by synthesizing ecological, hydrological, and socio-economic data, incorporating both traditional and modern approaches to water resource management.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							
CO 2			X				
CO 3			X		X	X	
CO 4							

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF FOREST HYDROLOGY (20 Hours)**	

	1	Hydrology – definition, importance, and scope.
	2	Hydrological cycle – components and processes.
	3	Rainfall
		a) characteristics, & types
		b) measurement (rain gauges, rainfall intensity, frequency, and distribution)
	4	Forest features of hydrologic significance
		a) soil organic matter, plant roots, canopy interception, and sheltering effects
	5	Hydrological processes in forest lands
		a) infiltration, overland flow, erosion, sedimentation, storage, and drainage
		b) Stream flow and groundwater recharge

2	**MODULE TITLE: SOIL EROSION AND CONSERVATION (15 Hours)**	
	1	Soil erosion
		a) Water erosion – mechanisms, types, and conservation methods.
		b) Wind erosion – mechanisms, types, and control measures.
		c) Universal Soil Loss Equation (USLE) – factors and applications.
	2	Hydrological evaluation of land treatment
		a) infiltration procedures, and multiple regression,
		b) regional and hydrographic analyses.
	3	Soil conservation in India- problems, national programmes, and achievements.
	4	Land use capability classification

3	**MODULE TITLE: WATERSHED HYDROLOGY AND PROCESSES (20 Hours)**	
	1	Watershed – definition, and components
		a) classification
		b) Characteristics of small and medium watersheds.
	2	Precipitation, infiltration, runoff, and evapotranspiration – processes and measurement.
	3	Runoff hydrographs – total and peak runoff estimation.
	4	Soil water storage – pore space, available water capacity, and soil moisture relationships.
	5	Stream flow and water yield – attributes, rate regime, and quality.
	6	Hydrological cycle and water balance – computation and applications in forest management.

4	**MODULE TITLE: WATERSHED AND LAND MANAGEMENT (10 Hours)**	
	1	History and evolution of watershed management
		a) Principles and objectives of watershed management
	2	Water harvesting techniques –
		a) traditional systems (tanks, bunds, khadins)
		b) modern systems (check dams, percolation tanks, farm ponds)
	3	Land management problems in India – soil degradation, erosion control, rotational grazing, and dryland farming.
	4	Stream zone management – riparian buffers, sediment control, and thermal regulation.
5	**Teacher Specific Module (10 Hours)**	

	This module shall be designed and implemented by the teacher handling the course. *Suggested directions include:* • *Field-based case studies of watershed management projects in Kerala.* • *Demonstration of hydrological instruments and rainfall–runoff modeling.* • *Mini-project on soil erosion mapping or water harvesting structure design.* • *Guest sessions by professionals from soil and water conservation departments.* • *GIS-based watershed delineation and morphometric analysis exercises.*
	Space to fill the selected area/ activity

Essential Readings:

1. Murthy, J.V.S. (2013). Watershed Management in India. New Age International Publishers
2. Patra, K.C. (2008). Hydrology and Water Resources Engineering. Narosa Publishing.
3. Sharma, K.D. & Singh, R.B. (2002). Watershed Management: Concepts and Principles. Scientific Publishers.
4. FAO (1987). Watershed Management Field Manual. FAO Conservation Guide 13.
5. Singh, G. & Babu, R. (2004). Soil and Water Conservation Engineering. Standard Publishers.
6. Das, M.M. & Saikia, M.D. (2012). Hydrology and Soil Conservation. PHI Learning.
7. Hudson, N.W. (1981). Soil Conservation. B.T. Batsford Ltd.

Assessment Rubrics:

Evaluation Type	Marks

End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

6. Define hydrology and describe its importance in forestry.
7. List the major components of the hydrological cycle.
8. What are the different types of rainfall?
9. Define watershed and its major components.
10. Write any three causes of soil erosion..

6-Mark Questions

1. Explain the role of forests in influencing hydrological processes.
2. Describe the Universal Soil Loss Equation and its factors.
3. Explain the methods of water harvesting used in watershed management.
4. Discuss the causes and control measures of wind erosion.
5. Briefly explain the land use capability classification system.

14-Mark Questions

1. Discuss in detail the hydrological cycle and its relevance in forest ecosystems.
2. Explain the types, causes, and control measures of soil and water erosion.
3. Describe the characteristics and hydrological processes of small and medium watersheds.
4. Evaluate the objectives and principles of watershed management and discuss traditional and modern water harvesting methods.

KU7DCCFOR403 WOOD BASED INDUSTRIES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DCC	400-499	KU7DCCFOR403	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This capstone course provides an advanced understanding of the industrial utilization of wood and its derivatives. It covers the science, technology, and economics of wood-based industries, including sawmilling, plywood, particle board, pulp and paper, matches, veneers, and composite wood manufacturing. Students will analyze raw material selection, production processes, and quality control methods in major and minor wood industries.

Course Prerequisite: Students should have completed introductory courses in Wood Science and Technology, Forest Products, and Forest Utilization. Basic knowledge of industrial processes and forest resource management is expected.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	*Critically evaluate* the structure, organization, and technological processes of major wood-based industries and their role in sustainable forest product utilization	***A***

2	*Analyze and compare* manufacturing technologies, raw material requirements, and quality control in timber, plywood, particle board, pulp, and paper industries.	***E***
3	*Design and assess* strategies for improving efficiency, value addition, and sustainability through innovation and precision silviculture technologies.	***C***
4	*Formulate policy and technological frameworks* for the development of eco-efficient wood industries in alignment with forest resource conservation and circular economy principles.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1				X			
CO 2					X		
CO 3	X						X
CO 4			X				

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO WOOD BASED INDUSTRIES (20 HOURS)**	
	1	Importance and scope of wood-based industries in India. Classification: Primary, secondary, and tertiary industries.

	2	Timber and sawn wood industries – organization, conversion methods, sawing patterns, defects, grading, and utilization.
	3	Constraints in wood-based industries – raw material scarcity, transportation, processing limitations.
	4	Wood demand and supply scenario in India.
	5	Measures for industrial development – precision silviculture, contract farming, technological innovations, value addition, and industrial linkages.

2	**MODULE TITLE: PLYWOOD, VENEER, AND COMPOSITE WOOD INDUSTRIES (20 HOURS)**	
	1	Veneers – manufacture, classification, and uses.
	2	Plywood – manufacture, types, adhesives (natural and synthetic), properties, and uses.
	3	Composite wood products – particle board, fiberboard, hardboard, and MDF: raw materials, manufacturing process, properties, and applications.
	4	Improved wood products – impregnated wood, heat-stabilized wood, compressed wood, chemically modified wood.
	5	Wood-plastic and wood-metal composites – processes, mechanical properties, and industrial applications.

3	**MODULE TITLE: PULP, PAPER, AND MATCH INDUSTRIES (15 HOURS)**	
	1	Pulp and paper industry – introduction, raw materials, pulping methods (mechanical, chemical, semichemical), bleaching, and paper formation.
	2	Manufacture of rayon and cellulose derivatives.
	3	Match industry – species used, match splint preparation, box manufacturing, safety and chemical processes.
	4	Destructive distillation of wood – process, by-products, and applications.

	5	Saccharification of wood – methods and industrial significance.

4	**MODULE TITLE: OTHER WOOD-BASED AND EMERGING INDUSTRIES (10 HOURS)**	
	1	Packing case and joinery industries – processes, materials, and market demand.
	2	Furniture and value addition industries – trends, mechanization, and ergonomic design.
	3	Dendro-biomass power generation – principles, raw material sourcing, and sustainability assessment.
	4	Eco-friendly wood processing technologies – carbon-neutral production, recycling, waste minimization.
	5	Industrial policies and trade – wood product certification, export/import regulations, and government incentives.
5	**Teacher Specific Module (10 Hours)**	
	This module will be developed by the teacher handling the course to provide applied and regional context. *Suggested directions:* • *Field visit to sawmills, plywood or furniture factories, pulp and paper mills.* • *Mini-project on process optimization, value addition, or waste utilization in a wood-based unit.* • *Guest lectures by industry professionals or forest-based entrepreneurs.* • *Case studies on sustainable industrial forestry practices and circular bioeconomy models.* • *Technical demonstration on wood adhesives or veneer preparation.*	
	Space to fill the selected area/ activity	

Essential Readings:

1. Desch, H.E. & Dinwoodie, J.M. (2016). Timber Structure, Properties and Utilization. Macmillan.
2. FAO (1980). Wood-Based Panels and Other Wood Products. FAO Forestry Paper.
3. Browning, B.L. (1963). The Chemistry of Wood. Interscience Publishers.
4. Panshin, A.J. & de Zeeuw, C. (1980). Textbook of Wood Technology. McGraw-Hill.
5. Singh, J. & Kumar, S. (2010). Wood Products and Utilization. Scientific Publishers, India.
6. Bowyer, J.L. et al. (2007). Forest Products and Wood Science: An Introduction. Blackwell Publishing.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Mark Questions

1. Define composite wood and list its main types.
2. What are the advantages of using impregnated wood?
3. Mention any two species commonly used in match industries.
4. What is destructive distillation of wood?

5. Define precision silviculture technology.

6-Mark Questions

1. Explain the manufacturing process of plywood with neat sketches.
2. Discuss the major constraints faced by the wood-based industries in India.
3. Describe the raw materials used in pulp and paper industries.
4. Explain the process and significance of wood-plastic composites.
5. Write short notes on adhesives used in composite wood manufacturing.

14-Mark Questions

1. Discuss the technological processes and challenges in the plywood and veneer industries.
2. Explain the organization, raw materials, and manufacturing steps in the pulp and paper industry.
3. Evaluate the role of value addition and technological innovation in the sustainable development of wood-based industries.
4. Describe the classification, manufacture, and properties of improved and composite wood products.

KU7DCCFOR404 ENVIRONMENTAL IMPACT ASSESSMENT AND AUDITING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DCC	400-499	KU7DCCFOR404	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This capstone course provides a comprehensive understanding of Environmental Impact Assessment (EIA) and Environmental Auditing (EA) as essential tools for sustainable development and environmental governance. It introduces students to the principles, procedures, and methodologies used to evaluate and mitigate the environmental impacts of developmental projects.

Course Prerequisite: Students must have completed foundational courses in Environmental Science, Forest Ecology, and Environmental Management. Familiarity with GIS, remote sensing, and environmental policies is desirable.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Critically analyse the principles, stages, and legislative frameworks of Environmental Impact Assessment (EIA) and its role in sustainable development.	***A***

2	Evaluate various EIA methodologies and analytical tools (checklists, matrices, network models, GIS) to identify and predict environmental impacts.	***E***
3	Design and conduct comprehensive EIA and auditing processes, incorporating public consultation, environmental monitoring, and cost-benefit analysis.	***C***
4	Formulate and assess Environmental Management Plans (EMPs), Environmental Impact Statements (EIS), and auditing frameworks aligned with national and global environmental policies.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2		X				X	
CO 3			X				
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: INTRODUCTION TO ENVIRONMENTAL IMPACT ASSESSMENT (20 HOURS)**	

	1	Environment and its components
		a) concept of ecological imbalance
		b) carrying capacity
		c) sustainable development
	2	Principles and purposes of IEE and EIA
		a) significance to society and environmental governance
		b) principles of EIA management
		c) key stages and procedural frameworks.
	3	Evolution of EIA – history, concepts, and global context.
	4	Cost and benefits of EIA.
		a) EIA involvement during the project life cycle

2	**MODULE TITLE: LEGAL, POLICY, AND REGULATORY FRAMEWORK (15 HOURS)**	
	1	Legislative and clearance procedures in India and abroad
		a) EIA Notification 2006 and its amendments
		b) Environmental laws: Environment Protection Act (1986), Forest Conservation Act (1980), Wildlife Protection Act (1972), Air and Water Acts
	2	EIA Notification 2006 and its amendments
	3	Institutional frameworks
		a) MoEFCC, CPCB, SPCBs, and international agencies
	4	Strategic Environmental Assessment (SEA) – concept, evolution, and applications
	5	Wood-plastic and wood-metal composites – processes, mechanical properties, and industrial applications

3	**MODULE TITLE: EIA METHODOLOGIES AND IMPACT IDENTIFICATION (20 HOURS)**	
	1	EIA Process – screening, scoping, prediction, evaluation, mitigation, and monitoring
	2	Impact assessment techniques – checklists, matrices (Leopold Matrix), overlays, network analysis, and quantitative models
	3	Impact identification and prediction for air, water, soil, flora, fauna, and socio-economic components
	4	GIS and remote sensing applications in EIA and natural resource assessment
	5	Public consultation and stakeholder participation in the EIA process

4	**MODULE TITLE: ENVIRONMENTAL IMPACT REPORTING AND AUDITING (10 HOURS)**	
	1	Environmental Impact Statement (EIS) – structure, formulation, and content
	2	Environmental Management Plan (EMP) – objectives, mitigation hierarchy, and implementation
	3	Environmental Auditing – definition, objectives, types, and procedure
	4	Post-project environmental monitoring and compliance reporting
	5	Economic valuation and cost-benefit analysis in EIA
	6	Case studies
		a) Industrial projects, forestry operations, water resource projects, mining, and infrastructure
		b) New approaches in EIA, SEA, and Environmental Risk Assessment
5	**Teacher Specific Module (10 Hours)**	

	This module will be developed by the teacher handling the course to provide applied and regional context. *Suggested directions:* • *Conduct mini-EIA studies of local development projects (campus construction, plantations, or road works).* • *Organize a mock public hearing or stakeholder consultation exercise.* • *Demonstrate use of GIS and remote sensing for impact mapping.* • *Review real EIA reports and audit statements to evaluate format and effectiveness.* • *Invite industry or government experts to discuss current practices in EIA compliance and auditing.* .
	Space to fill the selected area/ activity

Essential Readings:

1. Canter, L.W. (1996). *Environmental Impact Assessment.* McGraw-Hill Inc., Singapore.
2. Biswas, A.K. & Geping, Q. (1987). *Environmental Impact Assessment for Developing Countries.* Butterworth-Heinemann.
3. Chadwick, A. (2007). *Introduction to Environmental Impact Assessment.* Taylor & Francis.
4. Erickson, P.A. (1994). *A Practical Guide to Environmental Impact Assessment.* Academic Press.

Supplementary Readings:

1. Therivel, R. et al. (1992). *Strategic Environmental Assessment.* Earthscan, London.
2. MOEFCC (2006). *EIA Notification and Guidelines.* Government of India.
3. National Forest Commission Report (2006). Government of India.
4. Claussen, E. et al. (2001). *Climate Change: Science, Strategies and Solutions.* Pew Centre, USA.
5. Koskela, J. et al. (2007). *Climate Change and Forest Genetic Diversity.* Biodiversity International, Rome.

Assessment Rubrics:

Evaluation Type		Marks
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5
d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Marks

1. Define Environmental Impact Assessment (EIA).
2. What are the main objectives of an Environmental Audit?
3. List any three stages involved in the EIA process.
4. Mention any two environmental legislations relevant to EIA in India.
5. What is the role of public consultation in EIA?

6 Marks

1. Explain the significance of EIA in sustainable development.
2. Describe the screening and scoping procedures in EIA.
3. Discuss the role of GIS and remote sensing in environmental impact prediction.
4. Explain the process of environmental auditing.
5. Write short notes on cost-benefit analysis in EIA.

14 Marks

1. Discuss the various methodologies used in Environmental Impact Assessment and their comparative advantages.

2. Explain the structure and purpose of an Environmental Impact Statement (EIS) with examples.
3. Evaluate the legal and institutional framework governing EIA in India.
4. Describe the EIA process in detail and discuss the challenges in its implementation.

KU7DCCFOR405 FOREST PATHOLOGY AND ENTOMOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
7	DCC	400-499	KU7DCCFOR405	4	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
4	0	-	30	70	100	2

Course Description: This course provides an in-depth understanding of forest diseases and insect pests affecting nurseries, plantations, and natural forests. It integrates the study of disease and pest biology, epidemiology, and management with a focus on sustainable and eco-friendly approaches. Students will learn about key forest pathogens, insect pests, and vertebrate threats, their identification, and integrated pest and disease management (IPDM) strategies. The course also covers molecular approaches to disease resistance, wood biodegradation processes, and the ecological role of insects and fungi in forest ecosystems.

Course Prerequisite: Students are expected to have foundational knowledge in forest biology, silviculture, wood science, and forest ecology. Familiarity with plant physiology, microbiology, and pest ecology will enhance understanding. Prior completion of lower-level courses in forest protection and plant pathology is recommended.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Critically evaluate major forest diseases and insect pests, their biology, epidemiology, and impact on forest productivity	***An***

2	Design and implement integrated pest and disease management programs suitable for different forest types	***A***
3	Assess the effects of biotic and abiotic stressors on forest health and ecosystem stability	***E***
4	Integrate molecular, biotechnological, and ecological tools for forest protection and resilience enhancement	***C***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2	X						
CO 3		X	X				
CO 4				X			X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FUNDAMENTALS OF FOREST PATHOLOGY AND ENTOMOLOGY (20 HOURS)**	
	1	Historical development and scope of forest pathology and entomology in India.
	2	Morphology and taxonomy of major insect orders:

		a) Coleoptera, Lepidoptera
		b) Isoptera, Hymenoptera
		c) Orthoptera, Hemiptera
	3	Classification and biology of forest pathogens (fungi, bacteria, viruses)
	4	Principles of disease development and spread
		a) infection process, host–pathogen interaction
	5	Beneficial insects: honey bees, silkworms, and lac insects

2	**MODULE TITLE: PESTS AND DISEASES OF FOREST TREES (15 HOURS)**	
	1	Major pests and diseases of forest nurseries, plantations, avenue trees, and farm forestry
	2	Pathology and entomology of key Indian species:
		a) Tectona grandis, Dalbergia spp., Shorea robusta
		b) Santalum album, Azadirachta indica
		c) Casuarina spp., Eucalyptus spp., and Bambusoideae
	3	Mycoflora and insect pests of seeds—
		a) seed-borne diseases, storage fungi, and their control
	4	Assessment of losses due to pests, diseases, weeds, wildlife, and adverse climatic factors
	5	Disease management principles: exclusion, eradication, immunization, cultural, biological, and chemical methods

3	**MODULE TITLE: FOREST HEALTH AND BIODEGRADATION (20 HOURS)**	
	1	Biodegradation of wood: types of rot (white, brown, soft) and discoloration fungi; microscopic and chemical effects.

