DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

CIRCULAR NO.SU/Sci./University Deptt./NEP/01/2024

It is hereby inform to all concerned that, the syllabi prepared by the Ad-hoc Board and recommended by the Dean, Faculty of Science & Technology, **Academic Council at its meeting held on 05 June 2024 has accepted** the following Syllabi under the Faculty of Science & Technology **as per Norms of National Education Policy – 2020 run at University Department, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapathi Sambhajinagar** as appended herewith.

Sr.No.	Syllabi of the Department.	Semester
1.	M.Sc. Rural Technology	IIIrd & IVth Semester
2.	M.Sc. Coservation of Biodiversity	IIIrd & IVth Semester

This is effective from the Academic Year 2024-25 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Aurangabad-431 004.
REF.NO.SU/NEP/2024/844-52
Date:- 18.06.2024.

* * * * *

Deputy Registrar,
Academic Section

Copy forwarded with compliments to :-

1] **Head of the Department/Director, Department of Gopinathrao Munde National Institute of Rural Development & Research,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] **The Director, University Network & Information Centre, UNIC**, with a request to upload this Circular on University Website.

Copy to :-

1] **The Director, Board of Examinations & Evaluation,** Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
2] The Section Officer,[M.Sc.Unit] Examination Branch, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
3] The Programmer [Computer Unit-1] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
4] The Programmer [Computer Unit-2] Examinations, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
5] The In-charge,[E-Suvidha Kendra], Rajarshi Shahu Maharaj Pariksha Bhavan, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
6] The Public Relation Officer, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.
7] The Record Keeper, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,

AURANGABAD

Re-accredited with 'A' Grade

Gopinathrao Munde National Institute of Rural Development and Research
(GMNIRD)

Revised Course Structure and Curriculum

As per

National Education Policy 2020

(NEP – 2020)

for

2 Years (Four Semesters)

Post-Graduation Programme

Master of Science (M. Sc.)

in

CONSERVATION OF BIODIVERSITY

under

Faculty of Science & Technology

(Effective from Academic year 2024-25 & onwards)

Table of Contents

Name of Program: Master in Conservation of Biodiversity

1. PREAMBLE

Rural development needs an integration of all areas of knowledge. It needs multi-disciplinary approach towards the rural development ideology. The GMNIRD is committed to empower the youth for rural development by catering the needs of the rural development. It will integrate all local institutions, industries, and organizations in the vicinity for the universal coordination of knowledge for overall rural growth & development. Under the Gopinathrao Munde National Institute of Rural Development & Research (GMNIRD) a new syllabus is designed as per New National Education Policy 2020 (NEP – 2020) for Master of Science in Conservation of Biodiversity is to be implemented from the academic year 2023-24 onwards in GMNIRD of Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. The GMNIRD is established in the Dr. Babasaheb Ambedkar Marathwada University campus as one of the constituent Institute for conducting academic, research, training and extension activities associated with the rural development and management. It is a multidisciplinary Institute covering all disciplines of science, technology, social sciences, agricultural sciences, trade and managerial subjects.

The role of higher education is vital in securing the gainful employment and providing further access to higher education comparable to the best available in the world-class institutions elsewhere. The improvement in the quality of higher education, therefore, deserves to be given tom-most priority to enable the young generation of students to acquire skill, training, and knowledge to enhance their thinking, comprehension and application abilities and prepare them to compete, succeed and excel globally. Sustained initiatives are required to reform the present higher education system for improving and upgrading the academic resources and learning environments by raising the quality of teaching and standards of achievements in learning outcomes across all undergraduate programs in science, humanities, commerce, and professional streams of higher education. One of the significant reforms in the undergraduate education is to introduce the Learning Outcomes based Curriculum Framework (LOCF) which makes it student-centric, interactive and outcome oriented with well-defined aims, objectives, and goals to achieve. The University Grants Commission (UGC) took the initiative of implementing the LOCF in the Colleges and the Universities of the country. Accordingly, the University of Kerala has decided to implement the LOCF in all its departments under

the auspices of Internal Quality Assurance Cell (IQAC). A series of teacher training workshops were organised by IQAC and the office of the Credit and Semester System (CSS), and the departments have revised the syllabus accordingly, through workshops and in consultation with academic experts in the field.

2. VISION

1. Improving the quality of life of the rural population.
2. To improve the infrastructure of the rural areas.
3. To reduce unemployment by providing opportunities for employment.
4. To provide clean water, electricity, employment, and proper communication for rural development.
5. To ensure an improvement in the underprivileged populations standard of living.

3. MISSION

1. To achieve enhanced crop production for rural areas.
2. To bring about a greater socio-economic equity.
3. To bring about a spatial balance in socio-economic development.
4. To bring about improvement in the ecological environment.
5. To develop bread-based community participation for the rural development.

4. GENERAL OBJECTIVES OF THE COURSE:

1. To serve as a national and regional hub of knowledge connectivity for rural development.
2. To support developmental plans and policies for rural development by research, training and demonstration and create functioning packages of social and physical technologies and economic policy strategies.
3. To facilitate the development of techno-managerial cadres needed for the rural development.
4. To create innovative academic programmes. At the same time, evolve HRD package (including training) suitable for the development of the region.
5. To help create special institutional structures and schemes for nurturing the leadership in regional development/ Agripreneur / Coopreneurship with special focus on the most Socio-economically backward and drought regions.

5. PROGRAMME OBJECTIVES:

a) The Programme has been framed to provide an understanding and experience of different aspects of Rural Development.
b) It is to provide a holistic perspective of schemes/programmes of central govt. in general and particular in state government.
c) It is innovative, skill and employment oriented to attract bright students to the discipline of rural development.

6. COURSE OBJECTIVES (COs)

a) The course will cover conservation and biodiversity at both the population and ecosystem level with focus on ecological and evolutionary processes and their interactions.
b) Relevant principles from behavioural ecology, population ecology, genetics and evolution will be related to conservation biology and biodiversity.
c) Both the theoretical foundations of conservation biology and empirical examples will be covered.

7. PROGRAMME SPECIFIC OBJECTIVES (PSOs)

a) Mastery in biodiversity and its conservation strategies.
b) Experience and identify the diversity of plant and animal kingdom, from lower to higher level.
c) Recognize the need to conserve the wealth of Biodiversity.
d) Address environmental issues related to biodiversity.
e) Create social awareness in biodiversity conservation and sustainable utilization of bio resources.

8. ELIGIBILITY

i. Candidates who have passed any bachelor's degree [10+2+3+4] of Science, Engineering, Agriculture, and any other equivalent degree of statutory University recognized equivalent thereto must have obtained minimum aggregate **50** per cent marks for open categories and minimum **45** per cent marks for reserved categories.
ii. He/ She should have passed the Entrance Test conducted by the University with the specified criteria.

9. INTAKE CAPACITY

Admissions for 30 students are available in the first Semester at the beginning of the academic year.

10. DURATION

i. The course shall be a Post-Graduate Full Time Course.
ii. The duration of course shall be of Two years with Four Semesters.
iii. Maximum Period for Completion of Programme would be four years.

11. MEDIUM OF INSTRUCTION:

The medium of instruction shall be in English.

12. COURSE STRUCTURE (MARKING SCHEME)

Total Marks for PG Programme will be 2200.

13. COURSE STRUCTURE

Two-Year Post-graduate Program in
M.Sc. (Conservation of Biodiversity)
Course and Credits Distribution of Two years master's degree Program with Entry & Exit Option
Faculty of Science and Technology

Year /Level	Sem	Major Subject		RM	OJT/FP	RP	Credits	Degree
		DSC Core Mandatory	DSE (Elective)					
First year 6	I	3(4) +2 = 14	4	4			22	PG Diploma (After 3 years degree)
	II	3(4) +2 = 14	4		4		22	
Cum. Cr. For PG Diploma		28	8	4	4		44	
Exit option with Post-graduate Diploma (44 credits) after first year or two semesters with completion of courses equivalent to 44 credits								
Second Year 6.5	III	3(4) + 2=14	4			4	22	PG Degree after 3 years UG or PG Degree after 4 years UG
	IV	3(4) = 12	4			6	22	
Cum. Cr. For 1 year PG Degree		26	8			10	44	
Cum. Cr. For 2 years PG Degree		54	16	4	4	10	88	
2 Years - 4 sem.PG Degree (88 credits) after three-year UG Degree or 1 Year -2 sem.								
PG Degree (44 credits) after four-year UG degree								

ABBREVIATION:

DSC – Discipline Specific Core
Major – Comprising Mandatory – is based on specialization.
DSE- Discipline Specific Elective
OJT – On-the- Job Training
FP – Field Project (Corresponding to the Major (Core) Subject
RP – Research Project Corresponding to the Major (Core) Subject
RM – Research Methodology
Internship/Apprenticeship - Corresponding to the Major (Core) Subject

AS PER NEP – 2020

Credit distribution structure for Two Years/One Year Programme with Multiple Entry and Exit options.

Discipline Specific Core in (Conservation of Biodiversity)

Class: M.Sc. (Conservation of Biodiversity)

Year: First Year **Semester: I Semester**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MCB/MJ/500-T	Fundamentals of Biodiversity and Conservation	2	-	2	-	14
	MCB/MJ/501-T	Biodiversity Conservation, Human Society and Ethics	2	-	2	-	
	MCB/MJ/502-T	Ecosystem, Genetics and Species Diversity and Conservation	2	-	2	-	
	MCB/MJ/504-P	Lab-I: Fundamentals of Biodiversity and Conservation	-	4	-	2	
	MCB/MJ/505-P	Lab-II: Biodiversity Conservation, Human Society and Ethics	-	4	-	2	
	MCB/MJ/506-P	Lab-III: Ecosystem, Genetics and Species Diversity and Conservation	-	4	-	2	
	MCB/MJ/503-P	Lab IV: Advanced Technique: Planning and Execution of Field surveys	-	4	-	2	
DSE (Choose any one from pool of courses)	MCB/DSE/507-T	Greenhouse Technology	2		2	-	04
	MCB/DSE/508-P	Lab-I: Greenhouse Technology	-	4	-	2	
		or					
	MCB/DSE/509-T	Environmental Pollution and Control	2	-	2	-	
	MCB/DSE/510-P	Lab-II: Environmental Pollution and Control	-	4	-	2	
		or					
	MCB/DSE/511-T	Development of Communication in conservation	2	-	2	-	
	MCB/DSE/512-P	Lab-III: Development of Communication in conservation	-	4	-	2	
RM	MCB/RM/513-T	Research Methodology	4	-	4	-	04
		Total	**12**	**20**	**12**	**10**	**22 credits**

1. Major Mandatory (DSC)

MCB/MJ/500-T	Fundamentals of Biodiversity and Conservation
MCB/MJ/501-T	Biodiversity Conservation, Human Society and Ethics
MCB/MJ/502-T	Ecosystem, Genetics and Species Diversity and Conservation
MCB/MJ/503-T	Planning and Execution of Field surveys
MCB/MJ/504-P	Lab-I: Fundamentals of Biodiversity and Conservation
MCB/MJ/505-P	Lab-II: Biodiversity Conservation, Human Society and Ethics
MCB/MJ/506-P	Lab-III: Ecosystem, Genetics and Species Diversity and Conservation

2. Discipline Specific Electives: (Choose any one from Pool /Basket)

MCB/DSE/507-T	Greenhouse Technology
MCB/DSE/508-P	Lab-I: Greenhouse Technology
Or	
MCB/DSE/509-T	Environmental Pollution and Control
MCB/DSE/510-P	Lab-II: Environmental Pollution and Control
Or	
MCB/DSE/511-T	Development of Communication in conservation
MCB/DSE/512-P	Lab-III: Development of Communication in conservation

3. Research Methodology (RM): MCB/RM/513-T

AS PER NEP – 2020

Credit distribution structure for Two Years/One Year Programme with Multiple Entry and Exit options.

Discipline Specific Core in (Conservation of Biodiversity)

Class: M.Sc. (Conservation of Biodiversity)

Year: First Year **Semester: II Semester**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MCB/MJ/550-T	Biotechnological and Phylogenetic Approaches to Biodiversity Conservation	2	-	2	-	14
	MCB/MJ/551-T	Quantitative Biology	2	-	2	-	
	MCB/MJ/552-T	Taxonomy and Systematics of Plants, Animals and Microbes	2	-	2	-	
	MCB/MJ/553-T	Remote sensing and GIS applications for Environmental Monitoring	2	-	2	-	
	MCB/MJ/554-P	Lab-I: Biotechnological and Phylogenetic Approaches to Biodiversity Conservation	-	4	-	2	
	MCB/MJ/555-P	Lab-II: Quantitative Biology	-	4	-	2	
	MCB/MJ/556-P	Lab-III: Taxonomy and Systematics of Plants, Animals and Microbes	-	4	-	2	
DSE (Choose any one from pool of courses)	MCB/DSE/557-T	Natural Resources and their conservation	2	-	2	-	04
	MCB/DSE/558-P	Lab-I: Natural Resources and their conservation	-	4	-	2	
	or						
	MCB/ DSE/559-T	Soil Conservation and Management	2	-	2	-	
	MCB/ DSE/560-P	Lab-II: Soil Conservation and Management	-	4	-	2	
	or						
	MCB/ DSE/561-T	Water Resource Management	2	-	2	-	
	MCB/ DSE/562-P	Lab-III: Water Resource Management	-	4	-	2	
OJT/ FP	MCB/OJT/FP/563-P	On Job Training/Field Project	-	8	-	4	04
		Total	**10**	**24**	**10**	**12**	**22 credits**