	2	Heart rots: biology, ecological significance, compartmentalization, and management.
	3	Role of mycorrhiza in disease suppression and forest health improvement.
	4	Ecological and biochemical processes of wood deterioration; forest fires, grazing, and other mechanical damages.

4	**MODULE TITLE: INTEGRATED FOREST PROTECTION AND MOLECULAR APPROACHES (10 HOURS)**	
	1	Principles and tools of Integrated Pest Management (IPM) and Integrated Disease Management (IDM)
		a) Pest surveillance, forecasting, and economic threshold concepts.
		b) Mechanical, silvicultural, biological, and chemical control methods.
	2	Molecular and biotechnological tools for developing pest- and disease-resistant trees
	3	Eco-friendly and sustainable pest management innovations.
	4	Quarantine regulations and legislative measures in forest protection.
5	**Teacher Specific Module (10 Hours)**	
	This module will be developed by the teacher handling the course to provide applied and regional context. *Suggested directions:* • *Case studies on forest pest outbreaks in Western Ghats or Kerala forests.* • *Hands-on activities: identification of forest pathogens, insect specimens, or disease mapping using GIS.* • *Seminar on “Climate Change and Emerging Forest Pathogens.”* • *Recent research on forest microbiome and resilience.* • *Field-based learning on pest monitoring, sampling, and biological control implementation..*	

	Space to fill the selected area/ activity

Essential Readings

1. Sharma, J.K. (1994). *Forest Pathology: Principles and Practice in Forestry.* ICFRE.
2. Nair, K.S.S. (2007). *Tropical Forest Insect Pests: Ecology, Impact, and Management.* Cambridge University Press.
3. Agrios, G.N. (2015). *Plant Pathology.* Academic Press.
4. Pandey, B.P. (2010). *Entomology and Pest Management.* S. Chand Publications.
5. Ciesla, W.M. (2011). *Forest Entomology: A Global Perspective.* Wiley-Blackwell.

Supplementary Readings

1. Schowalter, T.D. (2011). *Insect Ecology: An Ecosystem Approach.* Academic Press.
2. Borror, D.J. & Johnson, N.F. (1989). *An Introduction to the Study of Insects.* Saunders.
3. Kuc, J. (2010). *Plant Disease Control.* Springer.
4. Singh, P. & Bhandari, R.S. (2017). *Forest Pathology and Protection.* Scientific Publishers**.**

Assessment Rubrics:

Evaluation Type		**Marks**
End Semester Evaluation		**70**
Continuous Evaluation		**30**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment	5

d)	Seminar	2
e)	Book/ Article Review	3
Total		**100**

Sample questions to Test Outcome

3 Marks

1. Define forest pathology and explain its scope in sustainable forestry.
2. Differentiate between heart rot and sap rot.
3. What is the role of mycorrhiza in forest disease management?
4. Define Integrated Pest Management and list its major components.
5. List the major insect pests affecting *Tectona grandis*.

6 Marks

1. Explain the effect of climatic and edaphic factors on pest dynamics in forest ecosystems.
2. Describe the classification and management of forest seed-borne diseases.
3. Discuss the economic threshold concept and its application in pest forecasting.
4. Explain the principles of quarantine and its relevance in forest protection.

14 Marks

1. Critically analyze the significance of Integrated Forest Protection in the context of sustainable forest management.
2. Evaluate the ecological and biochemical aspects of wood biodegradation and its management.
3. Discuss the role of molecular tools and biotechnological innovations in forest disease resistance.

KU8DCCFOR406 TREE BREEDING AND ADVANCED PROPAGATION TECHNIQUES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCC	400-499	KU7DCCFOR406	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides an in-depth exploration of the scientific principles and modern techniques of tree breeding and propagation. It integrates classical genetics, quantitative approaches, and biotechnological innovations to enhance genetic improvement and productivity in forest tree species. Students will gain expertise in selection, mating designs, genetic testing, and application of molecular markers for breeding. The course also highlights hybridization, clonal propagation, and advanced propagation methods contributing to sustainable forest management and conservation genetics.

Course Prerequisite: Students should possess a foundational understanding of forest genetics, plant propagation, and quantitative biology. Prior coursework in forest biology, ecology, or biotechnology will provide essential background for comprehending breeding principles and genetic evaluation methods.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains

1	Analyze genetic variation and breeding principles in relation to forest tree improvement.	***An***
2	Design and implement selective breeding and progeny testing programs for different traits.	***C***
3	Apply advanced genetic concepts such as heterosis, polyploidy, and marker-assisted selection in tree breeding.	***A***
4	Integrate biotechnological tools and propagation techniques in modern forestry practices.	***An***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							
CO 2		X					
CO 3			X			X	
CO 4					X		

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: PRINCIPLES OF FOREST TREE BREEDING AND GENETIC VARIATION (20 HOURS)**	

	1	Concept and importance of forest tree breeding, tree improvement, and forest genetics
	2	Reproductive biology in forest trees
		a) pollination mechanisms
		b) pollen dispersal
		c) pollinators
	3	Genetic variation – causes, significance, and role in tree improvement
	4	Geographic variation – ecotypes, clines, races, and land races
		a) Natural selection and its role in breeding

2	**MODULE TITLE: BREEDING METHODS AND GENETIC TESTING (15 HOURS)**	
	1	Selective breeding methods – mass, family, within-family, and family-plus-within-family selection.
	2	Plus tree selection for wood quality, disease resistance, and other objectives
		a) Provenance testing – objectives, layout, data collection, and analysis
		b) Seed orchards – types, design, establishment, and genetic base management
	3	Genetic testing and mating designs – complete and incomplete designs (diallel, nested, factorial, polycross)
	4	Estimation of genetic parameters, heritability, genetic gain, and genotype × environment interactions

3	**MODULE TITLE: ADVANCED BREEDING APPROACHES AND QUANTITATIVE GENETICS (20 HOURS)**	
	1	Quantitative genetics – genetic variance and its partitioning; heritability and genetic correlations.
	2	Mating systems and Hardy-Weinberg equilibrium.

		a) Inbreeding, hybrid vigor, and heterosis breeding
		b) Hybridization in forest trees – species and racial hybridization (examples: teak, shisham, eucalypts, acacias, poplars).
	3	Polyploidy, aneuploidy, and haploidy – induction and applications in hardwood and softwood species
	4	Statistical and experimental designs in genetic testing

4	**MODULE TITLE: BIOTECHNOLOGY AND ADVANCED PROPAGATION TECHNIQUES (10 HOURS)**	
	1	Biotechnology in tree improvement – molecular markers, genetic transformation, and cryopreservation.
		a) Marker-assisted selection (MAS) and genomic selection.
	2	Clonal forestry – concepts, propagation techniques, and clonal evaluation.
	3	In vitro propagation and somatic embryogenesis for elite genotypes.
	4	Integration of traditional breeding and biotechnological approaches for sustainable forestry
		a) Case studies in tree improvement programs (national and international).
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Introduce recent developments in genomics, bioinformatics, or AI applications in tree breeding.* • *Include field-based or laboratory-based mini-projects on clonal propagation or genetic diversity analysis.* • *Encourage literature review or presentations on current advances in forest genetics and breeding case studies in India.*	

	Space to fill the selected area/ activity

Essential Readings

1. Acquaah G. 2012. *Principles of Plant Genetics and Breeding.* John Wiley & Sons, UK.
2. Fins L., Friedman S.T., and Brotschol J.V. (Eds.). 1992. *Handbook of Quantitative Forest Genetics.* Springer, Netherlands.
3. Namkoong G. 1979. *Introduction to Quantitative Genetics in Forestry.* USDA Technical Bulletin No. 1588.
4. Surendran C., Sehgal R.N., and Paramathma M. 2003. *Textbook of Forest Tree Breeding.* ICAR.
5. Zobel B.J. and Talbert J. 1984. *Applied Forest Tree Improvement.* John Wiley & Sons.

Suggested Readings

1. Falconer D.S. and Mackay T.F.C. 1995. *Introduction to Quantitative Genetics.* Longman, Essex.
2. White T.L., Adams W.T., and Neale D.B. 2007. *Forest Genetics.* CABI, UK.
3. Mandal A.K. and Gibson G.L. 2002. *Forest Genetics and Tree Breeding.* CBS Publishers.
4. Wright J.W. 1976. *Introduction to Forest Genetics.* Academic Press.
5. Finkeldey R. and Hattemer H.H. 2006. *Tropical Forest Genetics.* Springer.
6. Dutta M. and Saini G.C. 2009. *Advances in Forestry Research in India, Vol. XXX.* International Book Distributors.
7. White T.L. and Hodge G.R. 1989. *Predicting Breeding Values with Applications in Forest Tree Improvement.* Kluwer Academic Publishers.

Assessment Rubrics:

Evaluation Type – Theory	**Marks**
End Semester Evaluation	**50**
Continuous Evaluation	**25**

a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3-Mark Questions

1. Define tree improvement and explain its importance in forestry.
2. Differentiate between ecotypes, clines, and land races.
3. What is the significance of genetic gain in tree breeding?
4. Write short notes on polyploidy and its applications.
5. Define provenance testing and state its objectives.

6-Mark Questions

1. Discuss the different selective breeding methods used in forest tree improvement.
2. Explain the Hardy-Weinberg equilibrium and its importance in tree breeding.

3. Describe the components and types of seed orchards.
4. Discuss hybridization and heterosis breeding with examples from Indian forestry.
5. Explain the principles and importance of clonal forestry in tree improvement.

14-Mark Questions

1. Elaborate on the principles of quantitative genetics and their application in forest tree breeding.
2. Discuss in detail the genetic testing and mating designs used in forestry research.
3. Explain the role of molecular tools and marker-assisted selection in forest tree improvement.
4. Critically evaluate the progress and challenges of tree breeding programs in India.
5. Describe the integration of biotechnological and classical breeding techniques for sustainable forestry development.

KU8DCCFOR407 ENVIRONMENTAL LEGISLATION AND MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCC	400-499	KU7DCCFOR407	3+1	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides an in-depth understanding of the evolution, structure, and implementation of environmental and forest legislation in India. It covers the history and development of forest policies, national and state acts, and their relationship with environmental protection, sustainable management, and biodiversity conservation. The course also introduces students to global conventions, judicial interventions, and governance frameworks that shape environmental law and forest management. Emphasis is placed on the intersection of law, policy, and environmental ethics in achieving sustainable development goals.

Course Prerequisite: Students should have a foundational understanding of environmental science, forest management, and biodiversity conservation. Prior exposure to forest governance or policy frameworks will help in contextualizing legislative and institutional mechanisms for environmental protection.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains

1	Evaluate the historical and legal evolution of forest policies and environmental laws in India	***E***
2	Interpret key legislative provisions and judicial interventions relevant to forest and wildlife governance	***C***
3	Apply legal and policy principles to real-world forest management, conservation, and environmental challenges	***A***
4	Analyze the relationship between national environmental policy frameworks and international treaties	***An***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2			X				
CO 3		X					
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: FOREST POLICY AND LEGAL FRAMEWORK IN INDIA (20 HOURS)**	

	1	History and evolution of forest policy – relevance and scope
	2	National Forest Policies of 1894, 1952, and 1988 – comparison and management strategies
		a) Objectives and functions of forests and forest management.
	3	Indian Forest Act (1927): salient features, provisions, and classification of forests
	4	Forest Conservation Act (1980), Wildlife (Protection) Act (1972) and amendments
		a) EIA Notification 2016 – framework, implementation, and challenges

2	**MODULE TITLE: STATE AND REGIONAL FOREST LEGISLATIONS (15 HOURS)**	
	1	Kerala Forest Act (1961), Kerala Preservation of Trees Act (1986)
	2	Kerala Private Forests (Vesting and Assignment) Act (1971)
		a) Kerala Forest (Vesting and Management of Ecologically Fragile Lands) Act (2003)
	3	Role of judiciary and landmark judgments related to forest conservation
	4	Indian Evidence Act as applied to forestry matters
		a) Legal definitions and objectives of species-specific forest laws

3	**MODULE TITLE: ENVIRONMENTAL POLICY, GOVERNANCE, AND JUDICIAL FRAMEWORK (20 HOURS)**	
	1	Constitutional provisions for environmental protection and fundamental rights
	2	History of environmental policy in India
		a) Environmental Protection Act (1986),
		b) Biodiversity Act (2002),

		c) Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 (FRA)
	3	Public interest litigation (PIL) and environmental jurisprudence in India
	4	Protection of Plant Varieties and Farmers' Rights Act, 2001; Quarantine laws and right to information
	5	Role of community-based forest governance – Van Panchayats, Joint Forest Management (JFM), and PESA Act.

4	**MODULE TITLE: INTERNATIONAL ENVIRONMENTAL CONVENTIONS AND GLOBAL FRAMEWORKS (10 HOURS)**	
	1	Major global treaties and conventions: CITES, CBD, Ramsar Convention, UNFCCC, Kyoto Protocol, Paris Agreement, and World Heritage Convention
	2	Soft law instruments: Stockholm Declaration (1972), Rio Declaration (1992), Agenda 21, Forest Principles (1992), SDGs (Goal 15)
	3	Regional agreements and economic implications – REDD+, ITTO, and global carbon mechanisms
	4	Role of international organizations: IUCN, UNEP, FAO, and World Bank in forest conservation
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. Teachers are encouraged to: • *Focus on emerging environmental issues such as climate litigation, environmental ethics, or carbon financing.* • *Include state-specific case studies, tribunal judgments, or simulation exercises on environmental clearance processes.* • *Conduct debates or research presentations on the intersection of traditional rights and modern environmental laws.* • *Encourage engagement with field-level agencies or NGOs to understand implementation challenges.*	

	Space to fill the selected area/ activity

Essential Readings

1. Divan S. and Rosencranz A. (2002). *Environmental Law and Policy in India.* Oxford University Press.
2. Shastri S.C. (2016). *Environmental Law.* Eastern Book Company.
3. Rosencranz A., Divan S., and Noble M.L. (2018). *Environmental Law and Policy in India: Cases, Materials and Statutes.* Oxford University Press.
4. Dharmadhikary S. (2014). *Legislations and Policy Frameworks for Forest and Environment in India.* CSE Publications.
5. Ministry of Environment, Forest and Climate Change (MoEFCC). *National Forest Policy (1988) and Forest Conservation Guidelines.*

Suggested Readings

1. Paras Diwan. (2007). *Environmental Administration, Law, and Judicial Attitude.* Deep & Deep Publications.
2. Sinha S.P. (2010). *Environmental Law and Sustainable Development in India.* Regal Publications.
3. UNEP. (2016). *International Environmental Governance: Global Trends and Challenges.*
4. Cullet P. (2019). *Research Handbook on Law, Environment and the Global South.* Edward Elgar Publishing.
5. Leelakrishnan P. (2008). *Environmental Law in India.* LexisNexis Butterworths.
6. MoEFCC Reports. (2016–2022). *National Biodiversity and Environmental Status Reviews.*

Assessment Rubrics:

Evaluation Type – Theory	Marks
End Semester Evaluation	**50**

Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3-Mark Questions

1. State the main objectives of the National Forest Policy, 1988.
2. Mention key provisions of the Forest Conservation Act, 1980.
3. Define the term “Ecologically Fragile Land” under the Kerala Act of 2003.
4. What is the significance of CAMPA (2016)?
5. List the major international conventions related to forest conservation.

6-Mark Questions

1. Compare the salient features of the National Forest Policies of 1894, 1952, and 1988.
2. Explain the role of the judiciary in environmental protection in India.
3. Discuss the importance of the Biodiversity Act, 2002, in forest conservation.
4. Describe the key provisions of the FRA, 2006, and its role in empowering forest dwellers.
5. Explain the concept and significance of REDD+ in forest management.

14-Mark Questions

1. Discuss in detail the evolution of environmental legislation and policies in India.
2. Analyze the effectiveness of the Forest Conservation Act, 1980, and the Wildlife Protection Act, 1972, in biodiversity protection.
3. Examine the constitutional framework for environmental protection and its judicial interpretation.
4. Evaluate the role of international treaties and conventions in shaping India’s environmental policy.
5. Critically discuss community-based forest governance models and their relevance in sustainable forest management.

KU8DCCFOR408 CLIMATE CHANGE AND DISASTER MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCC	400-499	KU7DCCFOR408	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course provides an advanced understanding of climate change science and disaster management with a focus on forestry and natural ecosystems. Students will explore the mechanisms of climate variability, greenhouse gas dynamics, and the environmental, ecological, and socio-economic impacts of global warming. The course integrates forest-based mitigation and adaptation strategies, carbon sequestration, policy instruments, and disaster resilience planning. It emphasizes the practical application of knowledge through case studies, modelling techniques, and policy analysis related to India's climate commitments and disaster risk reduction frameworks.