1. Major Mandatory (DSC)

MCB/MJ/550-T	Biotechnological and Phylogenetic Approaches to Biodiversity Conservation
MCB/MJ/551-T	Quantitative Biology
MCB/MJ/552-T	Taxonomy and Systematics of Plants, Animals and Microbes
MCB/MJ/553-T	Remote sensing and GIS applications for Environmental Monitoring
MCB/MJ/554-P	Lab-I: Biotechnological and Phylogenetic Approaches to Biodiversity Conservation
MCB/MJ/555-P	Lab-II: Quantitative Biology
MCB/MJ/556-P	Lab-III: Taxonomy and Systematics of Plants, Animals and Microbes

2. Discipline Specific Electives: (Choose any one from Pool /Basket)

MCB/DSE/557-T	Natural Resources and their conservation
MCB/DSE/558-P	Lab-I: Natural Resources and their conservation
	or
MCB/DSE/559-T	Soil Conservation and Management
MCB/DSE/560-P	Lab-II: Soil Conservation and Management
	or
MCB/DSE/561-T	Water Resource Management
MCB/DSE/562-P	Lab-III: Water Resource Management

3. OJT/FP: Field Project: MCB/OJT/FP/563-P

AS PER NEP – 2020

Credit distribution structure for Two Years/One Year Programme with Multiple Entry and Exit options.

Discipline Specific Core in (Conservation of Biodiversity)

Year: Second Year Class: **M.Sc. (Conservation of Biodiversity)** **Semester: III Semester**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MCB/MJ/600-T	Biodiversity Conservation and Climate Change	2		2		14
	MCB/MJ/601-T	Conservation Polices and Laws	2		2		
	MCB/MJ/602-T	Animal Ecology and Behaviour	2		2		
	MCB/MJ/603-T	Environmental Monitoring and Audit	2		2		
	MCB/MJ/604-P	Lab-I: Biodiversity Conservation and Climate Change		4		2	
	MCB/MJ/605-P	Lab-II: Conservation Polices and Laws		4		2	
	MCB/MJ/606-P	Lab-III: Animal Ecology and Behaviour		4		2	
DSE (Choose **any one** from pool of courses)	MCB/DSE/607-T	Environmental Chemistry	2		2		04
	MCB/DSE/608-P	Lab-I: Environmental Chemistry		4		2	
	or						
	MCB/DSE/609-T	Plant Reproductive Ecology	2		2		
	MCB/DSE/610-P	Lab-II: Plant Reproductive Ecology		4		2	
	or						
	MCB/DSE/611-T	Environment and Disaster Management	2		2		
	MCB/DSE/612-P	Lab-III: Environment and Disaster Management		4		2	
RP-I	MCB/RP-I/613-P	Research Project-I		8		4	04
			10	**24**	**10**	**12**	**22 credits**

Dabhade

1. **Major Mandatory (DSC)**

MCB/MJ/600-T	Biodiversity Conservation and Climate Change
MCB/MJ/601-T	Conservation Polices and Laws
MCB/MJ/602-T	Animal Ecology and Behaviour
MCB/MJ/603-T	Environmental Monitoring and Audit
MCB/MJ/604-P	Lab-I: Biodiversity Conservation and Climate Change
MCB/MJ/605-P	Lab-II: Conservation Polices and Laws
MCB/MJ/606-P	Lab-III: Animal Ecology and Behaviour

2. **Discipline Specific Electives:** (Choose any one from Pool /Basket)

MCB/DSE/607-T	Environmental Chemistry
MCB/DSE/608-P	Lab-I: Environmental Chemistry
or	
MCB/DSE/609-T	Plant Reproductive Ecology
MCB/DSE/610-P	Lab-II: Plant Reproductive Ecology
or	
MCB/DSE/611-T	Environment and Disaster Management
MCB/DSE/612-P	Lab-III: Environment and Disaster Management

3. **RP-I: Research Project-I:** MCB/RP-I/613-P

AS PER NEP – 2020

Credit distribution structure for Two Years/One Year Programme with Multiple Entry and Exit options.

Discipline Specific Core in (Conservation of Biodiversity)

Year: Second Year Class: M.Sc. (Conservation of Biodiversity) **Semester: ~~III~~ IV Semester**

Course type	Course Code	Course Name	Teaching Scheme (Hrs./ week)		Credits Assigned		Total Credits
			Theory	Practical	Theory	Practical	
Major Mandatory DSC	MCB/MJ/650-T	Human Aspects of biodiversity and Environment	2		2		14
	MCB/MJ/651-T	Wildlife biology and Environmental Stress Biology	2		2		
	MCB/MJ/652-T	Urban Biodiversity Strategies for Conservation	2		2		
	MCB/MJ/653-P	Lab-I: Human Aspects of biodiversity and Environment		4		2	
	MCB/MJ/654-P	Lab-II: Wildlife biology and Environmental Stress Biology		4		2	
	MCB/MJ/655-P	Lab-III: Urban Biodiversity Strategies for Conservation		4		2	
DSE (Choose **any one** from pool of courses)	MCB/DSE/656-T	Principle and Practices of Sustainable Development	2		2		04
	MCB/DSE/657-P	Lab-I: Principle and Practices of Sustainable Development		4		2	
	Or						
	MCB/DSE/658-T	Applications of Information Technology in Field Biology	2		2		
	MCB/DSE/659-P	Lab-II: Applications of Information Technology in Field Biology		4		2	
	Or						
	MCB/DSE/660-T	Bio-resource Exploration	2		2		
	MCB/DSE/661-P	Lab-III: Bio-resource Exploration		4		2	
RP-II	MCB/RP-II/662-P	Research Project-II		12		6	04
			08	**28**	**08**	**14**	**22 credits**

1. **Major Mandatory (DSC)**

MCB/MJ/650-T	Human Aspects of biodiversity and Environment
MCB/MJ/651-T	Wildlife biology and Environmental Stress Biology
MCB/MJ/652-T	Urban Biodiversity Strategies for Conservation
MCB/MJ/653-P	Lab-I: Human Aspects of biodiversity and Environment
MCB/MJ/654-P	Lab-II: Wildlife biology and Environmental Stress Biology
MCB/MJ/655-P	Lab-III: Urban Biodiversity Strategies for Conservation

2. **Discipline Specific Electives:** (Choose any one from Pool /Basket)

MCB/DSE/656-T	Principle and Practices of Sustainable Development
MCB/DSE/657-P	Lab-I: Principle and Practices of Sustainable Development
Or	
MCB/DSE/658-T	Applications of Information Technology in Field Biology
MCB/DSE/659-P	Lab-II: Applications of Information Technology in Field Biology
Or	
MCB/DSE/660-T	Bio-resource Exploration
MCB/DSE/661-P	Lab-III: Bio-resource Exploration

3. **RP-II: Research Project-II:** MCB/RP-II/699-P

Total Credits will be: 88.

Total-Credits -2	**Total Marks -50**
Total Period -30	
Unit-1-	**10**
Unit-2.	**10**
Unit-3.	**10**

List of Reference –Books

Note- 1. The workload relating to a course is measured in terms of credits hours.

2. A credit is a unit by which the coursework is measured

3. Each course may have –

a. only lectures-
b. lecture and tutorial –
c. lecture and practicum
d. lecture, tutorial and practice components

4. One credit- one clock hour lecture in a week
5. Three credits lecture course in a semester means three one-hour lectures per week.
6. In semester of 15 weeks duration = Two credit lecture course is equivalent to 30 hours of teaching in a semester
7. One credit for tutorial means one hour of engagement per week.

In a semester 15 weeks duration – a one credit tutorial in a course is equivalent to 15 hours engagement.

14. CURRICULUM FOR SEMESTER – I

(MANDATORY SUBJECT: I)

Course Code No: MCB/MJ/500-T	No. of Credits: 02	Hours: 30
Course Title: **Fundamentals of Biodiversity and Conservation**		

Learning Objectives:

1. To define biological diversity and its components.
2. To extend the importance of interactions among the species.
3. To demonstrate the importance and conservation of biodiversity.
4. To illustrate the significance of conservation of agricultural biodiversity.
5. To design a field based project with rationale and appropriate methodology.

Unit	Course Content	Periods
I	**Biodiversity** Concept, definition and type of biodiversity, biodiversity at global, country, and local level, evolution of biodiversity, factor promoting high diversity, Endemism and hotspots of biodiversity, India as mega biodiversity nation, wealth of Indian hotspots, monitoring and measures of biodiversity.	06
II	**Values of Biodiversity** Utilitarian value and their categories, direct use value, indirect/non-consumptive use value, Ecological Economics, Monetizing the value of Biodiversity, Intrinsic Value, Ethical and aesthetic values, Anthropocentrism, Biocentrism, Eco-centrism and Religions, Intellectual Value, Biodiversity, and sustainable development	06
III	**Threats to Biodiversity** Habitat destruction, fragmentation, transformation, degradation, and Loss: Causes, Patterns and consequences on the Biodiversity of Major Land and Aquatic Systems, Impact of human development on biodiversity, Invasive species: their introduction pathways, biological impacts of invasive species on terrestrial and aquatic systems, effect of pollution on biodiversity: Impacts of pesticide pollution, water pollution and air pollution on biodiversity, Overexploitation: Impacts of exploitation on target and non-target terrestrial and aquatic species and ecosystems, Extinction: Types of extinctions, processes responsible for species extinction, current and future extinction rates, IUCN threatened categories, sixth extinction/biological crisis.	06
IV	**Conservation Planning and Climate Change** The Bioclimatic Envelope Model for individual species; Climate Change - Integrated strategies for Conservation; Predictions on future responses of ongoing Climate Change on Biodiversity, Potential Adaptation Options and their consequences on Ecosystems and Biodiversity, REDD+, Synergies between Sustainable Use of Biodiversity and Climate Change	06
V	**Conservation of Agricultural Biodiversity** Conserving species of Economic significance, Significance of gene banks and germ plasm conservation, Use of wild species for producing improved hybrid varieties, Seed Banks and Artificial seeds in conservation, Conservation of Livestock species /varieties, Alternate species for future food securities examples; Job's tear plant (*Coix Lacryma Jobi*) Indian wild buffalo (*Bubalus Arnee*) Mithun (*Bos frontalis*). Hybrids between wild and domestic species (e.g., *Mithun*) Conservation of economically important aquatic species	06

Learning Outcome- At the end of this course students should be able to:

1. Understand biodiversity andproximate threats to biodiversity.
2. Understand that ecological processes are essential for maintaining biodiversity.
3. Understand the habitat loss and fragmentation and their impacts on biodiversity.
4. Understand threats posed by global climate change to biodiversity.
5. Implement a small project on monitoring of biodiversity.

Suggested readings

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. Principles of Conservation Biology. Sinauer Associates, Inc., USA.
2. Krishnamurthy, K. V. 2003. Textbook of Biodiversity, Science Publication.
3. Primack, R. 2006. Essentials of Conservation Biology. Sinauer Associates, Inc., USA.
4. Hambler, C. 2004. Conservation. Cambridge University Press.
5. Van Dyke, F.2008.Conservation Biology Foundations, Concepts, Applications 2nd Edition, Springer.
6. Primack, R. B. (2019). Essentials of Conservation Biology (7th ed.). Sunderland, MA: Sinauer Associates.
7. Meffe, G. K., Carroll, C. R., and contributors. (2017). Principles of Conservation Biology (4th ed.). Sunderland, MA: Sinauer Associates.
8. Purvis, A., Gittleman, J. L., and Brooks, T. M. (2019). Phylogeny and Conservation. Cambridge, UK: Cambridge University Press.
9. Heywood, V. H., and Watson, R. T. (Eds.). (2011). Global Biodiversity Assessment. Cambridge, UK: Cambridge University Press.
10. Hunter Jr, M. L. (2018). Fundamentals of Conservation Biology (4th ed.). Chichester, UK: Wiley.
11. Noss, R. F., and Cooperrider, A. Y. (1994). Saving Nature's Legacy: Protecting and Restoring Biodiversity. Washington, DC: Island Press.
12. Wilson, E. O. (2016). Half-Earth: Our Planet's Fight for Life. New York, NY: Liveright Publishing Corporation.
13. Primack, R. B., and Rodrigues, E. (2017). Fundamentals of Conservation Biology (4th ed.). Sunderland, MA: Sinauer Associates.
14. Groom, M. J., Meffe, G. K., and Carroll, C. R. (2006). Principles of Conservation Biology (3rd ed.). Sunderland, MA: Sinauer Associates.
15. Gaston, K. J., and Spicer, J. I. (2018). Biodiversity: An Introduction (3rd ed.). Chichester, UK: Wiley-Blackwell.

(MANDATORY SUBJECT: II)

Course Code No: MCB/MJ/501-T	No. of Credits :02	Hours: 30

Course Title: **Biodiversity Conservation, Human Society and Ethics**

Learning Objectives:

1. To demonstrate the role of ethics, values and norms in producing culturally attuned and effective conservation techniques.
2. To create awareness about biodiversity and its essential role in overall human health.
3. To explain the benefit to human health of preserving biodiversity.
4. To protect and preserve species diversity.
5. To ensure sustainable management of the species and ecosystems.