Course Prerequisite: Students should have a fundamental understanding of ecology, environmental science, and forest resource management. Prior exposure to courses in forest hydrology, forest ecology, and remote sensing will be advantageous.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Analyze the scientific basis of climate change, its impact on natural hazards, and the resulting vulnerabilities in forest ecosystems	***An***
2	Assess the biophysical and socio-economic impacts of climate change on forest ecosystems, biodiversity, and rural livelihoods	***A***
3	Evaluate mitigation and adaptation strategies, including carbon sequestration, clean development mechanisms, and national/international policy frameworks	***E***
4	Design and implement disaster management strategies emphasizing climate resilience, risk reduction, and sustainable recovery in forested landscapes	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1				X		X	
CO 2							
CO 3	*X*		X				
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: CLIMATE SCIENCE AND DISASTER FUNDAMENTALS (15 HOURS)**	
	1	Earth's climate system, Greenhouse Gas effect, radiative forcing, and historical climate variability.
	2	Intergovernmental Panel on Climate Change (IPCC) projections, scenarios (RCPs/SSPs), and regional climate modelling.
	3	International conventions and agreements: UNFCCC, Kyoto Protocol, Paris Agreement
	4	Concepts of Hazard, Vulnerability, Exposure, Risk, and Resilience. Classification of hydro-meteorological, geological, and climate-induced disasters

2	**MODULE TITLE: IMPACTS OF CLIMATE CHANGE ON ECOSYSTEMS AND FORESTS (15 HOURS)**	
	1	Effects of elevated CO_2 and temperature on forest growth, productivity, and health
		a) Impacts on soil health, nutrient cycling, and hydrological processes
		b) Shifts in vegetation types and species distribution
		c) Impacts on agriculture, fisheries, and livestock sectors
	2	Climate change and biodiversity loss
		a) Changes in pest and disease dynamics in forests
	3	Climate vulnerability assessments in Indian forest ecosystems
	4	Case studies: Western Ghats, Himalayas, and Coastal Ecosystems

3	**MODULE TITLE: MITIGATION AND ADAPTATION STRATEGIES (15 HOURS)**	
	1	Principles of climate adaptation and mitigation
	2	Carbon sequestration in forests
		a) aboveground and belowground biomass
		b) REDD and REDD+ mechanisms
		c) Clean Development Mechanism (CDM), carbon credits, carbon trading and foot printing
		d) Role of forestry in Nationally Determined Contributions (NDCs)
	3	Climate-smart forestry and afforestation programs
	4	National Action Plan on Climate Change (NAPCC) and State Action Plans
	5	Use of geospatial tools in climate modelling and carbon mapping

4	**MODULE TITLE: DISASTER MANAGEMENT AND RISK REDUCTION (20 HOURS)**	
	1	Definition, concepts, and classification of disasters – natural and anthropogenic
		a) Disaster cycle: mitigation, preparedness, response, and recovery
		b) Environmental and climate-induced disasters: floods, droughts, cyclones, forest fires, landslides
	2	National Disaster Management Act, 2005 – NDMA, SDMA, and NIDM framework
	3	Integration of Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA)
	4	Role of GIS, remote sensing, and drones in disaster management

		a) Case studies: Kerala floods, Uttarakhand landslides, and Odisha cyclones
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. Teachers are encouraged to: • *Focus Practical demonstration of carbon stock estimation and climate data analysis* • *Simulation of carbon flux using remote sensing and GIS tools* • *Forest fire risk mapping and disaster response planning* • *Analysis of national climate change policy frameworks and international commitments* • *Student-led presentations on India’s role in COP negotiations*	
	Space to fill the selected area/ activity	

Essential Readings

1. Claussen, E., Cochran, V.A., & Davis, D.P. (2001). *Climate Change: Science, Strategies and Solutions.* Pew Center on Global Climate Change, USA.
2. Committee on Abrupt Climate Change. (2002). *Abrupt Climate Change: Inevitable Surprises.* National Research Council, Washington.
3. IPCC. (2007). *Assessment Report on Climate Change.* Cambridge University Press.
4. Climate Change: *Challenges To Sustainable Development in India.* (2008). Research Unit (LARRDIS), Rajya Sabha Secretariat, New Delhi.

Suggested Readings

1. Houghton, J. (2009). *Global Warming* (4th Ed.). Cambridge University Press.
2. Reddy, K.R., & Hodges, H.F. (Eds.). *Greenhouse Gas Emission from Agricultural Systems.* IPCC–USEPA, CABI Publishing.
3. Robert M. Clausen & Henry L. Gholz. *Carbon and Forest Management.* School of Forest Resources and Conservation, University of Florida, Gainesville.
4. Koskela, J., Buck, A., & Teissier du Cros, E. (2007). *Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe.* Biodiversity International, Rome.

5. National Disaster Management Authority (NDMA). *National Policy on Disaster Management, 2009.*

Assessment Rubrics:

Evaluation Type – Theory		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		Marks
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define greenhouse effect and explain its role in global warming.
2. What are the major greenhouse gases and their global warming potentials?
3. Mention the key objectives of the Paris Agreement.
4. Define mitigation and adaptation with examples from forestry.
5. List any three major natural disasters affecting India.

6 Marks

1. Explain the mechanisms of greenhouse gas emission from forest ecosystems.
2. Discuss the impacts of climate change on biodiversity and forest health.
3. Describe the role of carbon sequestration in mitigating global warming.
4. Explain the structure and functions of the National Disaster Management Authority (NDMA).
5. Evaluate the role of forest management in climate change adaptation.

14 Marks

1. Critically analyze the role of international climate change agreements in shaping India's climate policies.
2. Discuss the interdisciplinary approaches involved in integrating disaster management and climate change adaptation in forestry.
3. Explain the mechanisms of carbon trading and its potential benefits for forest-based carbon markets in India.
4. Evaluate the long-term ecological and socio-economic implications of climate change on Indian forest ecosystems.

KU8DCEFOR409 ADVANCED BIOINFORMATICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR409	3+1	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This capstone-level course explores advanced computational approaches in bioinformatics, with emphasis on functional genomics, transcriptomics, and proteomics. Students will gain hands-on experience in analysing genomic, transcriptomic, and proteomic datasets of microbes, plants, and animals. The course integrates theoretical concepts with practical applications, including data mining, database utilization, and expression profiling. The curriculum emphasizes critical analysis, problem-solving, and bioinformatics tool development to prepare students for research and industry challenges in molecular biology and systems biology.

Course Prerequisite: Students should have a fundamental understanding of Molecular Biology and Genetics. Prior exposure to courses in Basic Bioinformatics, Computational Biology Genomics and Proteomics concepts, Basic programming skills (Python, R, or equivalent) will be advantageous.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Analyse and interpret high-throughput genomic, transcriptomic, and proteomic datasets using advanced bioinformatics tools	***An***
2	Critically evaluate current bioinformatics literature and develop data-driven solutions for real-world biological questions	***E***
3	Apply computational methods for functional annotation, gene expression profiling, and proteome analysis in diverse biological systems	***A***
4	Integrate bioinformatics resources and databases to design and solve complex research problems in molecular biology	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	*X*						
CO 2			X				
CO 3						X	
CO 4				X			

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: ADVANCED FUNCTIONAL GENOMICS (15 HOURS)**	
	1	Introduction to Functional Genomics
	2	Genome Annotation & Gene Prediction
		a) Structural annotation: ORFs, gene models
		b) Functional annotation: GO terms, pathways
		c) Tools: GenBank, Ensembl, MAKER, AUGUSTUS
	3	Comparative Genomics: Homology, orthology, and paralogy; Phylogenomic approaches; Case studies in microbial, plant, and animal genome
	4	Functional Network Analysis:
		a) Gene regulatory networks
		b) Protein-protein interaction networks
		c) Network visualization tools: Cytoscape

2	**MODULE TITLE: TRANSCRIPTOME ANALYSIS (15 HOURS)**	
	1	Transcriptomics Overview
		d) RNA types and transcriptome definition
		e) Role in gene expression studies
	2	Microarray Technology
		i) Principles of hybridization
		j) Types of microarrays
		k) Data normalization and interpretation
	3	RNA-Seq and SAGE

		a) RNA sequencing workflow
		b) Serial Analysis of Gene Expression (SAGE) methodology
		c) Analysis pipelines and data interpretation
	4	Databases of Expressed Sequence Tags (ESTs)
		a) NCBI dbEST, TIGR Gene Indices
		b) Applications in gene discovery and expression profiling
	5	Data Mining and Expression Profiling
		a) Tools: Bioconductor, GEO2R, STRING
		b) Identification of differentially expressed genes
		c) Visualization using heatmaps and clustering

3	**MODULE TITLE: PROTEOMICS AND SYSTEMS BIOLOGY (15 HOURS)**	
	1	Introduction to Proteomics: Definition, scope, and importance; Comparison with genomics and transcriptomics
	2	Protein Separation Techniques
		a) 2D gel electrophoresis
		b) Multidimensional chromatography
	3	Mass Spectrometry in Proteomics
		a) MALDI, ESI techniques
		b) Protein identification and quantification
	4	Expression Proteomics & Post-Translational Modifications
		a) Differential protein expression analysis

		b) Phosphorylation, glycosylation, ubiquitination
		c) Applications of Proteomics: Disease biomarker discovery, Functional pathway mapping

4	**MODULE TITLE: ADVANCED BIOINFORMATICS (20 HOURS)**	
	1	Metagenomics and Microbiome Analysis
		a) 16S rRNA sequencing, shotgun metagenomics
		b) Microbiome data analysis pipelines
	2	Structural Bioinformatics
		a) Protein structure prediction and modelling
		b) Docking studies and molecular interactions
	3	Machine Learning in Bioinformatics
		a) Predictive modeling for gene expression and protein function
	4	Network Biology
		a) Systems-level interaction analysis
		b) Integration of genomics, transcriptomics, and proteomics data
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Focus on practical demonstration of transcriptome and proteome data analysis using real datasets.* • *Simulation of gene regulatory networks and protein interaction networks.* • *Integration and visualization of multi-omics datasets.* • *Student-led presentations on case studies analyzing bioinformatics data.* • *Demonstration of machine learning applications for gene/protein function prediction.*	

	Space to fill the selected area/ activity

Essential Reading

1. Pevsner, J. Bioinformatics and Functional Genomics, 3rd Edition, Wiley-Blackwell, 2015.
2. Baxevanis, A.D., & Ouellette, B.F.F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd Edition, Wiley, 2005.
3. Lesk, A.M. Introduction to Bioinformatics, 5th Edition, Oxford University Press, 2019.

Suggested Reading

1. Bajaj, Y.P.S. (ed.). Biotechnology in Agriculture and Forestry, Springer Verlag, 1988.
2. Gupta, P.K. Elements of Biotechnology, Rastogi Pub., 2000.
3. Kumar, S. & Singh, M.P. Plant Tissue Culture, APH Pub., 2008.
4. Mandal, A.K. & Gibson, G.L. (ed.). Forest Genetics and Tree Breeding, CBS, 1997.
5. Punia, M.S. Plant Biotechnology and Molecular Biology, Scientific Pub., 1998.
6. Singh, B.S. & Singh, M.P. Fundamentals of Plant Biotechnology, Sodesh Serial Pub., 2007.
7. Srivastava, P.S., Narula, A. & Srivastava, S. (ed.). Plant Biotechnology and Molecular Markers, Anamaya Pub., 2004.
8. Kanehisa, M., Goto, S., Sato, Y., Furumichi, M., & Tanabe, M. KEGG for integration and interpretation of large-scale molecular data sets, Nucleic Acids Research, 2012.
9. Ranganathan, S. Proteomics: Methods and Protocols, Humana Press, 2005.
10. Conesa, A., et al. A survey of best practices for RNA-seq data analysis, Genome Biology, 2016.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define functional genomics and explain its significance in microbial studies.
2. Mention two databases used for expressed sequence tags (ESTs).
3. What is MALDI and its basic principle?

6 Marks

1. Compare microarray and RNA-Seq approaches for transcriptome analysis, including advantages and limitations.
2. Explain the workflow of 2D gel electrophoresis for proteome analysis.
3. Describe how data mining can be applied in functional genomics studies.

14 Marks

1. Analyze a given dataset of RNA-Seq results and identify differentially expressed genes. Suggest possible biological interpretations.
2. Discuss a case study on proteomics of a plant or animal system using MALDI-MS and 2D chromatography. Include data interpretation and potential applications.
3. Propose a bioinformatics workflow to integrate genomic, transcriptomic, and proteomic datasets for studying disease resistance in plants.

KU8DCEFOR410 ECOLOGICAL MODELLING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR410	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This capstone-level course introduces students to ecological and environmental modelling with a focus on environmental sciences and management. It covers theoretical and practical aspects of model construction, including conceptual, mathematical, and physical models. Students will learn to simulate population dynamics, material flows, biogeochemical cycles, and human-environment interactions. The course integrates system dynamics, GIS-based modelling, and software-based applications to analyze complex ecological systems and support decision-making for conservation and environmental management.

Course Prerequisite: Students should have a foundational understanding of ecology and environmental science, including population biology and ecosystem processes. Basic knowledge of statistics and quantitative methods is essential for interpreting and constructing models. Familiarity with Geographic Information Systems (GIS) and remote sensing.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Apply theoretical and computational approaches to build ecological and environmental models for complex systems.	***A***
2	Analyse population dynamics, material flows, and biogeochemical cycles using deterministic, stochastic, and spatial modelling approaches.	***An***
3	Critically evaluate and validate ecological models for practical environmental management and decision-making.	***E***
4	Integrate GIS and environmental datasets to simulate and visualize ecological scenarios.	***C***

Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1			X				
CO 2	*X*						
CO 3							X
CO 4		X					

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO ECOLOGICAL MODELLING (15 HOURS)**	
	1	Overview of Ecological Modelling: Definition, scope, and objectives; Role in environmental science and management
	2	Types of Models
		a) Physical, conceptual, and mathematical models
		b) Deterministic vs stochastic models
		c) Causal diagrams and system dynamics
	3	Model Building Process: Problem definition, goal setting, and objective; Model formulation and assumptions
	4	Introduction to Modelling Software

2	**MODULE TITLE: POPULATION AND MULTI-SPECIES DYNAMICS (15 HOURS)**	
	1	Population Modelling
		a) Single species population growth
		b) Extinction risk assessment
	2	Multi-Species and Predator-Prey Dynamics
		a) Lotka-Volterra models
		b) Decision trees for species interactions
	3	Home Range and G-Test Analysis
		d) Home range estimation methods
		e) Application of G-test in population studies

	4	Geo-Spatial Modelling
		c) Integration of spatial data
		d) GIS functions for population modelling

3	**MODULE TITLE: ENVIRONMENTAL AND MATERIAL FLOW MODELLING (15 HOURS)**	
	1	Material and Pollutant Flow Modelling: Modelling of nutrient and pollutant transfer; Applications in environmental management
	2	Modelling Cycles in Nature: Carbon cycle, nitrogen cycle, and other biogeochemical cycles
	3	Deterministic, Stochastic, and Physical Approaches
	4	Model Validation and Assessment: Comparing model predictions with observed data; Calibration and uncertainty analysis

4	**MODULE TITLE: GIS AND SPATIAL ENVIRONMENTAL MODELLING (20 HOURS)**	
	1	GIS data for environmental models, spatial data processing
	2	Spatial modelling: mapping, raster/vector data, interpolation, overlay analysis
	3	Physical environmental models & Human (cultural, social, economic, etc.) environmental models.
	4	Environmental decision-support: risk mapping, scenario analysis
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. Teachers are encouraged to: • *Focus on practical demonstration of population and multi-species dynamics using ArcGIS and modelling software.* • *Simulation of material flows and pollutant transfer in ecosystems.* • *Student-led presentations analyzing real-world ecological datasets and scenarios.*	

	• *Demonstration of model validation, sensitivity analysis, and decision-support tools.*
	Space to fill the selected area/ activity

Essential Reading

1. Clarke K et al. 2001. Geographic Information Systems and Environmental Modeling. Prentice Hall.
2. DeMers M. 2002. GIS Modeling in Raster. Wiley.
3. Goodchild et al. 1996. GIS and Environmental Modeling: Progress and Research Issues. GIS world, Inc.
4. Hooman R and Lukas KB. 2005. Bioinformatics Basics: Applications in Biological Science And Medicine. John Wiley.
5. Hooman Rashidi, Lukas K and Buehler. 2005. Bioinformatics Basics: Applications in Biological Science and Medicine. Taylor & Francis.
6. Maguire Batty and Goodchild. 2005. GIS, Spatial Analysis, and Modeling. ESRI Press. Nirmal
7. Khandan N. 2001.

Suggested Reading

1. Modelling Tools for Environmental Engineers and Scientists, CRC Press, Boca Raton, Florida.
2. Rosner B. 2006. Fundamentals of Biostatistics, ed. 6,. DuXbury Press. USA.
3. Smith J and Smith P. 2007. Introduction to Environmental Modelling. OXford: OXford University Press.
4. Whitlock MC and Schluter D. 2009. The Analysis of Biological Data. Roberts and Company Publishers.
5. Zar JH. 2010. Biostatistical Analysis. 5th Edition. Pearson Education International.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

4. Define deterministic and stochastic models in ecological modelling.
5. What is a conceptual model? Give one example.
6. Mention two applications of GIS in ecological modelling.
7. What is the Lotka-Volterra model used for?
8. Define sensitivity analysis in environmental models.
9. Name two physical environmental models used in ecosystem studies.