Unit	Course Content	Periods
I	**Sustainability** Humans and sustainability - An overview, sustaining key resources: Food, soil and pest management, Sustaining water resources, Energy efficiency and renewable energy, Environmental problems, their causes and sustainability, Sustaining biodiversity- Sustaining biodiversity: The Species Approach, Sustaining Terrestrial biodiversity: The Ecosystem Approach, Sustaining Aquatic biodiversity: The Ecosystem Approach, Sustaining Human societies-Nature and society, sociology of environmental knowledge, Sensitivity towards sustaining nature, Environmental/Conservation Ethics	06
II	**Economics and Biodiversity** Ecosystem services and biodiversity conservation, Economic valuation of environmental goods, Cost and benefits of land use conversion, Measuring benefits and loss, Economic values and moral issues, Methodologies of Economic valuation- A classification of valuation procedures, The direct valuation approach, The indirect valuation approach, Conventional market, approaches, Choice of valuation techniques	06
III	**Biodiversity and Human Health** Biodiversity Loss and implication for human health - Causes and consequences of biodiversity loss, Ecosystem disturbances and their effects on infectious diseases, Vector, pathogen and host diversity and human infectious disease, Climate change and its effect on infectious disease, Medicines from nature - History of natural products as medicines, Role of traditional herbs and shrubs.	06
IV	**Biodiversity and Traditional Health Systems** Indigenous people and conservation, Significance of traditional ways of life, Ethno-biology and Ethno-pharmacology, Benefits from Ethno-botanical discoveries for native communities, Opportunities for collaboration between biomedical and conservation communities, Biodiversity and human dimension-cultural and biological diversity, Indigenous movement and conservationists, Conservation through self-determination, green consumerism, Conservation education, integrated conservation and development	06

V	**Tracking Biodiversity Towards Management** Biodiversity indicators: Surrogate species, taxon-based biodiversity indicators, structureand function-based biodiversity indicators, ecological redundancy and functional based indicators.	06

Learning Outcome- At the end of this course students should be able to:

1. Participate in an ongoing discussion about the relationship between conservation biology, ecology, ethics, and society.
2. Understand the foundations of environmental ethics and apply them to current issues.
3. Recognize the ethical implications of their work as a developing conservation biologist and/or ecologist.
4. To interpret the role of climate change competition nutrients and levels of biodiversity.
5. Understand the key scientific concepts for species and ecosystem conservation.

Suggested Readings:

1. Miller, G. T. and Spoolman, S. 2011. Living in the environment. Cengage learning
2. Pearce, D. W. and Moran, D. 1994. The Economic value of Biodiversity. Earthscan Publishers
3. Kontoleon, A., Pascual, U and Swanson, T. 2007. Biodiversity Economics: PrinciplesMethods and Applications. Cambridge University Press
4. Chivian, E and Bernstein, A. 2008. Sustaining life: How human health depends on biodiversity. Oxford university press
5. Macnaghten, P and Urry, J. 1998. Contested Natures. SAGE publications Ltd.
6. Mulder, M. B. and Coppolillo, P. 2004. Conservation: Linking Ecology, Economics andCulture. Princeton University Press
7. Tellegen, E and Wolsink, T. (Eds.) 1998. Society and its Environment. Routledge Press
8. Wood, P. M. 2000. Biodiversity and democracy: rethinking society and nature. University ofBritish Columbia Press.
9. Grifo, F. and Rosenthal, J. 1997. Biodiversity and Human Health: Implications for humanhealth. Island Press
10. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology,Sinauer Associates, Inc., USA.

(MANDATORY SUBJECT: III)

Course Code No: MCB/MJ/502-T	No. of Credits: 02	Hours: 30
Course Title: **Ecosystem, Genetics and Species Diversity and Conservation**		

Learning Objectives:

1. To define ecological efficiencies, ecosystem resilience and tropic dynamics.
2. To classify genetic diversity, gene flow, and gene erosion.
3. To examine ecosystem, genetics, species diversity and their conservation methods.
4. To interpret intra and inter specific computation.
5. Understanding the basics of science of Biodiversity in an ecological context.

Unit	Course Content	Periods
I	**Ecosystem Concept** Introduction and overview of ecosystem ecology- Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies, Human induced Ecosystem change, Urban Ecosystem. Species effects on ecosystem processes-Overview, Functional type effects, Functional type response, integrating the effects of traits on ecosystems, Species interaction and ecosystem processes, Ecosystem Services.	06
II	**Applied Population Biology** Gathering Ecological Information, Monitoring Population of species, establishing new populations, Behavior of released animals, Evaluation of successful programs through case studies. Ex-situ conservation strategies: An overview, Botanical Gardens and Arboreta, Zoological Parks, Aquaria, Seed Banks.	06
III	**Genetic Biodiversity and Conservation** Definition and importance of genetic variation, within individuals, within and between populations, Understanding population genetics, Measuring genetic diversity: The Hardy-Weinberg law; genetically effective populations size, Gene flow-Genetic pollution and gene erosion, Evolutionary forces for genetic variation, Genetic drift: Wahlund effect, Inbreeding depression, Out breeding depression, Mutation, Natural selection: Genetic load and Mutation-selection balance, Conservation Genetics and Management, Time scale of concern in species revival; Use of genetic information in identification and prioritization of groups for conservation, for designing and implementation of reproductive strategies in plants and animals, and in population estimation, Understanding different levels of population exploitation on of genetic diversity.	06
IV	**Species Diversity and Conservation** Density independent growth: Fundamentals of population growth, Types of models, Density independent versus density dependent growth, Geometric growth in populations with non-overlapping generations, Exponential growth in populations with overlapping generations, The finite rate of increase and the intrinsic rate of increase, Density dependent growth and intraspecific competition: Density dependence in populations with discrete generations, Density dependence in populations with overlapping generations, Non-linear density dependence of birth and death rates and the Allee effect, Behavioral	06

	aspects of intraspecific competition Population regulation: Understanding population regulation, combining density dependent and density independent factors, Tests of density dependence	
V	**Community Ecology** Interspecific and intraspecific Competition, Host-Parasite interactions, Predator- prey interactions, Plant herbivore interaction, Community ecology- Structure and function of communities, Functional aspects of communities, Stability and change in communities, Regulation of communities- Role of species diversity, Role of predators, Role of competition, Role of nutrients, other factors	**06**

Learning Outcome- At the end of this course students should be able to:

1. The scope of biodiversity, including ecosystem, species, and genetic diversity
2. Assessment of species diversity, rapid assessment techniques, strength, and weakness of concepts such as keystone, indicator species and species diversity indices.
3. Interpret the role of climate change, competition, nutrients, and species diversity.
4. Interpret basics of science of biodiversity conservation covered in Modules.
5. Implement a small project on monitoring of biodiversity.