6 Marks

1. Explain the differences between conceptual, mathematical, and physical models.
2. Describe the steps in building an environmental model, from problem definition to validation.
3. Explain a method for extinction risk assessment in a population.
4. Describe how GIS data can be integrated into population or spatial modelling.
5. Discuss the importance of sensitivity analysis and model validation in ecological modelling.
6. Explain the application of decision trees in multi-species population dynamics.

14 Marks

1. Develop a simple predator-prey model using given population data and interpret the results.
2. Using ArcGIS Model Builder, design a workflow to map pollutant flow in a river ecosystem and discuss the outcomes.
3. Propose an integrated ecological modelling approach to simulate carbon cycling in a forest ecosystem, considering human impacts.
4. Analyze a multi-species population dataset, identify interactions using decision trees, and suggest management strategies.
5. Design a conceptual model for an environmental problem (e.g., eutrophication of a lake) and describe how it could be validated and applied for decision-making.

KU8DCEFOR411 R PROGRAMMING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR411	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This capstone-level course introduces students to R programming, a powerful language for statistical computing, data analysis, and visualization. Students will learn R syntax, data structures, and key programming concepts. The course covers data import, cleaning, transformation, exploratory data analysis, and advanced visualization using ggplot2 and interactive tools like plotly. Additionally, students will explore statistical modelling, regression, ANOVA, and an introduction to machine learning techniques for classification, regression, and clustering. Emphasis is given to practical, hands-on exercises to develop data analysis and computational skills applicable to ecological, environmental, and bioinformatics datasets.

Course Prerequisite: Students should have a basic understanding of statistics, data interpretation, and familiarity with spreadsheets or any programming language. Knowledge of ecological or bioinformatics datasets is helpful but not mandatory. No prior experience with R is required; however, computational literacy and logical reasoning are recommended to engage effectively with data manipulation, analysis, and visualization tasks throughout the course.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Demonstrate proficiency in R programming, including data structures, variables, and programming constructs	***A***
2	Import, clean, manipulate, and transform complex datasets using R	***E***
3	Apply statistical and machine learning methods to perform exploratory and inferential data analysis	***A***
4	Create effective and interactive visualizations using ggplot2, plotly, and other R packages for reporting and decision-making	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1				X			
CO 2							
CO 3							X
CO 4			X				

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: INTRODUCTION TO R PROGRAMMING (15 HOURS)**
	1	Overview of R and RStudio: What is R and why use it?; Installing R and RStudio IDE; R environment, console, editor, and help system
	2	Basics of R Programming
		a) Variables, scalars, vectors, matrices, lists, and data frames
		b) Factors, c(), cbind(), rbind(), attach(), detach() functions
		c) Arithmetic operations and logical operators
	3	Functions in R: Mathematical, summary, and string functions; User-defined functions, local and global variables
	4	Control Structures in R*: If, while*, and *for* loops
2		**MODULE TITLE: DATA IMPORT AND PREPARATION (15 HOURS)**
	1	Importing Data
		a) Reading CSV, Excel, SAS files
		b) Accessing databases
		c) Saving and loading R data objects
	2	Data Cleaning and Transformation
		a) Selecting rows/columns, relabeling, type conversion
		b) Sorting and aggregating data

		c) Merging datasets
	3	Using *dplyr* and *tidyr* for Data Manipulation
		a) Filtering, arranging, summarizing, and transforming datasets
		b) Pivoting and reshaping data

3	**MODULE TITLE: DATA ANALYSIS AND STATISTICS (15 HOURS)**	
	1	Descriptive Statistics and EDA: Mean, median, mode, variance, standard deviation; Summary functions and exploratory analysis
	2	Inferential Statistics: Hypothesis testing *(t-test, chi-square);* Regression analysis and ANOVA
	3	Statistical Functions and Modelling in R: Implementing statistical tests; Interpreting results

4	**MODULE TITLE: DATA VISUALIZATION (20 HOURS)**	
	1	Principles of Effective Visualization: Types of graphs and charts, visual storytelling
	2	Basic Plots in R: Histogram, boxplot, line chart, scatterplot, pie chart, Pareto chart
	3	Advanced Visualization with *ggplot2:* Grammar of graphics concepts; Creating layered, grouped, and faceted plots
	4	Interactive Visualization: Introduction to *plotly* for interactive charts
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Demonstrate machine learning workflows in R: classification, regression, clustering* • *Focus on model evaluation and tuning* • *Implement student-led mini-projects integrating data cleaning, analysis, and visualization*	

	- *Show integration of R with real-world datasets for ecological, environmental, or bioinformatics applications*
	Space to fill the selected area/ activity

Essential Reading

1. N. Metzler, " R Programming for Beginners: An Introduction to Learn R Programming with Tutorials and Hands-On Examples," Independently Published, 2019.
2. Fischetti, Tony, " R: Data Analysis and Visualization," Packt Publishing, 2016.
3. Lander, Jared. "R for Everyone: Advanced Analytics and Graphics," Pearson Education, 2017.
4. Singh, Ajit. "R Programming: Simply In Depth," Amazon Digital Services LLC -Kdp, 2020.
5. G. Grolemund, " R Programming An Approach to Data Analytics," Mjp Publisher, 2021.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Total	**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define a data frame in R and give an example.
2. What is the difference between a vector and a list in R?
3. Name two functions from dplyr used for data manipulation.
4. Mention two basic plotting functions in R.
5. Define clustering in machine learning.
6. What is the purpose of the ggplot2 package?

6 Marks

1. Explain the difference between scalars, vectors, matrices, and lists in R with examples.
2. Demonstrate how to merge and relabel datasets in R using *dplyr*.
3. Describe the steps for performing regression analysis and interpreting results in R.
4. Explain how to create a histogram and scatterplot using *ggplot2*.
5. Describe the use of if, while, and for loops in R with an example.

14 Marks

1. Import a CSV dataset, clean and transform it, perform descriptive and inferential statistics, and visualize key patterns using *ggplot2*. Interpret the results.
2. Build a simple classification or regression model in R using a sample dataset. Evaluate the model performance and visualize the results.
3. Develop an R workflow integrating data import, cleaning, analysis, and visualization for a real-world ecological or environmental dataset. Present your findings in a report.

KU8DCEFOR412 BIOSTATISTICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR412	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This capstone-level course introduces students to advanced biostatistical techniques applicable to biological, ecological, and biomedical research. Students will learn univariate and multivariate statistical methods, probability distributions, regression analysis, and hypothesis testing. The course covers modern statistical approaches such as MANOVA, cluster analysis, discriminant analysis, principal component and coordinate analysis, multidimensional scaling, likelihood methods, Bayesian estimation, and resampling techniques including bootstrapping and jackknifing. Emphasis is given to practical applications of biostatistics in proportions, rates, ratios, correlation, and contingency table analysis, enabling students to perform robust data analysis, interpret results, and make evidence-based conclusions.

Course Prerequisite: Students enrolling in this course should have a foundational understanding of basic statistics, probability, and experimental design. Familiarity with univariate data analysis, t-tests, and ANOVA is recommended. Computational literacy and experience with statistical software (R, SPSS, or equivalent) will enhance engagement with advanced statistical modeling, multivariate analysis, and simulation exercises.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Apply advanced statistical techniques, including multivariate analysis, regression, and likelihood-based methods, to biological and biomedical datasets	***A***
2	Utilize graphical and tabular methods for exploratory data analysis, correlation, and distribution assessments	***E***
3	Analyze proportions, rates, ratios, and contingency tables using appropriate biostatistical methods	***An***
4	Interpret statistical results from hypothesis testing, Bayesian estimation, and resampling techniques to support evidence-based conclusions in research	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							
CO 2				X			
CO 3			X				
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: FUNDAMENTALS AND DESCRIPTIVE METHODS (15 HOURS)**
	1	Tabular and Graphical Methods:
		a) One-way scatter plots, frequency distribution, histogram, frequency polygon
		b) Cumulative frequency graphs, percentiles, stem-and-leaf diagrams
	2	Measures of Central Tendency and Dispersion
		a) Mean, median, mode
		b) Variance, standard deviation, coefficient of variation
	3	Boxplots and Binary Data Analysis
		a) Visualizing data spread, detecting outliers
		b) Special case of binary data
	4	Correlation Analysis
		a) Pearson’s correlation coefficient
		b) Nonparametric correlation coefficients

2		**MODULE TITLE: PROBABILITY AND DISTRIBUTIONS (15 HOURS)**
	1	Probability concepts and rules relevant to biostatistics
	2	Discrete and Continuous Distributions

		l) Normal, Binomial, Poisson distributions
	3	Estimation Methods
		f) Confidence interval estimation
		g) Estimation of proportions, odds ratios, correlation coefficients

3	**MODULE TITLE: ADVANCED STATISTICAL TECHNIQUES (15 HOURS)**	
	1	Multivariate Analysis
		a) MANOVA, factor analysis, ordination techniques
		b) Principal component analysis (PCA)
		c) Principal coordinate analysis
		d) Multidimensional scaling
	2	Classification and Clustering: Cluster analysis, discriminant analysis
	3	Regression Analysis and Likelihood Methods
		a) Multiple regression analysis
		b) Likelihood-based estimation and testing
	4	Markov Models and Hidden Markov Models: Overview, applications in biology and environmental studies

4	**MODULE TITLE: HYPOTHESIS TESTING, CONTINGENCY TABLES, AND RESAMPLING (20 HOURS)**	
	1	Hypothesis Testing Fundamentals
		a) Statistical evidence, rejection region, p-values
		b) Type I and Type II errors

		c) Relationship to confidence intervals
	2	Contingency Tables and Proportions
		a) One-sample binary data, paired-matched data
		b) Comparison of two proportions, Mantel–Haenszel method
		c) Ordered *2xk* tables, generalized odds ratios, Fisher's exact test
	3	Resampling Techniques: Bootstrapping and jack knifing; Applications for confidence interval estimation
	4	Bayesian Methods: Bayesian estimation, Gibbs sampling
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. Teachers are encouraged to: • *Focus on application of multivariate methods (MANOVA, PCA, clustering) on real datasets.* • *Demonstrate Bayesian estimation, Gibbs sampling, and resampling techniques.* • *Encourage student-led mini-projects integrating hypothesis testing, correlation, regression, and contingency table analysis.* • *Guide interpretation and reporting of statistical results for research studies.*	
	Space to fill the selected area/ activity	

Essential Reading

1. Chap T.L. (2003). Introductory Biostatistics, John Wiley &Sons.
2. Rosner, B. (2010). Fundamentals of Biostatistics, Cenage Learning, Harvard University.
3. Chernick, M.R. and Fris, R.H. (2003). Introductory Biostatistics fortheHealth Sciences, John Wiley & Sons.
4. Peter Armitage, Geoffrey Berry, J. N. S. Matthews (2008).· Statistical Methods in Medical Research. John Wiley & Sons

5. Daniel, Wayne W (2009). Biostatistics: A Foundation for Analysis intheHealth Sciences.John Wiley & Sons.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define Pearson's correlation coefficient.
2. What is the Mantel–Haenszel method used for?
3. Define bootstrapping in statistical inference.
4. Explain the difference between Type I and Type II errors.
5. What is a contingency table? Give an example.

6 Marks

1. Explain the difference between ANOVA and MANOVA with examples.
2. Describe the steps for estimating odds ratios in a biomedical study.
3. Perform a correlation analysis for a given dataset and interpret the results.
4. Explain the application of principal component analysis in reducing dimensionality.
5. Describe the process of hypothesis testing for paired binary data.

14 Marks

1. Analyze a pair-matched case-control dataset: estimate proportions, odds ratios, and interpret significance using Mantel–Haenszel method.
2. Conduct a multiple regression and MANOVA analysis on a multi-variable dataset and interpret the outputs.
3. Apply bootstrapping or jackknife resampling to a sample dataset, estimate confidence intervals, and interpret results.
4. Perform cluster analysis or discriminant analysis on a multivariate dataset, visualize results, and explain biological interpretation.
5. Conduct PCA or multidimensional scaling on a dataset and discuss the key components influencing variation.

KU8DCEFOR413 RESEARCH METHODOLOGY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR413	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This capstone course equips students with the knowledge and skills to design, execute, analyze, and report research studies in biological, ecological, and forestry sciences. Students will learn principles of experimental design, sampling theory, multivariate analytical tools, and advanced statistical techniques. The course also covers the ethical conduct of research, publication ethics, and research metrics, enabling students to perform research responsibly, interpret results accurately, and communicate findings effectively in scientific and academic contexts.

Course Prerequisite: Students should have a basic understanding of statistics, probability, and research methodology. Familiarity with univariate data analysis, experimental techniques, and statistical software (R, SPSS, or Excel) is recommended to maximize engagement with advanced research methods and ethical applications.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains

1	Utilize research databases, bibliometric tools, and open-access resources to support evidence-based scholarly communication.	***A***
2	Utilize graphical and tabular methods for exploratory data analysis, correlation, and distribution assessments	***E***
3	Design and implement biological and ecological experiments using classical and advanced experimental designs	***An***
4	Demonstrate ethical conduct in scientific research, understand publication ethics, and avoid misconduct	***C***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							X
CO 2							
CO 3		X					
CO 4				X			

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: EXPERIMENTAL DESIGN (20 HOURS)**	
	1	Introduction to Research and Experimental Design

		a) Research problem identification, types of research
		b) Need and objectives of experimental design
		c) Hypothesis
	2	Basic Principles of Experimental Design
		a) Uniformity trials, plot size and shape, blocks
		b) Randomization, replication, local control
	3	Classical Experimental Designs
		a) Completely Randomized Design (CRD)
		b) Randomized Block Design (RBD)
		c) Latin Square Design
	4	Factorial and Advanced Designs
		a) Symmetrical and asymmetrical factorial designs
		b) Confounding, control treatments
		c) Split-plot and strip-plot designs

2	**MODULE TITLE: SAMPLING THEORY (10 HOURS)**	
	1	Basic Sampling Concepts: Definitions, terms, and objectives
	2	Sampling Methods
		a) Simple random sampling, stratified random sampling
		b) Systematic random sampling, cluster and multistage sampling
		c) Probability proportional to size, inverse sampling

3		**MODULE TITLE: MULTIVARIATE ANALYTICAL TOOLS (20 HOURS)**
	1	Classification and Discriminant Function: Introduction, applications, computation
	2	Factor Analysis
	3	Principal Component & Cluster Analysis
		a) PCA for dimensionality reduction
		b) Cluster analysis for grouping of observations
	4	Multidimensional Scaling (MDS)
		a) Visualization of similarities/dissimilarities
		b) Application in ecology/forestry

4		**MODULE TITLE: RESEARCH & PUBLICATION ETHICS (15 HOURS)**
	1	Philosophy and Ethics in Science
		a) Definition, nature, scope, branches of ethics
		b) Moral philosophy, scientific conduct, intellectual honesty
	2	Scientific Misconduct
		a) Falsification, fabrication, plagiarism (FFP)
		b) Redundant publications, selective reporting, misrepresentation
	3	Publication Ethics
		a) COPE, WAME guidelines, conflicts of interest
		b) Authorship and contributorship, predatory publishing
	4	Open Access and Research Metrics

		a) SHERPA/RoMEO, JANE, Elsevier/ Springer journal finder
		b) Indexing databases (Web of Science, Scopus)
		c) Impact factor, h-index, g-index, CiteScore, altmetrics
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Guide student mini-projects integrating experimental design, sampling, and multivariate analysis.* • *Organize case study discussions on ethical dilemmas, misconduct, and predatory publishing.* • *Facilitate hands-on exercises with research databases, bibliometric tools, and open-access platforms.* • *Encourage report writing and presentations based on real or simulated datasets.*	
	Space to fill the selected area/ activity	

Essential Reading

1. Aggarwal BL. 2011. *Theory and Analysis of Experimental Designs*. CBS Publisher, New Delhi. 202
2. Gomez KA and Gomez AA. 1984. *Statistical Procedure for Agricultural Research*. John Wiley and Sons.
3. Johnson Richard A and Dean W Wichern. 2015. *Applied Multivariate Statistical Analysis*. Prentice Hall of India.
4. Mukopadhyay Parimal. 2008. *Theory and Methods of Survey Sampling*. Prentice Hall of India.
5. Sahu PK and Das AK.2014. *Agriculture and Applied Statistics* 2. Kalyani Publisher.
6. Singh D and Chaudhary FS. 2018. *Theory and Analysis of Sample Survey Design*. New Age International Ltd.
7. Zar Jerrold H. 2010. *Biostatistical Analysis*. Prentice Hall

Suggested Readings

1. Sokal, R.R. & Rohlf, F.J., Biometry, 4th Edition, Freeman, 2012.

2. Agresti, A., An Introduction to Categorical Data Analysis, 3rd Edition, Wiley, 2018.
3. COPE Guidelines and WAME resources (Online)
4. Turnitin, Urkund and other plagiarism detection software manuals
5. Journals on open-access publishing, SHERPA/RoMEO online resources

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define CRD and RBD.
2. What is stratified random sampling?
3. Explain principal component analysis.
4. What are falsification, fabrication, and plagiarism (FFP)?
5. Name two open-access journal initiatives.

6 Marks

1. Differentiate between factorial and split-plot designs.
2. Describe cluster analysis and its applications.
3. Explain the ethical considerations in authorship and conflicts of interest.
4. Demonstrate the use of SHERPA/RoMEO or JANE for journal selection.
5. Describe balanced incomplete block design with example.

14 Marks

6. Design a factorial experiment for a forestry study and analyze hypothetical data.
7. Apply PCA or cluster analysis to an ecological dataset and interpret results.
8. Critically evaluate a research misconduct case study and suggest corrective measures.
9. Use Web of Science or Scopus to calculate h-index and Cite Score for a researcher/journal.
10. Conduct a mini-project integrating experimental design, sampling, multivariate analysis, and ethical reporting.

KU8DCEFOR414 SCIENTIFIC WRITING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR414	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides a comprehensive framework for effective scientific writing and communication in the fields of biology, forestry, and environmental sciences. It focuses on writing research papers, reviews, technical reports, theses, and grant proposals, while emphasizing clarity, coherence, and adherence to ethical and publication standards. Students will gain practical skills in structuring manuscripts, referencing, preparing illustrations, and navigating the publication process, including submission to peer-reviewed journals and open-access platforms.

Course Prerequisite: Students should have prior exposure to basic research methodology, data analysis, and literature review techniques. Familiarity with statistical analysis, experimental design, and research ethics will help students fully engage with manuscript preparation and publication processes.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Write clear, structured, and coherent scientific manuscripts, reports, and technical documents	***A***
2	Write clear, structured, and coherent scientific manuscripts, reports, and technical documents	***A***
3	Critically evaluate scientific literature and incorporate ethical writing practices	***E***
4	Navigate the peer-review and publication process, including open-access publishing and journal selection	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2	X						
CO 3			X				
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1		**MODULE TITLE: INTRODUCTION TO SCIENTIFIC WRITING (15 HOURS)**
	1	Principles of Scientific Writing
		a) Purpose, audience, clarity, conciseness
		b) Differences between scientific and general writing
	2	Types of Scientific Documents: Research papers, review articles, technical reports, theses, grant proposals
	3	Structure of Manuscripts
		a) IMRAD structure (Introduction, Methods, Results, Discussion)
		b) Writing abstracts and keywords

2		**MODULE TITLE: WRITING TECHNIQUES AND STYLE (15 HOURS)**
	1	Language and Style: Clarity, conciseness, coherence, grammar; Active vs. passive voice, sentence and paragraph structuring
	2	Tables, Figures, and Illustrations
		a) Designing effective tables and figures
		b) Labelling, legends, captions, formatting

3		**MODULE TITLE: REFERENCING AND LITERATURE MANAGEMENT (20 HOURS)**
	1	Citation Styles
		a) APA, Vancouver, Chicago, and other common styles
		b) In-text citations vs. bibliographies
	2	Reference Management Software
		a) Mendeley, Zotero, EndNote

		b) Importing references, organizing libraries, generating bibliographies
	3	Avoiding Plagiarism and Paraphrasing
		a) Identifying plagiarism
		b) Techniques for proper paraphrasing and summarizing
	4	Writing Literature Reviews
		a) Structure and synthesis
		b) Identifying gaps in research

4	**MODULE TITLE: PUBLICATION PROCESS AND ETHICS (15 HOURS)**	
	1	Journal Selection and Submission
		a) Selecting journals based on scope, impact, and indexing
		b) Writing cover letters and submission guidelines
	2	Peer Review Process
		a) Understanding reviewer comments
		b) Responding to critiques and revisions
	3	Ethical Issues in Publishing
		a) Authorship and contributorship
		b) Conflicts of interest
		c) Misconduct, FFP (falsification, fabrication, plagiarism)
		d) Predatory journals
	4	Open Access and Research Metrics

		a) Open access publishing, SHERPA/RoMEO
		b) Impact factor, h-index, altmetrics
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Guide student-led manuscript writing and preparation of research reports.* • *Conduct peer-review simulations where students evaluate each other's drafts.* • *Organize exercises on abstract writing, figure/table creation, and reference formatting.* • *Facilitate case studies on publication ethics and predatory journals.* • *Encourage presentations of mini-projects or research summaries prepared by students.*	
	Space to fill the selected area/ activity	

Essential Reading

1. Day, R.A. & Gastel, B., How to Write and Publish a Scientific Paper, 8th Edition, Cambridge University Press, 2016.
2. Alley, M., The Craft of Scientific Writing, 4th Edition, Springer, 2018.
3. Peat, J., Elliott, E., Baur, L. & Keena, V., Scientific Writing: Easy When You Know How, BMJ Books, 2002.
4. Resnik, D.B., The Ethics of Research with Human Subjects, Springer, 2018.

Suggested Reading

1. Hofmann, A.H., Scientific Writing and Communication, 3rd Edition, Oxford University Press, 2019.
2. Day, R.A., Scientific English: A Guide for Scientists and Other Professionals, 2nd Edition, Oryx Press, 1998.
3. COPE Guidelines, WAME resources (Online)
4. Journal submission guidelines of major open-access publishers
5. Software manuals: Mendeley, Zotero, EndNote

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define IMRAD structure.
2. What is the purpose of an abstract?
3. Name two reference management software tools.
4. Define predatory journals.
5. What is the difference between plagiarism and self-plagiarism?

6 Marks

1. Describe the key components of a well-written scientific manuscript.
2. Explain the role of tables and figures in scientific communication.
3. Discuss ethical considerations in authorship and conflicts of interest.
4. Outline the steps in the peer-review and publication process.

14 Marks

1. Prepare a sample abstract and introduction for a research study based on provided data.
2. Critically evaluate a published research article for clarity, structure, referencing, and ethical compliance.
3. Simulate manuscript submission: select a journal, prepare cover letter, respond to reviewer comments.
4. Conduct a mini-writing project: develop a short research report with tables, figures, and references, adhering to ethical and publication guidelines.

KU8DCEFOR415 SCIENTIFIC WRITING

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR415	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides an integrative understanding of the global environmental changes reshaping the planet’s ecosystems. It focuses on the Earth’s climate system, biogeochemical cycles, and the human dimensions of global change. Students will explore the ecological consequences of climate change, global warming, and biodiversity loss, while developing the analytical tools to assess vulnerabilities and design adaptation strategies. The course encourages critical reflection on resilience and sustainability principles, preparing learners to address pressing challenges in global change ecology through informed policy and ecosystem management approaches.

Course Prerequisite: Students are expected to have a foundational understanding of ecology, environmental science, and climate processes. Prior completion of courses such as Forest Ecology, Environmental Science, and Meteorology or equivalent modules will aid comprehension. Basic knowledge of biodiversity conservation and ecosystem functioning is desirable.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Explain the structure and functioning of the Earth's climate system and its role in global ecological processes	***R***
2	Evaluate the biological and ecological impacts of global change on biodiversity and ecosystem functioning.	***E***
3	Assess vulnerabilities and adaptation strategies for ecosystems and human societies under climate change scenarios.	***A***
4	Critically analyse the principles of ecological resilience and apply adaptive management strategies for sustainability.	***An***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2	X						
CO 3			X				
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: GLOBAL CHANGE ECOLOGY (15 HOURS)**	
	1	Introduction to global change ecology
		a) Earth’s climate system: structure and functioning
		b) Greenhouse gases and greenhouse effect
	2	Human population dynamics, energy use, and emission trends
	3	Global carbon cycle and biogeochemical interactions (CH_4, N_2O)
		a) Resource utilization and global commons
		b) Future climate scenarios: global and regional perspectives

2	**MODULE TITLE: IMPACTS OF GLOBAL CHANGE (15 HOURS)**	
	1	Impacts of climate change on plants and animals
	2	Biodiversity loss and species migration
		a) Effects on ecosystem productivity and community dynamics
		b) Impacts on water resources and aquatic ecosystems
	3	Marine changes: ocean acidification and coral bleaching
	4	Global warming and natural resource availability

3	**MODULE TITLE: ASSESSING IMPACTS AND VULNERABILITIES (20 HOURS)**	
	1	Concepts of vulnerability, sensitivity, and exposure
		a) Frameworks and indicators for vulnerability assessment
		b) Sectoral vulnerability: forestry, agriculture, land and water resources

	2	Climate sensitivity analysis and uncertainty in prediction
	3	Strategies for heatwave, flood, and coastal adaptation
	4	Global and national adaptation policies and practices

4	**MODULE TITLE: RESILIENCE AND ECOSYSTEM MANAGEMENT (15 HOURS)**	
	1	Concept and importance of ecological resilience
		a) Stability and regime shifts in ecosystems
		b) Biodiversity–resilience relationships
	2	Ecosystem/biodiversity management under global change
	3	Climate change politics and global negotiations
	4	Case studies on resilience and sustainable ecosystem restoration
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Climate modelling and simulation exercises* • *Case studies on ecosystem restoration and adaptation planning* • *National commitments under Paris Agreement and IPCC frameworks* • *Student seminars, field studies, or research paper reviews*	
	Space to fill the selected area/ activity	

Essential Readings

1. Parry, M.L. et al. (2007). *Climate Change 2007: Impacts, Adaptation and Vulnerability.* Cambridge University Press.
2. Lovejoy, T.E. & Hannah, L.J. (2006). *Climate Change and Biodiversity.* Yale University Press.

3. Schlesinger, W.H. (1997). *Biogeochemistry: An Analysis of Global Change.* Academic Press.
4. Patt, A. et al. (2009). *Assessing Vulnerability to Global Environmental Change.* Earthscan, London.

Suggested Readings

1. Rathinasamy, M., Chandramouli S., & Phanindra K.B.V.N. (2018). *Resources and Environmental Engineering II: Climate and Environment.*
2. NRC. (1999). *Global Environmental Change: Research Pathways for the Next Decade.* National Research Council.
3. NRC. (1999). *Our Common Journey: A Transition Toward Sustainability.* National Research Council.
4. Cleland, E.E. et al. (2007). "Shifting plant phenology in response to global change." *Trends in Ecology & Evolution,* 22(7): 357–365.
5. Bruno, J.F. & Selig, E.R. (2007). "Regional decline of coral cover in the Indo-Pacific." *PLoS ONE,* 2(8): e711.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks Questions

1. Define greenhouse effect and list major greenhouse gases.
2. What are the indicators used for vulnerability assessment?
3. What is meant by ecological resilience?
4. Explain coral bleaching in brief.
5. Write a short note on global commons.

6 Marks Questions

1. Describe the role of CH_4 and N_2O in global warming.
2. Explain how climate change affects terrestrial and marine ecosystems.
3. Discuss the concept of vulnerability and sensitivity in global change studies.
4. Explain resilience in ecological systems with examples.
5. Summarize the significance of international climate agreements in global change management.

14 Marks Questions

1. Describe the structure of the Earth’s climate system and discuss how it influences global ecological processes.
2. Critically examine the impacts of global warming on biodiversity and ecosystem functioning.
3. Explain frameworks used for assessing vulnerability and adaptation in ecosystems.

KU8DCEFOR416 WOOD VARIATION

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR416	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course provides an in-depth understanding of the nature, causes, and control of variation in wood properties across and within tree species. It focuses on the genetic, environmental, and silvicultural factors influencing wood quality and its industrial applications. Students will develop the ability to analyze the variability in wood characteristics, understand how these variations affect end uses, and apply principles of forest genetics and management to improve wood quality through selection and breeding.

Course Prerequisite: Students are expected to have completed foundational courses in Wood Science and Technology and Forest Genetics and Tree Improvement, with basic knowledge of wood anatomy, forest management, and silvicultural systems.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Describe the fundamental physical and mechanical properties of wood and their variation across species and provenances	***R***
2	Analyse how tree form, reaction wood, and environmental factors influence wood quality	***An***
3	Evaluate the impact of silvicultural practices and site conditions on wood properties	***E***
4	Apply genetic principles to the improvement and control of wood quality for industrial and ecological applications	***A***

*****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1			X				
CO 2				X			
CO 3	X						
CO 4					X		

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: FUNDAMENTALS OF WOOD PROPERTIES (15 HOURS)**	
	1	Definition and significance of wood properties – specific gravity, cell length, and structural attributes.
	2	Relationships among wood properties and their role in determining quality and utility
	3	Factors controlling wood properties – anatomical, physiological, and environmental influences
	4	Measurement and quantification of wood variation

2	**MODULE TITLE: SPECIES AND PROVENANCE VARIATION (15 HOURS)**	
	1	Wood variation related to species, provenance, and ecological zones
	2	Comparative properties of trees grown as exotics versus indigenous species
	3	Variation within and among trees – radial, axial, and circumferential variation
	4	Industrial implications of provenance-based wood differences

3	**MODULE TITLE ENVIRONMENTAL AND GROWTH INFLUENCES (20 HOURS)**	
	1	Relationship between tree form, reaction wood, and mechanical stresses
	2	Effect of growth rate on specific gravity and strength in hardwoods and softwoods
	3	Influence of site, soil, climate, and biotic factors (pests and diseases) on wood formation
	4	Environmental and biological agencies affecting wood uniformity and performance

4	**MODULE TITLE: SILVICULTURAL AND GENETIC CONTROL OF WOOD QUALITY (15 HOURS)**

	1	Effect of silvicultural practices on wood properties – fertilization, spacing, pruning, thinning, and nutrient management
	2	Genetic control of wood properties – heritability and genetic correlation among traits
	3	Role of breeding in improving wood quality – case studies in tropical tree species
	4	Future perspectives: biotechnological and molecular approaches to enhance wood characteristics
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. *Teachers are encouraged to:* • *Comparative study of wood variation in local commercial timbers* • *Case studies on genetic improvement programs for wood quality* • *Application of modern imaging or analytical techniques in wood property evaluation* • *Project-based analysis using provenance data from local plantations*	
	Space to fill the selected area/ activity	

Essential Readings

1. Panshin, A. J., and de Zeeuw, C. (1980). *Textbook of Wood Technology.* McGraw-Hill Book Company, New York.
2. Zobel, B. J., and van Buijtenen, J. P. (1989). *Wood Variation: Its Causes and Control.* Springer-Verlag, New York.

Suggested Readings

1. Bowyer, J. L., Shmulsky, R., & Haygreen, J. G. (2003). *Forest Products and Wood Science: An Introduction.* Iowa State Press.
2. Kollmann, F. F. P., & Côté, W. A. (1984). *Principles of Wood Science and Technology.* Springer-Verlag.
3. Larson, P. R. (1969). *Wood Formation and the Concept of Wood Quality.* Yale University Press.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks Questions

1. Define wood variation and list its major types.
2. Explain the relationship between cell length and specific gravity.
3. What are the effects of provenance on wood quality?
4. Differentiate between reaction wood in hardwoods and softwoods.
5. What is the influence of soil and climate on wood density?

6 Marks Questions

1. Discuss the factors controlling wood properties and their interrelationships.
2. Explain how silvicultural practices such as spacing and pruning influence wood quality.
3. Describe the variation within and among trees and its implications for wood utilization.
4. Elaborate on the genetic control of wood properties.
5. Analyze the effects of environmental stresses on wood structure and performance.

14 Marks Questions

1. Critically evaluate the role of genetics and breeding in improving wood quality in tropical trees.
2. Discuss in detail how environmental and growth factors contribute to wood property variation.
3. Explain the relationship between reaction wood formation, mechanical stress, and tree form.
4. With suitable examples, describe how provenance studies contribute to the selection of superior timber sources.

KU8DCEFOR417 BIOMETRICAL GENETICS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DCE	400-499	KU7DCEFOR417	3+1	75

<table>
<tr><th colspan="3">Learning Approach (Hours/ Week)</th><th colspan="3">Marks Distribution- Theory</th><th rowspan="2">Duration of ESE (Hours)</th></tr>
<tr><th>Lecture</th><th>Practical/ Internship</th><th>Tutorial</th><th>CE</th><th>ESE</th><th>Total</th></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This capstone course integrates advanced statistical methods with genetic principles to analyze the inheritance of complex, quantitative traits. Students will move beyond Mendelian genetics to explore the mathematical models that describe polygenic inheritance, focusing on applications in forestry and crop improvement. The course emphasizes the practical design and interpretation of genetic experiments (like diallel and line x tester), the partitioning of variance, and the prediction of selection outcomes. As a capstone, students will synthesize these principles to design breeding programs, critically evaluate genetic data using biometrical tools (like D^2 analysis and path analysis), and integrate modern genomic approaches (like QTL mapping) with classical biometrical theory to solve real-world genetic improvement challenges.