Suggested Readings:

1. Hastings, A. (Ed.). 1953 Population biology: concepts and models. Springer Science and Business Media
2. Neal, D. 2004. Introduction to Population Biology. Cambridge University Press.
3. Vandermeer, J. H. and Goldberg, D. E. 2013. Population Ecology: First principles. Princeton University Press.
4. Begon, M., Mortimer, M. and Thompson, D. J. 2009. Population ecology: A unified study of animals and plants. John Wiley and Sons.
5. Lomnicki, A. 1988. Population Ecology of Individuals. Princeton University Press.
6. Rockwood, L. R. 2015. Introduction to Population Ecology. John Wiley and Sons.
7. Smith, R. L. and Smith, T. M. 2014. Elements of Ecology. Benjamin-CummingsPublishing Company.
8. Primack, R. 2014. Essentials of Conservation Biology (Sixth Edition) Sinauer Associates, Inc., USA
9. Morris, W. F. and Doak. D. F. 2002. Quantitative Conservation Biology: Theory and practice of Population Viability Analysis. W. H. Freeman Publishers.
10. Landi, R., Engen, S. and Saether, B. 2003. Stochastic population dynamics in Ecologyand conservation. Oxford University Press.
11. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.
12. Gardner, E. J. 1975. Principles of Genetics. John Wiley and Sons.
13. Hamilton, M. 2009. Population Genetics. Wiley-Blackwell Publications, USA
14. Hedrick, P. W. 1999. Genetics of Population. Jones and Bartlet Publishers, Inc., London.
15. Lockwood, M., Vorobey's, G. and Kothari A. (Ed.). Managing Protected Areas
16. Stuart, C., Spalding, M and Jenkins, M. the world's Protected Areas: Status, Values and prospects in 21st century
17. Turner, M.G., Gardner, R. H. and ONeill, R. V. Landscape ecology in theory andpractice: pattern and process

Lab course: MCB/MJ/504-P

based on

Fundamentals of Biodiversity and Conservation

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. To Conduct a biodiversity survey in a local ecosystem, Identify and document various species of plants, animals, and microorganisms.
2. Research and present on a specific biodiversity hotspot, discussing its unique species, threats, and conservation efforts.
3. Investigate endemic species in your region and discuss their importance in terms of conservation.
4. Conduct a case study on a specific ecosystem service provided by biodiversity, such as pollination, water purification, or carbon sequestration.
5. Plan and execute a habitat restoration project in a degraded area.
6. Study the effects of pollution on local biodiversity by analyzing soil, water, and air quality in different environments.
7. Determination of primary production as GPP and NPP by light and dark bottle technique and its importance for biodiversity conservation.
8. Identification and inventory of phytoplankton diversity in water body.
9. Identification and listing of zooplanktons diversity in water body.
10. Ecological adaption of hydrophytes, mesophytes and xerophytes.
11. Quantitative analysis of planktons by Sedgwick rafter cell method.
12. Estimation of biomass from grassland by harvest method.
13. Productivity study of grassland ecosystem by harvest method.
14. Determination of relative density relative frequency and relative abundance of species by using simulation.
15. Profile study of natural pond/lake and manmade reservoir.

Lab course: MCB/MJ/505-P

based on

Biodiversity Conservation, Human Society and Ethics

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Identification of wild animals by using pug marks.
2. Identification of wild species by using feeding signs and artifacts.
3. Determination of relative abundance of light attracting insects by using light trap.
4. Determination of relative abundance of creeping invertebrates by using pitfall trap.
5. Determination of bird's population by using Lincoln index (Simulation).
6. Determination of total population of birds/ bats in their roost by using extrapolation method.
7. Determination of total population /density of birds from nesting ground during breeding season / or determination of total population of birds by using nests.
8. Identification of mammals from the hair morphology and histology.
9. To study the bird species by using vocal display.
10. Identification of wild species by direct observation in their habitat.
11. Determination of burrowing animal's population by using their artifacts.
12. Field visit for the study of wild species and collection of samples from various domestic and wild animals.
13. Visit to Zoo/ National Park /Sanctuary / Aquarium etc., for the study of wildlife.
14. Field visit to study the habitat components of wild species.
15. To study the natality of wild species during breeding season at zoo/aquarium/in closed ecosystem.

Lab course: MCB/MJ/506-P

based on

Ecosystem, Genetics and Species Diversity and Conservation

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Determine the required size of quadrat to study the vegetation by species area curve method.
2. Analyze the vegetation by Line transect method (Quadrat Method)
3. Analyze the vegetation by Belt transect method (Quadrat Method)
4. Biodiversity assessment of forest tree community.
5. Quantitative inventory of Liana abundance and diversity in relation to host trees.
6. Forest Biomass calculation by allometric method.
7. Determination of carbon stock of woody plant species.
8. Reproductive trait analysis for understanding forest component interactions.
9. Nutrient cycling in forest: Soil sampling and organic carbon.
10. Field Survey in University Campus for studying plant species diversity.
11. Ex-situ conservation of plant species using vitro technique.
12. Micro-propagation of an endangered plant species.
13. Green pod (embryo culture) culture of orchid.
14. Blood Cell counting using Hemocytometer (RBC and WBC).
15. Microscopy: Handling of Dissection, Stereo and Compound microscopes.

Lab course: MCB/DSE/503-P

on

Advanced Technique: Planning and execution of Field Surveys

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Develop the Site Selection and Reconnaissance Skills
2. To familiarize Students with Various Survey Instruments and Applications
3. Practice Baseline Data Collection for Urban Planning and Environmental Studies
4. Enhance Map Reading and Navigation Skills for Efficient Fieldwork
5. Conduct a Topographic Survey for Detailed Terrain Analysis
6. Ensure the Data Quality through Validation and Error Checking in Field Surveys
7. Engage the Stakeholders for Input and Feedback in Community Planning Surveys
8. Conduct an Environmental Impact Assessment (EIA) for Project Planning
9. Integrate the Remote Sensing Techniques to Enhance Survey Accuracy
10. Improve the Field Report and Presentation Skills for Effective Communication
11. Apply the Geodetic Surveying Techniques for High-Precision Measurements
12. Conduct a Cadastral Survey for Property Boundary Definition
13. Utilize the Hydro-graphic Survey Techniques for Underwater Mapping
14. Analyse the Traffic Flow Patterns for Urban Transportation Planning
15. Apply the Archaeological Survey Techniques for Site Documentation

(ELECTIVE PAPER- I)

Course Code No: MCB/MJ/507-T	No. of Credits: 02	Hours: 30
Course Title: **Greenhouse Technology**		

Learning Objectives:

1. Understand the principles and components of greenhouse technology as applied to biodiversity conservation.
2. Apply crop production techniques within greenhouse environments to support biodiversity conservation goals.
3. Manage greenhouse environmental factors effectively to optimize crop growth while minimizing ecological impact.
4. Implement integrated pest management strategies to control pests and diseases in greenhouse settings sustainably.
5. Evaluate and recommend sustainable practices and innovations for greenhouse management to enhance biodiversity conservation efforts.