Course Prerequisite: Students are expected to have completed foundational courses in Principles of Genetics and Biostatistics, Introductory Statistics, Forest Genetics and Tree Improvement, with basic knowledge on plant or animal breeding concepts.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Evaluate the genetic architecture of complex quantitative traits by partitioning phenotypic variance into its additive, dominance, epistatic, and environmental components	***E***
2	Design appropriate mating strategies and experimental layouts (e.g., Diallel, North Carolina designs, GxE trials) to estimate key genetic parameters like heritability, combining ability, and heterosis	***C***
3	Formulate selection strategies (e.g., individual, family, index selection) and predict the genetic gain in breeding programs, accounting for factors like selection intensity, heritability, and GxE interactions	***C***
4	Synthesize classical biometrical models with modern genomic data (e.g., QTL, GWAS, Genomic Selection) to critically appraise and propose solutions for complex genetic improvement challenges	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2	X	X					
CO 3	X						X
CO 4	X	X			X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1		**MODULE TITLE: FOUNDATIONS OF QUANTITATIVE GENETICS & VARIANCE COMPONENTS (20 HOURS)**
	1	Concepts in Quantitative Genetics: Historical aspects; Galton (1869) methods for studying quantitative traits
	2	Mendelian Basis: Evidence that quantitative traits are inherited in a Mendelian fashion. Nilsson-Ehle's (1908) multiple factor hypothesis; East's (1916) experiment on *Nicotiana longifera*
	3	Genetic Components of Variation
		a) Gene models (additive, dominance, epistasis). Features of additive and non-additive gene action
		b) Partitioning Variance: Genetic variance in F_2 populations under various gene models. Variance derivation in F_2 and backcrosses
		c) Origin of variation. Important principles established by NCSU (North Carolina State University) for forest tree improvement.
	4	GxE Interaction
		a) Genotype x Environment interaction, its measurement, and significance
		b) Concepts of heritability (broad and narrow-sense) and genetic advance
		c) Random mating in forest trees, their population structure, and response to selection

2		**MODULE TITLE: MATING DESIGNS & SCALING TESTS (20 HOURS)**
	1	Breeding Methodology: Quantitative genetics in relation to efficient breeding methodology

	2	Analysis of Means & Variance
		a) Partitioning of means and variances
		b) Simple scaling tests (A, B, C scales) and the joint scaling test to assess the adequacy of the additive-dominance model
	3	Line x Tester Analysis: Principles, statistical model, analysis, and interpretation for estimating General Combining Ability (GCA) and Specific Combining Ability (SCA)
	4	Diallel Analysis
		a) Concepts, assumptions, and analysis of complete diallel crosses (e.g., Griffing's methods)
		b) Pedigree Designs: Mating designs in tree improvement, including incomplete pedigree design and complete pedigree design.

3	**MODULE TITLE: BIOMETRICAL AIDS TO SELECTION & STABILITY (15 HOURS)**	
	1	Usefulness of Biometrical Techniques
	2	Assessment of Variability
		a) Analysis of Variance (ANOVA) for genetic experiments
		b) Metroglymph analysis for visual representation of diversity
		c) Mahalanobis D^2 statistic for measuring genetic divergence
	3	Aids to Selection
		a) Correlation: Phenotypic, genotypic, and environmental correlations
		b) Path Analysis: Partitioning correlation coefficients into direct and indirect effects
		c) Discriminant Function: Constructing selection indices for simultaneous improvement of multiple traits

	4	Aids to Choice of Parents: Assessment of adaptability and stability analysis (e.g., Eberhart-Russell, AMMI models).

4	**MODULE TITLE: MOLECULAR BIOMETRICS (10 HOURS)**	
	1	Molecular Diversity Analysis: Using molecular markers to assess genetic diversity
	2	Methods for Mapping QTL: Principles and methods for Quantitative Trait Loci (QTL) mapping (e.g., interval mapping)
	3	Software Applications: Introduction to software used in forest genetic analysis and interpretation of their output
5	**Teacher Specific Module (10 Hours)**	
	This module is to be developed by the teacher handling the course. Teachers are encouraged to: • *Analyze a multi-location trial dataset* • *Assess variability using D^2 statistics* • *Analyze the provided mating design (e.g., a diallel) to find GCA/SCA* • *Construct a selection index for parent selection* • *Write a final report proposing a complete breeding strategy, justifying all decisions with their biometrical analysis.*	
	Space to fill the selected area/ activity	

Essential Reading

1. Falconer, D. S., & Mackay, T. F. C. (2009). *Introduction to Quantitative Genetics* (4th ed.). Longman.
2. Mather, K., & Jinks, J. L. (1971). *Biometrical Genetics*. Chapman and Hall.

Suggested Readings

1. Singh, R. K., & Chaudhary, B. D. (1985). *Biometrical Methods in Quantitative Genetical Analysis*. Kalyani Publishers.
2. White, T. L., Adams, W. T., & Neale, D. B. (2007). *Forest Genetics*. CABI.

3. Bernardo, R. (2020). *Breeding for Quantitative Traits in Plants* (3rd ed.). Stemma Press.
4. Lynch, M., & Walsh, B. (1998). *Genetics and Analysis of Quantitative Traits*. Sinauer Associates.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4

c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks Questions

1. Explain Nilsson-Ehle’s multiple factor hypothesis for the inheritance of kernel color in wheat.
2. Differentiate between additive genetic variance and dominance variance.
3. What is a Genotype x Environment (GxE) interaction? Give a practical example in forestry or agriculture.

6 Marks Questions

1. You are given 8 inbred lines of a crop. Design a Line x Tester experiment to evaluate their combining ability. State how you would choose the lines and testers, and provide the ANOVA table (Source of Variation and *df* only) you would use for the analysis.
2. A breeder wants to select for high yield, which is negatively correlated with drought tolerance. Explain how you would use a discriminant function (selection index) to help them select for both traits simultaneously. What information would you need to construct it?
3. You are given data for 10 genotypes grown in 4 environments. Explain the steps you would take to perform a stability analysis. What do "stable" and "unstable" genotypes mean in this context?

14 Marks Questions

1. Explain the multiple factor hypothesis as the Mendelian basis for quantitative inheritance, detailing how genetic variance is partitioned into additive V_A, dominance V_D, and epistatic V_I components, and discuss why narrow-sense heritability h^2 is the most critical parameter for predicting response to artificial selection.
2. Compare and contrast the Line x Tester analysis and the Diallel cross (Griffing's methods) as tools for evaluating parental lines, focusing on their experimental design, statistical models, the types of combining ability (GCA, SCA) they estimate, and the inferences you can draw from each to formulate a hybrid breeding strategy.
3. Discuss the practical application of Mahalanobis' D^2 statistic and Path Coefficient Analysis in a plant or tree improvement program, explaining how a breeder would use the results from both techniques to first choose diverse and promising parents, and then to formulate an effective selection strategy based on the direct and indirect effects influencing a complex trait like yield.

KU8DSEFOR418 ETHNOBIOLOGY AND INTELLECTUAL PROPERTY RIGHTS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR418	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course explores the interdisciplinary field of ethnobiology with a special focus on forestry, traditional ecological knowledge, and the rights of indigenous and local communities. Students will examine the traditional use of forest resources, ethnobotanical research methods, conservation strategies, and the legal frameworks protecting biological resources and traditional knowledge. Emphasis is given to the role of ethnobiology in sustainable forest management, community-based conservation, and the protection of intellectual property related to biological diversity and traditional wisdom.

Course Prerequisite: Students are expected to have a basic understanding of forest ecology, biodiversity conservation, and community forestry principles.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Apply ethnobiological and anthropological research methods to document traditional forest-related knowledge	***A***
2	Evaluate the cultural, ecological, and economic significance of forest-based traditional practices	***E***
3	Interpret the national and international legal frameworks related to biodiversity conservation and intellectual property rights	***C***
4	Develop community-based strategies for protecting traditional ecological knowledge and promoting sustainable forest livelihoods	***C***

**Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)*

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2		X	X				
CO 3							X
CO 4	X	X			X		X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: INTRODUCTION TO ETHNOBIOLOGY AND TRADITIONAL KNOWLEDGE (15 HOURS)**	
	1	History and development of ethnobotanical studies: contributions of J.W. Harshberger, R.E. Schultes, E.K. Janaki Ammal, S.K. Jain, K.S. Manilal, V.V. Sivarajan, and P. Pushpangadan.
	2	Major ethnobiological research centers and organizations: AICRPE, FRLHT, NBA.
	3	Overview of tribal and folk communities in Kerala – cultural, anthropological, and ecological aspects (Koraga, Kurichiya, Paniya, Cholanaikan, Kadar, Kani, etc.).
	4	Role of ethnobiology in sustainable forest management, conservation, and rural development.

2	**MODULE TITLE: METHODS AND APPLICATIONS IN ETHNOBIOLOGICAL RESEARCH (15 HOURS)**	
	1	Ethnobotanical field methods: Anthropological, quantitative (open-ended, semi-structured interviews, transects) and qualitative (structured interviews, free listing, preference ranking).
	2	Plant collection and taxonomy – voucher specimens, herbarium preparation, plant identification.
		a) Archaeobotanical and linguistic analyses.
	3	Ethnobotanical data documentation and analysis – cultural significance, symbolic interpretation, and resource mapping.
	4	Practical applications: ethnomedicine, traditional forest management, NWFP use, and biodiversity conservation.

3	**MODULE TITLE: ETHNOMEDICINE, ETHNOPHARMACOLOGY AND COMMUNITY BENEFITS (15 HOURS)**	
	1	Plants used by indigenous groups as food, medicine, fibre, resins, oils, dyes, fodder, and other forest products.
		a) Role of ethnomedicine in primary health care.

	2	Sustainable harvesting and management of NWFPs
	3	Integration of traditional forest knowledge in conservation and eco-development programmes.
	4	Benefit sharing, bio-prospecting, and community rights over forest resources.

4	**MODULE TITLE: INTELLECTUAL PROPERTY RIGHTS AND BIODIVERSITY LEGISLATION (15 HOURS)**	
	1	Introduction to IPR: Patents, copyrights, trademarks, trade secrets, geographical indications (GI), and plant breeders' rights.
	2	Biodiversity Act, 2002; Biological Diversity Rules; Convention on Biological Diversity (CBD); Nagoya Protocol.
	3	National Biodiversity Authority (NBA), State Biodiversity Boards (SBB), Biodiversity Management Committees (BMCs).
	4	Farmers' rights and researchers' rights.
		a) Case studies on biopiracy and benefit sharing related to forest products.
		b) Ethical considerations and community consent in ethnobiological research.
5	**Teacher Specific Module (10 Hours)**	
	This module should be designed by the course instructor and may include: • *Field visits to tribal communities or sacred groves.* • *Documentation of traditional ecological knowledge or NWFP utilization.* • *Interaction with biodiversity management committees.* • *Preparation of ethnobiological profiles or community-based conservation plans.*	
	Space to fill the selected area/ activity	

Essential Reading

1. Chaudhuri, Rai, H. N., Guha, A., Roychowdhury, E. & Pal, D. C. 1980. Ethnobotanical
2. uses of Herbaria-II. J. Econ. Tax. Bot. 1:163-168.
3. Chaudhuri, Rai, H. N., Banerjee, D. K. & Guha, A. 1977. Ethnobotanical uses of
4. herbaria. Bull. Bot. Surv. India19:256-261.
5. Faulks, P.J. 1958. An Introduction to Ethnobotany. Moredale Publications Ltd., London.
6. Ford, R. I.(Ed.). 1978. The Nature and Status of Ethnobotany. Anthropological Paper
7. no.67. Museum of Anthrop., Univ. of Michigan.
8. Harshberger, J. W. 1896. The Purpose of Ethnobotany. Bot. Gazette 31 : 146-154.

Suggested Readings

1. Jain, S. K. & Rao, R. R. 1983. Ethnobotany in India-An Overview. Botanical Survey of
2. India.
3. Jain, S. K. (Ed.). 1981. Glimpses of Indian Ethnobotany. Oxford & IBH Publishing Co.
4. Jain, S. K. 1964. The role of a Botanist in folklore Research. Folklore 5:145-150
5. Jain, S. K. 1967a. Ethnobotany – Its scope and study. Indian Museum Bull. 2:39-43.
6. Jain, S. K. 1995. A Manual of Ethnobotany. Scientific Publishers.
7. Jain, S. K., Mudgal, V., Banerjee, D. K., Guha, A., Pal, D. C. & Das, D.1984.
8. Bibliography of Ethnobotany. Botanical Survey of India.
9. Ranfrew, Jane. 1973. Paleoethnobotany. Columbia University Press.

Assessment Rubrics:

Evaluation Type – Theory		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		Marks
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define ethnobiology and its scope in forestry.
2. Mention two ethnobotanical field techniques.
3. What are Non-Wood Forest Products (NWFPs)?
4. Name two international conventions related to biodiversity protection.

6 Marks

1. Discuss the role of tribal communities in forest conservation.
2. Explain the process of ethnobotanical data collection and verification.
3. Describe the key features of the Biological Diversity Act, 2002.
4. Write a note on benefit sharing in bioprospecting.

14 Marks

1. Evaluate the role of ethnobiology in sustainable forest management and biodiversity conservation.
2. Discuss the significance of Intellectual Property Rights in protecting traditional forest knowledge.
3. Explain how ethnobotanical studies contribute to rural development and community empowerment.
4. Critically analyze the legal and ethical dimensions of ethnobiological research in India.

KU8DSEFOR419 ENTREPRENEURIAL FORESTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR419	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces forestry students to the principles and practices of entrepreneurship with a focus on forest-based enterprises. It blends forestry science, business management, and sustainability to build competencies in idea generation, planning, financing, and managing forest enterprises. Students will learn how to prepare viable business plans, manage resources, assess risks, and apply entrepreneurial and managerial skills in forestry-related ventures. The course promotes innovation, sustainability, and value addition in the forestry sector.

Course Prerequisite: Basic knowledge of forest management, forest economics, and non-wood forest products.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Demonstrate an understanding of entrepreneurial and managerial principles in forestry contexts	***A***
2	Develop and evaluate business plans for sustainable forest-based enterprises	***E***
3	Apply financial, marketing, and organizational management strategies for enterprise development	***A***
4	Integrate innovation, sustainability, and leadership in forestry entrepreneurship	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1	X						
CO 2			X				
CO 3					X		
CO 4				X			

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: FUNDAMENTALS OF ENTREPRENEURSHIP AND ENTERPRISE MANAGEMENT (15 HOURS)**	
	1	Concept and importance of entrepreneurship.
	2	Entrepreneurial and managerial characteristics; Entrepreneurial motivation and development.
	3	Managing an enterprise: functions of management, planning, organizing, leading, and controlling.
	4	Developing organizational, managerial, and problem-solving skills; encoding and decoding in communication

2	**MODULE TITLE: IDEA GENERATION, PROJECT PLANNING AND FEASIBILITY ANALYSIS (15 HOURS)**	
	1	Idea generation, incubation, and commercialization.
	2	SWOT analysis and identifying forest-based business opportunities.
		a) Project identification and development stages
		b) Pre-feasibility and feasibility studies
		c) Techniques for financial appraisal and project evaluation
	3	Importance of planning, monitoring, evaluation, and follow-up in enterprise success
	4	Supply chain management and total quality management in forestry enterprises

3	**MODULE TITLE: FINANCING AND POLICY FRAMEWORK FOR FORESTRY ENTREPRENEURSHIP (15 HOURS)**	
	1	Sources of finance: venture capital, angel investors, KSIDC, DIC, MSME, NABARD, and SIDBI
		a) Organizational and institutional support for forest-based enterprises

		b) Government policies and schemes for entrepreneurship development
	2	Entrepreneurship in forest business management and eco-enterprise sectors
	3	Forest-based industries and value addition – opportunities and constraints
	4	Financial management and budgeting for small and medium forestry enterprises

4	**MODULE TITLE: INNOVATION, SUSTAINABILITY AND ENTERPRISE DEVELOPMENT (15 HOURS)**	
	1	Entrepreneurship behavior and sustainable innovation
		a. Circular economy and eco-innovation in forestry
	2	Carbon trading, green finance, and ecosystem-based entrepreneurship
	3	Community-based Forest enterprises and cooperative models
	4	Marketing of forest products – strategies, branding, and export potential
		a) Risk management and adaptation strategies in forestry ventures
		b) Case studies of successful forest entrepreneurs and enterprises in India
5	**Teacher Specific Module (10 Hours)**	
	This module should be designed by the course instructor and may include: • *Preparation of a business plan for a forest-based enterprise.* • *Field visits to forest-based industries or cooperatives.* • *Interaction with entrepreneurs and financial institutions.* • *Workshop on project proposal and financial appraisal techniques.*	

	Space to fill the selected area/ activity

Essential Readings

1. Nair, K.R.G. (2013). *Entrepreneurship in Forestry: Sustainable Ventures for Green Growth.* Indian Forester Publication, Dehradun.
2. FAO. (2018). *Forest Business Incubation: Towards Sustainable Forest-Based Enterprises.* Food and Agriculture Organization, Rome.
3. Tiwari, D.N. (2001). *Non-Wood Forest Products and Livelihoods.* International Book Distributors, Dehradun.

Suggested Readings

1. Shepherd, D.A. & Patzelt, H. (2017). *Sustainable Entrepreneurship: A Framework for Forest Enterprises.* Springer, New York.
2. Pandey, D. (2005). *Forest Certification and Sustainable Enterprises.* IIFM Publications, Bhopal.
3. Singh, G. (2010). *Forest-Based Small Scale Enterprises in India.* TERI Press, New Delhi.
4. FAO (2012). *Developing Forest-Based Enterprises: A Practical Guide.* FAO Forestry Paper 171, Rome.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define entrepreneurial forestry.
2. What is SWOT analysis in entrepreneurship?
3. Mention any two institutional supports for forestry-based enterprises.
4. Define supply chain management.

6 Marks

1. Explain the importance of entrepreneurial motivation in forestry.
2. Discuss the steps involved in project feasibility analysis.
3. Describe the sources of finance available for small forest-based enterprises.
4. Explain the role of communication in entrepreneurship development.

14 Marks

1. Critically discuss the process of business development planning in forestry enterprises.
2. Evaluate the role of financial institutions and government policies in promoting entrepreneurial forestry.
3. Discuss the significance of innovation and sustainability in the success of forest-based ventures.
4. Develop a business plan outline for a Non-Wood Forest Product enterprise.

KU8DSEFOR420 GREEN TECHNOLOGY AND SUSTAINABLE DEVELOPMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR420	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
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<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course introduces students to the principles, applications, and global relevance of green technology in fostering sustainable development. It explores eco-design, eco-farming, and corporate sustainability practices, emphasizing the role of scientific and technological innovations in mitigating environmental impacts. Learners will develop an understanding of environmental management systems, certification standards, and quality assurance measures aligned with global sustainability goals.