Unit	Course Content	Periods
I	**Introduction to Greenhouse Technology:** Introduction to greenhouse technology and its significance in biodiversity conservation. Types of greenhouses and their suitability for different environments. Basic principles of greenhouse design, orientation, and construction.	06
II	**Greenhouse Environmental Control Systems**: Understanding environmental factors affecting greenhouse cultivation (temperature, humidity, light, CO2 levels). Principles and operation of greenhouse climate control systems (heating, cooling and ventilation). Importance of energy efficiency and sustainable practices in greenhouse management.	06
III	**Greenhouse Crop Production Techniques**: Selection of suitable plant species for greenhouse cultivation in biodiversity conservation efforts. Crop management practices including irrigation, fertilization, and pest/disease control in greenhouse settings. Techniques for optimizing crop growth and yield in controlled greenhouse environments.	06
IV	**Greenhouse Integrated Pest Management (IPM):** Introduction to integrated pest management principles and practices. Identification of common pests and diseases affecting greenhouse crops. Implementation of IPM strategies including biological control, cultural practices, and judicious pesticide use to minimize environmental impact.	06
V	**Sustainable Greenhouse Practices and Innovations:** Sustainable practices in greenhouse management to minimize environmental footprint and promote biodiversity conservation. Innovative technologies and trends in greenhouse design, automation, and resource utilization. Case studies and practical applications of greenhouse technology in biodiversity conservation projects worldwide.	06

Learning Outcome – At the end of this course students should be able to:

1. Understanding greenhouse principles for biodiversity conservation.
2. Applying crop production techniques in greenhouse settings.
3. Managing greenhouse environments effectively.
4. Implementing integrated pest management strategies.
5. Evaluating and promoting sustainable greenhouse practices.

Suggested Readings:

1. Greenhouse Technology for Controlled Environment 2009 by G.N. Tiwari
2. Greenhouse Technology - Management, Operations and Maintenance 2016 by N. N. Patil.
3. Greenhouse Technology and Management 14 December 2012 by Nicolas Castilla and Esteban Baeza.
4. Greenhouse Technology and Management 2016 by HernaDez Jose Del Sagrado.
5. Palmstierna, I. (2012). Greenhouse vegetable gardening: Expert advice on how to grow vegetables, herbs, and other plants. Skyhorse Publishing.
6. Nelson, P. V., and Boodley, R. A. (1980). Greenhouse operation and management. Prentice Hall.
7. Marshall, R. (2014). The greenhouse gardener's manual. Timber Press.
8. Khan, N. A. (2019). Greenhouse technology: Management practices. Springer.
9. Smith, S. (2000). Greenhouse gardener's companion: Growing food and flowers in your greenhouse or sunspace. Fulcrum Publishing.

Lab course: MCB/MJ/508-P
based on

Greenhouse Technology

Lab Course: 04Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Preparation of soil and water samples for analysis in the lab, sanitation, and safety.
2. Calibration of equipment's and preparation of different types of solutions.
3. Preparation of soil samples for analysis.
4. Estimation of N, P, K and OC of soil samples.
5. Estimation of EC and TDS of water samples.
6. Functioning of spectrophotometer.
7. Conduct analysis of different parameters of water used for green house.
8. Methods of soil sampling from farmers field and processing soil samples for analysis.
9. Nursery establishment: types of nursery beds, Site selection, lay out, planning and records.
10. Potting and repotting of nursery plants.
11. Identification of weeds and herbarium preparation.
12. Different methods of Seed treatment and Germination of seeds.
13. Different methods of breaking of Seed dormancy.
14. Identification of nutrient deficiency of Macronutrients i.e., N, P, and K and its rectification.
15. Identification of nutrient deficiency of Micronutrients i.e., Zn, Cu, Fe, S, Mo, and B and its rectification.

(ELECTIVE PAPER- II)

Course Code No: MCB/DSE/509-T	No. of Credits: 02	Hours: 30

Course Title: **Environmental Pollution and Control**

Learning Objectives:

1. To study the different types of pollution and their effects on biodiversity.
2. To familiarize learners with the basic concepts and pollution related problems to time varying fields.
3. To study air, water, land, and noise and radiation pollution.
4. To understand physiological and psychological effects of all types of pollution.
5. To understand health impacts of different pollutions.

Unit	Course Content	Periods
I	**Introduction to Environmental pollution:** Definition and sources of pollution, Different types of pollution and their global, regional, and local aspects, Types and sources of air pollutants, Reaction of pollutants in air forming smog, PAN, Acid rain, Atmospheric diffusion and stack performance, Transport of pollutants, Effects of air pollutants on flora and fauna, Sinks of atmospheric gases.	06
II	**Soil pollution and solid waste pollution:** Causes of soil pollution, Effects of Fungicides and weedicides on soil components, residual toxicity and pollution, Different kinds of synthetic fertilizer (N, P, K), and their interactions with different components of soil, their toxicity and pollution, Industrial effluents and their interactions with soil components, Contamination by radio nuclides. Solid waste pollution: sources, nature, classification, and environmental effects.	06
III	**Radiation and Noise pollution:** Radioactive decay; Interaction of radiation with matter; Biological impact and health hazards associated with radiation, Units of radioactivity and radiation dose, Protection against ionizing isotopes and their applications in wastewater and air pollution analysis and treatment, Radioactive waste disposal. Basic properties of sound waves – plane and spherical waves, sound pressure, loudness and intensity levels, decibel, Sources of Noise Pollution– Measurement and analysis of sound, Measures to control noise pollution.	06
IV	**Thermal pollution, Oil Pollution and Electronic waste (E-waste):** Definition and sources, Chemical and biological effects of thermal pollution, Effect on marine life, bacteria and water quality and other aquatic biota; Thermal pollution from power plants and their control. Oil pollution and marine ecology, sources of oil pollution, factors effecting fate of oil after spillage movement, spreading, evaporation, emulsification, dispersion, remote sensing in water quality monitoring. Sources and types and constituents of E-wastes and its environmental consequences.	06
V	**Water Pollution:** Sources of water and their contamination; Types of pollutants, various industrial effluents such as pulp and paper mills, oil exploration and refinery, petrochemicals, iron and steel industries, domestic wastes, organic debris, agricultural wastes, pesticides; Eutrophication - causes and effects and control measures.	06

Learning Outcome- At the end of this course students should be able:

1. To recognize the physical, chemical, and biological components of the earth's systems.
2. To show the function of Ecosystem.
3. To apply lessons from various courses through field experiences.
4. To evaluate all the environmental factors considering with at all points such as technical, social, legal, and economical aspect.
5. To identify potential Environmental impacts.

Suggested Readings:

1. Agarwal, S. K. (2016). Environmental Pollution Control Engineering. New Delhi: Khanna Publishers.
2. Rao, M. N. (2006). Air Pollution. New Delhi: Tata McGraw-Hill Education.
3. Miller, G. T., and Spoolman, S. E. (2019). Environmental Science. Stamford, CT: Cengage Learning.
4. De, A. K. (2018). Environmental Chemistry: Fundamentals. New Delhi: New Age International.
5. Masters, G. M., and Ela, W. P. (2008). Introduction to Environmental Engineering and Science. Upper Saddle River, NJ: Pearson Prentice Hall.
6. Manahan, S. E. (2010). Environmental Chemistry (9th ed.). Boca Raton, FL: CRC Press.
7. Peavy, H. S., Rowe, D. R., and Tchobanoglous, G. (2016). Environmental Engineering. New York, NY: McGraw-Hill Education.
8. Chakraborty, S., and Rahman, I. (2017). Environmental Management: Science and Engineering for Industry. Boca Raton, FL: CRC Press.
9. Kamyotra, J. S. (2015). Fundamentals of Environmental Pollution and Control. New Delhi: New Age International.
10. Vesilind, P. A., and Morgan, S. M. (2017). Introduction to Environmental Engineering (5th ed.). Stamford, CT: Cengage Learning.