Course Prerequisite: Basic understanding of environmental science, sustainable resource management, and industrial processes.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Analyze the role of scientific advancements and policy frameworks in promoting sustainable development	***An***
2	Apply ISO and environmental management standards in evaluating sustainability performance	***A***
3	Design and evaluate eco-friendly systems and products through eco-design and eco-farming practices	***C***
4	Interpret the core principles and objectives of green technology and sustainability	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							
CO 2			X				
CO 3			X		X		
CO 4							

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: INTRODUCTION TO GREEN TECHNOLOGY AND SUSTAINABILITY (15 HOURS)**	
	1	Definition and concept of green technology
		a) Principles and objectives of sustainable development
	2	Relationship between green technology and circular economy
	3	Environmental impacts of conventional technologies
	4	Green innovation and cleaner production technologies

2	**MODULE TITLE: ECO-DESIGN AND ECO-FARMING (15 HOURS)**	
	1	Concept and principles of eco-design
		a) Life cycle analysis (LCA) in eco-design
	2	Eco-farming: definition, methods, and applications
	3	Role of biotechnology and smart agriculture in eco-farming
	4	Eco-mark certification – objectives, process, and relevance

3	**MODULE TITLE: ENVIRONMENTAL MANAGEMENT SYSTEMS AND QUALITY STANDARDS (15 HOURS)**	
	1	ISO 14000 Environmental Management System (EMS) – framework and components
	2	ISO 26000 – social responsibility and ethical business
	3	Quality standards: WHO and IBS water quality norms
	4	Environmental auditing and monitoring
		a) Corporate Social Responsibility (CSR) and sustainable corporate governance

4	**MODULE TITLE: APPLICATIONS AND EMERGING TRENDS IN GREEN TECHNOLOGY (15 HOURS)**	
	1	Applications of green technology in forestry, energy, water, and waste management
	2	Role of scientific advancements in developing environmentally friendly technologies
	3	Green nanotechnology, renewable energy innovations, and sustainable materials
	4	Policy and institutional support for green innovation in India and globally
5	**Teacher Specific Module (10 Hours)**	
	This module should be designed by the course instructor and may include: • *Case studies on successful green technology implementation in forestry and agriculture* • *Discussion on Indian initiatives like "Green India Mission" and "National Solar Mission"* • *Student seminars on ISO standards, CSR models, and sustainable production systems* • *Field visit to eco-industrial parks or green-certified industries*	
	Space to fill the selected area/ activity	

Essential Readings

1. Peiró, L.T., Polverini, D. & Ardente, F. (2018). *Eco-Design and Sustainability*. Springer.
2. UNEP (2011). *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*. United Nations Environment Programme.
3. ISO (2015). *ISO 14001: Environmental Management Systems – Requirements with Guidance for Use*. ISO Publications.

Suggested Readings

1. Sarkar, A.N. (2012). *Green Growth and Sustainable Development*. The Energy and Resources Institute (TERI).
2. Rao, P.K. (2014). *Sustainable Development: Economics and Policy*. Blackwell Publishing.
3. Shrivastava, P. (1995). *Industrial/Environmental Management: Integrating Ecology and Economy*. Sage Publications.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4

b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define green technology and explain its core objectives.
2. What is the significance of eco-mark certification?
3. Mention any three components of ISO 14000 Environmental Management System.
4. Differentiate between eco-design and conventional design.

6 Marks

1. Discuss the role of eco-farming in promoting sustainable agriculture.
2. Explain the principles and structure of ISO 26000.
3. Describe the relationship between CSR and sustainable development.
4. How do advancements in science contribute to green innovation?

14 Marks

1. Elaborate on the applications of green technology in forestry and water management.
2. Analyze the importance of Environmental Management Systems (EMS) in achieving sustainability goals.
3. Discuss the integration of eco-design, eco-farming, and environmental standards as a holistic model for sustainable development.
4. Critically evaluate India’s progress in implementing green technology initiatives.

KU8DSEFOR421 REMOTE SENSING AND GIS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR421	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides an in-depth understanding of remote sensing (RS) and geographic information systems (GIS) and their applications in forest resource management. Students will learn the principles of satellite imaging, digital image processing, and spatial analysis to address forestry problems such as forest inventory, monitoring, mapping, and modeling. The course emphasizes practical exposure to modern geomatic tools for sustainable forest planning, management, and conservation.

Course Prerequisite: Basic knowledge of computer applications, forest management, and environmental science. Prior understanding of map reading and ecological data interpretation will be beneficial.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Integrate multi-source geospatial data (satellite, aerial, and ground-based) to analyze spatial patterns and changes in forest ecosystems using advanced RS and GIS tools	***An***
2	Design and implement spatial modeling workflows for forest management applications such as land cover change detection, biomass estimation, and fire risk zonation	***A***
3	Critically evaluate and synthesize remote sensing products and algorithms (NDVI, SAVI, EVI, etc.) to assess vegetation health, carbon dynamics, and ecological resilience	***E***
4	Develop geospatial decision-support systems integrating RS, GIS, and GPS technologies for sustainable forest resource management, planning, and policy formulation	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							X
CO 2		X					
CO 3							
CO 4			X				

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: FUNDAMENTALS OF REMOTE SENSING (15 HOURS)**
	1	Introduction to Remote Sensing: Concepts, principles, and electromagnetic spectrum
		a) Recent developments in geomatics and earth observation technologies
	2	Satellite missions: Indian (IRS, CartoSat, Resourcesat) and global missions (Landsat, MODIS, Sentinel, SPOT)
	3	Spatial, spectral, radiometric, and temporal resolutions
	4	Image acquisition and data sources

2		**MODULE TITLE: IMAGE PROCESSING AND INTERPRETATION (15 HOURS)**
	1	Geo-referencing of topo-sheets and satellite imagery
	2	Principles of image interpretation and elements of visual interpretation.
	3	Digital Image Processing (DIP):
		a) Image registration and geometric correction
		b) Image enhancement techniques
		c) Image classification: supervised and unsupervised
		d) Accuracy assessment and error matrix generation.
	4	Tools for processing and interpretation (ERDAS Imagine, ENVI, QGIS, etc.)

3	**MODULE TITLE: REMOTE SENSING APPLICATIONS IN FORESTRY (15 HOURS)**

	1	RS applications in forest resource management:
	2	Land use and land cover mapping; Vegetation classification and change detection; Forest biomass estimation and carbon stock mapping; Forest degradation and damage assessment (pests, diseases, mining, fire)
	3	Forest fire risk zonation and monitoring; Watershed delineation and management; Wildlife habitat assessment.
	4	Multi-hazard monitoring using vegetation indices (NDVI, EVI, SAVI, NDBI, etc.).

4	**MODULE TITLE: GIS AND GPS IN FOREST RESOURCE MANAGEMENT (15 HOURS)**	
	1	Introduction to GIS: Concepts, data types, and data models (raster and vector).
	2	GIS data collection, storage, and spatial analysis
	3	Development of forest information and decision support systems
	4	GPS principles, working mechanism, and applications in forestry
5	**Teacher Specific Module (10 Hours)**	
	This module should be designed by the course instructor and may include: • *Advances in drone-based remote sensing and LiDAR applications* • *Integration of RS, GIS, and IoT in smart forest monitoring* • *Open-source platforms and cloud-based geospatial analysis (Google Earth Engine)* • *Introduction to AI and machine learning applications in forest resource management*	
	Space to fill the selected area/ activity	

Essential Readings

1. Lillesand, T.M., Kiefer, R.W., & Chipman, J.W. (2015). *Remote Sensing and Image Interpretation.* Wiley.
2. Jensen, J.R. (2013). *Remote Sensing of the Environment: An Earth Resource Perspective.* Pearson Education.
3. Burrough, P.A., & McDonnell, R.A. (1998). *Principles of Geographical Information Systems.* Oxford University Press.
4. Campbell, J.B. (2007). *Introduction to Remote Sensing.* CRC Press.

Suggested Readings

1. Congalton, R.G. & Green, K. (2009). *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices.* CRC Press.
2. Gupta, R.P. (2003). *Remote Sensing Geology.* Springer-Verlag.
3. Sabins, F.F. (1997). *Remote Sensing: Principles and Interpretation.* Waveland Press.
4. Heywood, I., Cornelius, S., & Carver, S. (2011). *An Introduction to Geographical Information Systems.* Pearson.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

Short Answer (3 Marks)

1. Define spatial and spectral resolution with examples.
2. Differentiate between supervised and unsupervised classification.
3. Write short notes on NDVI and its significance in vegetation mapping.

Medium Answer (6 Marks)

1. Explain the principles of digital image processing and its importance in forestry.
2. Describe the various types of satellite data used for forest resource management.
3. Discuss the applications of GPS and GIS in forest inventory and monitoring.

Long Answer (14 Marks)

1. Discuss in detail the role of remote sensing and GIS in sustainable forest resource management.
2. Explain the methodology and steps involved in forest biomass and carbon mapping using remote sensing.
3. Elaborate on the integration of remote sensing, GIS, and decision support systems in modern forest management.

KU8DSEFOR422 MEDICINAL AND AROMATIC PLANTS

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR422	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides comprehensive knowledge on the botany, cultivation, and utilization of medicinal and aromatic plants (MAPs) with emphasis on their role in forestry, industry, and traditional medicine. It focuses on conservation strategies, industrial prospects, and sustainable utilization of MAPs, integrating ethnobotanical knowledge, biotechnological advances, and national policies to promote green entrepreneurship and biodiversity conservation.

Course Prerequisite: Students should have prior understanding of plant taxonomy, forest ecology, and non-timber forest products (NTFPs) from earlier semesters. Basic knowledge of plant physiology, ethnobotany, and forest resource management will enhance comprehension.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Critically evaluate the economic, ecological, and medicinal significance of MAPs in forest ecosystems	***E***
2	Demonstrate advanced understanding of MAP cultivation, processing, and value chain development	***A***
3	Analyze national and international frameworks for MAP conservation, trade, and industrial application.	***An***
4	Integrate ethnobotanical and technological approaches for sustainable utilization and entrepreneurship in MAPs	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1							X
CO 2		X					
CO 3							
CO 4			X				

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1	**MODULE TITLE: INTRODUCTION TO MEDICINAL AND AROMATIC PLANTS (15 HOURS)**	
	1	Definition, history, importance and future prospects of MAPs
		a) Medicinal plants: global and Indian status — past, present and future trends.
	2	MAPs as industrial crops — constraints and remedial measures.
		a) Medicinal plant diversity and local healthcare traditions.
		b) Conservation of medicinal plants — issues, approaches, and role of forests.
	3	Medicinal Plant Conservation Areas (MPCA), NTFPs, Good Agricultural Practices (GAP).
	4	MAPs in the Indian Himalayan Region (IHR).
2	**MODULE TITLE: PROMOTION, POLICY AND INDUSTRY (10 HOURS)**	
	1	National Medicinal Plant Board (NMPB) and State Boards — objectives and functions
	2	Organizational initiatives: National and International (WHO, FRLHT, UNDP, IUCN-MPSG).
	3	Demand, supply and marketing chains of medicinal and aromatic plants.
		a) Role of herbal industries and forest-based entrepreneurship.
		b) Quality assurance and standardization of herbal products.
	4	Role of NGOs and cooperatives in MAP conservation and value chain development.

3	**MODULE TITLE: MEDICINAL PLANTS: DIVERSITY, CULTIVATION AND USES (20 HOURS)**	
	1	Important medicinal plants of India — systematics, distribution, and uses. *Examples: Acorus calamus*, *Adhatoda vasica*, *Abrus precatorius*, *Aloe vera*, *Phyllanthus amarus*, *Stevia rebaudiana*, *Belladona*, *Cinchona*, *Rauwolfia serpentina*, *Atropa belladonna*, *Senna*, *Costus speciosus*, *Neem*, *Dioscorea spp.*, *Digitalis spp.*
	2	Cultivation and propagation techniques: soil, climate, spacing, and harvesting.
	3	Conservation and regeneration in forest ecosystems: *Gmelina arborea*, *Terminalia chebula*, *Phyllanthus emblica*, *Azadirachta indica*.
	4	Role of ethnobotany and ethnopharmacology in traditional medicine.

4	**MODULE TITLE: AROMATIC PLANTS: ESSENTIAL OILS AND INDUSTRIAL USES (15 HOURS)**	
	1	Essential oil–yielding species — botany, cultivation, extraction, and uses. (Lemongrass, Citronella, Palmarosa, Vetiver, Eucalyptus, Japanese mint, Patchouli, Geranium, Jasmine, Rose, Basil)
	2	Aromatic and cosmetic industries — raw materials for perfumes, soaps, and pharmaceuticals.
	3	Aromatic spices of India: Clove, Cinnamon, Nutmeg, Ajwain, Dill, Celery, Tamarind, Curry leaf, Saffron
	4	Sustainable harvesting, post-harvest technology, and value addition
5	**Teacher Specific Module (10 Hours)**	
	• *Demonstration of extraction techniques for essential oils and plant alkaloids.* • *Visit to herbal and aromatic industries, FRLHT/NMPB-supported units.* • *Case studies on successful MAP-based forest entrepreneurship.* • *Practical session on the identification of MAPs and preparation of herbarium specimens.*	

	Space to fill the selected area/ activity

Essential Readings

1. Zobel, B.J. & van Buijtenen, J.P. (1989). *Wood Variation: Its Causes and Control.* Springer-Verlag.
2. Kirtikar, K.R. & Basu, B.D. (1995). *Indian Medicinal Plants.* International Book Distributors, Dehradun.
3. Chadha, K.L. & Gupta, R. (1995). *Advances in Horticulture Vol. 11: Medicinal and Aromatic Plants.* Malhotra Publishing House.
4. Schultes, R.E. & Von Reis, S. (1995). *Ethnobotany: Evolution of a Discipline.* Chapman & Hall.

Suggested Readings

1. Handa, S.S., Kaul, M.K., & Kapoor, V.K. (2008). *Pharmacognosy and Phytochemistry.* Vallabh Prakashan, New Delhi.
2. Pushpangadan, P. & Atal, C.K. (1984). *Ethnobotany and Medicinal Plant Research in India.* NISCAIR.
3. FRLHT (2020). *Medicinal Plant Conservation Strategies in India.* Foundation for Revitalisation of Local Health Traditions.
4. National Medicinal Plants Board (NMPB) Reports, Ministry of AYUSH, Govt. of India.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10

b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks

1. Define medicinal and aromatic plants and mention their importance in forestry.
2. What are the functions of the National Medicinal Plant Board?
3. List any three essential oil–yielding plants of India.

6 Marks

1. Discuss the conservation strategies for medicinal plants in India.
2. Explain the role of ethnobotany in promoting medicinal plant utilization.
3. Describe the process of essential oil extraction and its industrial relevance.

14 Marks

1. Critically analyze the status and challenges of medicinal and aromatic plants as industrial crops in India.
2. Explain the scope, objectives, and policies of NMPB and State Medicinal Plant Boards.
3. Discuss the cultivation, propagation, and industrial applications of aromatic plants in India with examples.

KU8DSEFOR423 ZOONOTIC DISEASE MANAGEMENT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR423	3+1	75

Learning Approach (Hours/ Week)			Marks Distribution- Theory			Duration of ESE (Hours)
Lecture	Practical/ Internship	Tutorial	CE	ESE	Total	
3	1		25	50	75	2
			Marks Distribution- Practical			
			10	15	25	

Course Description: This course provides an in-depth understanding of zoonotic diseases—infectious diseases transmitted between animals and humans—and their growing significance in the context of global environmental change. It explores the ecological, climatic, and socio-economic drivers of zoonotic outbreaks, India’s vulnerability, and the One Health approach integrating human, animal, and ecosystem health. Students will learn national and international strategies for surveillance, prevention, and control of zoonotic diseases, as well as policy frameworks like NADCP, NOHP-PCZ, and G20 Pandemic Fund. The course emphasizes applied knowledge through case studies, ecological mapping, and integrated response mechanisms, fostering critical competencies for addressing emerging public health and environmental challenges.

Course Prerequisite: Students should have a foundational understanding in Basic concepts in ecology, epidemiology, and wildlife biology. Environmental health and biodiversity conservation principles. Introductory microbiology and disease transmission pathways

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Evaluate India's preparedness, surveillance systems, and One Health approaches in mitigating zoonotic risks.	***E***
2	Integrate scientific, ecological, and policy perspectives to design holistic zoonotic management strategies.	***A***
3	Analyze global and national trends, causes, and ecological implications of zoonotic diseases.	***An***
4	Develop informed, evidence-based frameworks for zoonotic disease prevention and sustainable public health management.	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1			X				
CO 2							
CO 3	X						
CO 4							X

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**

1	**MODULE TITLE: INTRODUCTION TO ZOONOSES AND GLOBAL OVERVIEW PLANTS (15 HOURS)**	
	1	Definition, classification, and characteristics of zoonotic diseases
		a) Historical perspectives and epidemiological transitions
	2	Major zoonotic pathogens: viral, bacterial, parasitic, and fungal
		a) Global burden of zoonotic diseases – prevalence, morbidity, and mortality
		b) Modes of transmission – direct, vector-borne, food-borne, and water-borne routes
	3	Regional and global vulnerability patterns – Latin America, Asia, Africa, and Oceania
	4	Case examples: Rabies, Anthrax, Nipah, H1N1, Ebola, SARS, and COVID-19

2	**MODULE TITLE: DRIVERS, RISKS, AND INDIA'S ZOONOTIC LANDSCAPE (15 HOURS)**	
	1	Ecological and anthropogenic drivers: deforestation, wildlife trade, agriculture, and urbanization
	2	Impact of climate change and land-use changes on zoonotic spillover risks
	3	National strategies: NADCP, NOHP-PCZ, ASCAD, and Animal Birth Control (Dogs) Rules, 2023
		a) Zoonotic burden in India (2018–2023) – regional distribution and trends
	4	Disease mapping and seasonality – role of monsoon and vector ecology

3	**MODULE TITLE: INTEGRATED SURVEILLANCE, POLICY, AND MANAGEMENT (15 HOURS)**	
	1	One Health Approach: principles, framework, and applications in zoonotic management

	2	Institutional linkages – WHO, FAO, OIE, and GLEWS (Global Early Warning System): International programmes: ZODIAC (IAEA, 2020), G20 Pandemic Fund, and Global Coordination
	3	Surveillance systems – early detection, response mechanisms, and integrated data systems
	4	Community engagement, risk communication, and inter-sectoral collaboration

4	**MODULE TITLE: PREVENTION, CONTROL, AND FUTURE DIRECTIONS (15 HOURS)**	
	1	Strategies for prevention and control: vaccination, vector control, hygiene, and waste management
	2	Research and innovations in zoonotic management – genetic tracing, biosafety, and AI-based surveillance
	3	Climate-smart policies and adaptive management for zoonotic resilience
	4	Global governance and ethical considerations in pandemic preparedness
5	**Teacher Specific Module (10 Hours)**	
	• *Demonstration of zoonotic disease surveillance tools and dashboards* • *GIS-based mapping of zoonotic risk zones in India* • *Case discussions on recent outbreaks (e.g., Nipah 2023, COVID-19)* • *Seminar on the One Health model in forest-dependent communities* • *Student presentations on zoonotic disease policies and action frameworks*	
	Space to fill the selected area/ activity	

Essential Readings

1. World Health Organization (WHO). 2021. *A Guide to Zoonotic Diseases and One Health Approaches.*
2. Food and Agriculture Organization (FAO). 2020. *Taking a Multisectoral, One Health Approach: A Tripartite Guide to Addressing Zoonotic Diseases.*
3. IAEA. 2021. *Zoonotic Disease Integrated Action (ZODIAC) Programme Report.*

Suggested Readings

1. Karesh, W.B., et al. (2012). *Ecology of Zoonoses and Emerging Infections.* The Lancet Infectious Diseases.
2. Atlas, R.M. & Maloy, S. (2020). *One Health: People, Animals, and the Environment.* ASM Press.
3. National Centre for Disease Control (NCDC). 2022. *National One Health Programme for Prevention and Control of Zoonoses: Annual Report.*

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical	**Marks**
End Semester Evaluation	**15**
Continuous Evaluation	**10**
a) Test Paper	4
b) Practical Record and Submissions	4
c) Viva-Voce	2
Total	**25**

Sample questions to Test Outcome

3 Marks

4. Define zoonotic diseases and give two examples.
5. What is the role of climate change in zoonotic spillover?
6. Mention the objectives of the NADCP programme.

6 Marks

1. Explain the One Health approach and its significance in zoonotic disease control.
2. Describe the functions of the ZODIAC programme launched by the IAEA.
3. Discuss the major zoonotic disease trends in India during 2018–2023.

14 Marks

1. Critically analyze India’s national strategy for managing zoonotic diseases, highlighting the roles of NOHP-PCZ and NADCP.
2. Evaluate global and regional vulnerabilities to zoonotic diseases in the context of environmental change.
3. Explain the integrated framework for zoonotic disease prevention and management under the One Health paradigm.

KU8DSEFOR424 BIOCHEMISTRY

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR424	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
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<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This course provides a comprehensive understanding of the biochemical foundations of life, focusing on the molecular structure, function, and energetics of biological systems. It explores the biochemical pathways underlying energy production, macromolecule synthesis and degradation, and enzymatic regulation. The course also emphasizes biochemical applications in forestry and environmental sciences — such as plant metabolism, stress biochemistry, and carbon cycling.

Course Prerequisite: Basic understanding of general chemistry, plant physiology, and molecular biology.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Critically analyze the molecular mechanisms of biochemical reactions, energy transfer, and enzyme kinetics, relating them to physiological and environmental processes in living systems	***An***
2	Evaluate the structure–function relationship of major biomolecules and their roles in plant, microbial, and animal metabolism with specific emphasis on forest ecosystems.	***E***
3	Integrate biochemical pathways to explain metabolic regulation, stress responses, and adaptive mechanisms in forest plants under varying climatic and ecological conditions.	***C***
4	Apply advanced biochemical and analytical techniques (e.g., enzyme assays, chromatography, and electrophoresis) to investigate metabolic processes and develop sustainable bioresource management strategies.	***A***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1					X		
CO 2							
CO 3					X		
CO 4		X					

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	UNIT	DESCRIPTION
1		**MODULE TITLE: FUNDAMENTALS OF BIOCHEMISTRY AND BIOENERGETICS (15 HOURS)**
	1	Structure and properties of organic and inorganic compounds.
		a) Chemical bonds: ionic, covalent, coordinate, metallic, and hydrogen bonds.
	2	Ionization of water, pH and pOH, equilibrium constants, buffer systems, and pH measurement (Henderson–Hasselbalch equation)
		a) Hydrophilic interactions and van der Waals forces.
	3	Principles of bioenergetics and thermodynamics: free energy, entropy, standard free energy change.
	4	High-energy compounds: ATP and thioesters; biological oxidation and active transport mechanisms.

2		**MODULE TITLE: BIOMOLECULES AND BIO-ORGANIC CHEMISTRY (15 HOURS)**
	1	Carbohydrates: Classification, structure, and functions of mono-, oligo-, and polysaccharides.
	2	Amino Acids and Proteins: Structure, classification, amphoteric nature, peptide bonds, levels of protein organization.
	3	Lipids: Classification (fatty acids, phospholipids, steroids, terpenes, waxes); structure and biological roles.
		a) Nucleic Acids: Structure of purines, pyrimidines, DNA and RNA; Watson–Crick model; nucleotides and their functions.
	4	Bioinorganic Aspects: Role of metal ions (Fe, Mg, Mo, Co) in biomolecules such as chlorophyll, cytochromes, and vitamin B12.

3	**MODULE TITLE: ENZYMOLOGY (15 HOURS)**	
	1	General properties, apoenzymes, holoenzymes, cofactors, and coenzymes
	2	Mechanism of enzyme action – Lock and Key and Induced Fit models.
	3	Enzyme specificity, allosteric enzymes, activation and inhibition (competitive, non-competitive, uncompetitive).
	4	Enzyme kinetics: Michaelis–Menten equation, types of inhibition and their kinetic implications.
		a) Single- and bi-substrate kinetics.
		b) Mechanisms of selected enzymes – *chymotrypsin*, *myoglobin*, and *hemoglobin*.

4	**MODULE TITLE: METABOLISM AND ENERGY PATHWAYS (15 HOURS)**	
	1	Carbohydrate Metabolism: Glycolysis, gluconeogenesis, citric acid cycle (TCA), and glycogen metabolism; regulation and energetics.
	2	Amino Acid Metabolism: Biosynthesis, degradation, transamination, deamination, urea cycle.
	3	Nucleotide Metabolism: Biosynthesis, catabolism, and salvage pathways.
	4	Lipid Metabolism: Biosynthesis and degradation of fatty acids; cholesterol synthesis; physiological functions of steroid hormones.
5	**Teacher Specific Module (10 Hours)**	
	Faculty may design context-specific sessions such as: • *Biochemical aspects of forest tree metabolism and stress physiology.* • *Enzyme-based assays in plant and soil biochemical studies.* • *Role of biochemistry in carbon sequestration and climate resilience.* • *Demonstration of biochemical instrumentation and analytical tools.*	

	Space to fill the selected area/ activity

Essential Readings

1. Lehninger, A.L., Nelson, D.L. & Cox, M.M. 2017. *Principles of Biochemistry*. W.H. Freeman.
2. Berg, J.M., Tymoczko, J.L. & Stryer, L. 2015. *Biochemistry*. W.H. Freeman.
3. Voet, D. & Voet, J.G. 2011. *Biochemistry*. Wiley.

Suggested Readings

1. Devlin, T.M. 2010. *Textbook of Biochemistry with Clinical Correlations*. Wiley.
2. White, A., Handler, P., Smith, E.L., Hill, R.L. & Lehman, I.R. *Principles of Biochemistry*. McGraw Hill.
3. Campbell, M.K. & Farrell, S.O. 2014. *Biochemistry*. Cengage Learning.

Assessment Rubrics:

Evaluation Type – Theory		Marks
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
b)	Test Paper-2	10
c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2

Total	75

Evaluation Type – Practical		Marks
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4
c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

Short Answer (3 Marks)

1. Define enzyme specificity and give examples.
2. What are high-energy compounds?
3. Explain the concept of competitive inhibition.
4. Define oxidative phosphorylation.
5. What is the role of magnesium in chlorophyll?

Paragraph (6 Marks)

1. Describe the role of cofactors and coenzymes in enzyme catalysis.
2. Discuss the energetics of the citric acid cycle.
3. Explain the structure and function of phospholipids.
4. Outline the principle of ELISA and its biochemical applications.

Essay (14 Marks)

1. Discuss enzyme kinetics with reference to Michaelis–Menten theory and types of inhibition.

2. Describe the biochemical pathways of glycolysis and gluconeogenesis with regulation.
3. Explain the synthesis and physiological role of steroid hormones.
4. Elaborate on oxidative and photophosphorylation processes and their ecological significance.

KU8DSEFOR425 INSTRUMENTATION AND BIOLOGICAL TECHNIQUES

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	DSE *(For Minor Pathway)*	400-499	KU7DSEFOR425	3+1	75

<table>
<tr><td colspan="3">Learning Approach (Hours/ Week)</td><td colspan="3">Marks Distribution- Theory</td><td rowspan="2">Duration of ESE (Hours)</td></tr>
<tr><td>Lecture</td><td>Practical/ Internship</td><td>Tutorial</td><td>CE</td><td>ESE</td><td>Total</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">1</td><td rowspan="3"></td><td>25</td><td>50</td><td>75</td><td rowspan="3">2</td></tr>
<tr><td colspan="3">Marks Distribution- Practical</td></tr>
<tr><td>10</td><td>15</td><td>25</td></tr>
</table>

Course Description: This capstone course integrates advanced analytical, molecular, cellular, and microbial techniques essential for biological and forestry research. The course emphasizes laboratory instrumentation, cell culture, microscopy, chromatography, spectroscopy, and electrophoresis. It aims to provide students with the technical competency required for forest biotechnology, molecular ecology, and bioresource conservation research, focusing on real-time analytical applications, data interpretation, and research design.

Course Prerequisite: Students should have completed foundational courses in Molecular Biology, Biochemistry, and Microbiology. Basic knowledge of biological macromolecules, cellular organization, and laboratory safety is required.

Course Outcomes:

CO No.	Expected Outcome	Learning Domains
1	Analyze and interpret data from advanced spectroscopic, chromatographic, and electrophoretic systems in biological and forestry research contexts	***An***
2	Design and execute molecular biology experiments including PCR, blotting, and gene expression studies with precision and reproducibility	***E***
3	Demonstrate proficiency in microscopy, cell culture, and cytometric techniques for cellular and tissue-level investigations	***C***
4	Integrate microbial and molecular tools for applied forestry research, biodiversity conservation, and bioresource management	***C***

****Remember (R), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C)***

Mapping of Course Outcomes to PSOs

	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7
CO 1				X			
CO 2							
CO 3		X					
CO 4					X		

COURSE CONTENTS

Contents for Classroom Transaction:

MODULE	**UNIT**	**DESCRIPTION**
1	**MODULE TITLE: ANALYTICAL AND SPECTROSCOPIC TECHNIQUES (15 HOURS)**	
	1	Introduction to analytical methods and their importance in biological sciences.
	2	Spectroscopy: UV-Visible, Fluorescence, Infrared, FTIR, Raman, and NMR Spectroscopy.
	3	Mass Spectrometry: Principles and applications.
	4	Environmental and forestry research applications of analytical instrumentation

2	**MODULE TITLE: CHROMATOGRAPHY AND MOLECULAR BIOLOGY TECHNIQUES (15 HOURS)**	
	1	Chromatography: Paper, TLC, HPLC, GC, LC – principles, instrumentation, and applications.
	2	Molecular Techniques: PCR (multiplex, nested, real-time, touchdown, hot start, etc.), Blotting (Southern, Northern, Western), ISH, FISH, ISA, RFLP, SSCP, DHPLC, DGGE, and nucleic acid sequencing.
	3	Microarrays, 16S rRNA typing, EST, SAGE – functional genomics tools

3	**MODULE TITLE: ELECTROPHORESIS AND CENTRIFUGATION (15 HOURS)**	
	1	Electrophoresis: Agarose, SDS-PAGE, native and gradient gels, isoelectric focusing, and 2D electrophoresis.
	2	Capillary and single-molecule electrophoresis.
	3	Centrifugation: Principles, types (micro, high-speed, ultracentrifuge), preparative and analytical methods, sedimentation velocity and equilibrium analysis.

4	**MODULE TITLE: MICROSCOPY AND CELLULAR TECHNIQUES (15 HOURS)**

	1	Microscopy: Light, dark-field, phase contrast, fluorescence, confocal, TEM, SEM, AFM, and super-resolution imaging (STORM, PALM).
	2	Cell Biology Techniques:
		a) In vitro cell culture, trypsinization, reseeding, and cell counting.
		b) Cell imaging and analysis of organelles, apoptosis, and protein localization.
		c) Immunocytochemistry, FACS analysis, tissue sectioning, cryostat, and visualization.
5	**Teacher Specific Module (10 Hours)**	
	Faculty may design context-specific sessions such as: • *Bacterial and fungal culture techniques, media preparation, microbial growth kinetics.* • *Isolation and identification of microbes, Gram staining, and biochemical assays.* • *Antibiotic inhibition, transformation, competent cell preparation, and E. coli as a model system.* • *Application of these methods in forest pathology, wood microbiology, and environmental bioremediation.*	
	Space to fill the selected area/ activity	

Essential Readings

1. Boyer, R. (2012). *Concepts in Biochemistry.* Brooks/Cole.
2. Wilson, K., & Walker, J. (2010). *Principles and Techniques of Biochemistry and Molecular Biology.* Cambridge University Press.
3. Plummer, D. T. (2011). *An Introduction to Practical Biochemistry.* Tata McGraw Hill.

Suggested Readings

1. Brown, T. A. (2010). *Gene Cloning and DNA Analysis.* Wiley-Blackwell.

2. Maloy, S. R., Cronan, J. E., & Freifelder, D. (2017). *Microbial Genetics.* Jones & Bartlett.
3. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2018). *Principles of Instrumental Analysis.* Cengage Learning.
4. Lodish, H. et al. (2021). *Molecular Cell Biology.* W.H. Freeman.

Assessment Rubrics:

Evaluation Type – Theory		**Marks**
End Semester Evaluation		**50**
Continuous Evaluation		**25**
a)	Test Paper- 1	10
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c)	Assignment/ Seminar/ Book/ Article Review/ Field Report	3
d)	Viva-Voce	2
Total		**75**

Evaluation Type – Practical		**Marks**
End Semester Evaluation		**15**
Continuous Evaluation		**10**
a)	Test Paper	4
b)	Practical Record and Submissions	4

c)	Viva-Voce	2
Total		**25**

Sample questions to Test Outcome

3 Marks (Short Answer)

1. Differentiate between UV-Visible and Fluorescence Spectroscopy.
2. Define FACS and its role in cell cycle analysis.
3. What is the principle of SDS-PAGE?
4. List the major types of centrifuges used in biological studies.
5. Write short notes on Eco-mark certification of biological instruments.

6 Marks (Analytical/Descriptive)

1. Explain the working principle and applications of HPLC in biological systems.
2. Discuss the role of PCR variants in genetic analysis.
3. Describe how fluorescence microscopy is used to study cell signaling.
4. Elaborate on the significance of sedimentation equilibrium in macromolecule characterization.

14 Marks (Comprehensive/Capstone Questions)

1. “Advanced biological instrumentation has revolutionized forestry and life science research.”
   – Discuss with suitable examples of integrated molecular and imaging approaches.
2. Explain in detail the methodology and applications of modern chromatographic and electrophoretic techniques in bioresource characterization.
3. Design an experimental workflow using molecular, microbial, and spectroscopic techniques to identify fungal contamination in forest wood samples.

PROJECT

Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	PROJECT	-	**KU8PRJFOR426**	8	240
Semester	Course Type	Course Level	Course Code	Credits	Total Hours
8	PROJECT	-	**KU8PRJFOR427**	12	360

Course Description

The Project Course provides an opportunity for students to independently design and conduct research in forestry and allied fields, integrating theoretical knowledge with field and laboratory experience. It develops critical thinking, scientific writing, and data interpretation skills essential for professional forestry research, conservation, and sustainable management. Students are expected to identify a relevant problem, review literature, design an experimental or analytical framework, collect and analyze data, and present the findings as a scientific report or dissertation.

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 requiredpermissions for off-campus projects. Students must maintain and submit a project logbook/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

A student pursuing UG Honors with research must complete a mandatory research project worth 12 credits by the end of the eighth semester. For other UG Honors 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 8 Credits **KU8PRJFOR426**	**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)*
Research Project of 12 Credits **KU8PRJFOR427**	**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)*