Lab course: MCB/MJ/510-P

based on

Environmental Pollution and Control

Lab Course: 04 Hrs./ week **Credit assigned: 02**

Total hours: 30

1. Determination of Biological Oxygen Demand in wastewater
2. Solve the given problems on BOD.
3. Determination of Chemical Oxygen Demand in wastewater
4. Determination of oil and grease in wastewater.
5. Determination of H_2S in wastewater.
6. Characterization of solid waste.
7. Analysis of chemicals used in waste and wastewater treatment:
   i. Analysis of alum non-ferric alum
   a. Determination of water insoluble matter in non-ferric alum.
   b. Determination of water-soluble aluminium compounds as Alumina (Al_2O_3) from alum by using gravimetric method.
8. Analysis of activated carbon
   a. Determination of moisture content in activated carbon.
   b. Determination of adsorbing power of activated carbon.
9. Analysis of bleaching powder.
   a. Determination of available chlorine in bleaching powder.
   b. Determination of stability of bleaching powder.
10. Problems on calculation of capacity of aeration tank in activated sludge process.
11. To study the design, working and problems of primary clarifier, trickling filter, and septic tank.
12. Determine of MLSS, MLVSS, and SVI of industrial wastewater.
13. Organize a field trip to polluted sites where students can collect samples and analyze air, water, and soil pollution levels using scientific instruments and methods.
14. Develop comprehensive pollution control plans for specific environmental pollutants, considering regulatory frameworks, technological solutions, and community engagement strategies.
15. Conduct a simulated EIA exercise where students evaluate the potential environmental impacts of a proposed project or industrial activity.

(ELECTIVE PAPER- III)

Course Code No: MCB/DSE/511-T	No. of Credits: 02	Hours: 30
Course Title: **Development Communication in Conservation**		

Learning Objectives:

1. Introduction to concept, model, theories, and approaches of communication for conservation of natural resources.
2. To develop the communication skills of speaking, listening, reading, and writing.
3. To write editorial or blog promoting a conservation issue.
4. To impart knowledge, change the attitude and behavior of the students by adopting communication methods.
5. To critically analyze and apply various theories, models, and strategies of development communication to effectively communicate conservation messages and catalyzes positive behavioral change towards sustainable environmental practices.

Unit	Course Content	Periods
I	**Introduction to social and scientific writing:** Historical perspective, Ethics in scientific publishing, need for development communication, Orientation to writing for publications: Orientation to writing articles for public; communication through Conference short term papers, theses, and dissertations; Writing short non-research papers, review articles, original Research papers, Avoiding Plagiarism; Preparation of a poster; Compilation of conference report; Organizing a workshop, seminar, conference. Preparation of talks: Oral paper presentation with/without audio–visual support; Power Point Presentations, Scientific talks, Community talks	06
II	**Communication Skills:** a. **Speaking**: The essential qualifications of an effective speaker, conversation, extemporaneous speaking, and group discussion. b. **Listening**: Requirements for effective listening. Types of listening: listening to conversation, listening to classroom lectures, listening to public lectures, listening to group discussions, listening and mass media. c. **Reading**: Dynamics of effective reading, reading for pleasure and appreciation, reading newspapers, reading magazines, reading books. d. **Writing**: Functional forms stories, editorials, book reviews, informal and formal essay, short stories, personal letters, scientific reports, biographical sketches, setting a theme, simple development of an idea, critical appraisal of facts and investigation reports.	06
III	**Orientation to prepare research Proposal:** Approach of writing a proposal, developing initial idea, Orientation to proposal writing, Understanding the nature and philosophy of the agency and funding environment, need based program development, Writing the needs or problem statements, Writing the goals, objectives and implementation, Writing the evaluation plan, Budgeting and utilization, Agency capability and finishing touches.	06
IV	**Communication:** Definition and Functions, Elements and steps, Barriers of Communication, Types of Communication: Verbal and Nonverbal, Intrapersonal, Interpersonal, Group and Mass Communication, Characteristics and differences between various types, Definition, Elements and Functions of Mass Communication Channels	06

	of Mass Communication: Print, Radio, Television, Film, Video, New Media	
V	**Development:** Definition, Meaning, Paradigms, Indicators, Changing concepts, Development communication: Definition and Concept, Various Approaches to Development Communication: Participatory Communication approach; Development Support Communication– Extension, Biodiversity, Conservation and development, Communication for Biodiversity and Conservation.	06

Learning Outcome- At the end of the course, students should be able to:

1. Write and critique stories for various journalistic genres.
2. Design and evaluate strategic plans and practices for public relations.
3. Analyze audience's relevance to natural resource management issues.
4. Understand approaches for designing environmental communications.
5. Design comprehensive communication campaigns tailored to specific conservation issues, utilizing appropriate media platforms,

Suggested Readings:

1. Robert A. Day and Barbara Gastel, 2006. How to write and publish a scientific paper; 6th Edition; Cambridge University Press.
2. Soraya M. Coley and Cynthia A. Scheinberg 2001. Proposal Writing; Sage Publication.
3. Jacobson S. K. 2009. Communication Skills for Conservation Professionals, Island Press; Second Edition, USA M.Sc. Biodiversity and Conservation w.e.f. August 2015
4. Jacobson S. K., McDuff M. D. and Monroe M. C. 2006. Conservation Education and Outreach Techniques (Techniques in Ecology and Conservation). Oxford University Press, UK.
5. Corbett J. B. 2006. Communicating Nature: How We Create and Understand Environmental Messages. Island Press; 2nd Edition.
6. Jacob, J. (2012). Development Communication: Theory and Practice (2nd ed.). New Delhi, India: Sage Publications India Pvt Ltd.
7. Narula, U. (2014). Development Communication: Theory and Practice. New Delhi, India: Pearson Education India.
8. Mohan, G. (2013). Participatory Development: Learning from South Asia. New Delhi, India: SAGE Publications Pvt. Ltd.
9. Mukhopadhyay, M. (2004). Communication in Development. New Delhi, India: Pearson Education India.
10. Srinivas, M. N. (2016). Village India: Studies in the Little Community. New Delhi, India: Oxford University Press.

Lab course: MCB/DSE/512-P

based on

Development of Communication in Conservation

Lab Course: 04Hrs./ week **Credit assigned: 02**

Total hours: 30

1. Develop and execute social media campaigns to raise awareness about conservation issues.
2. Produce multimedia content (videos, podcasts, info-graphics) highlighting conservation challenges and solutions.
3. Conduct field research to understand local conservation issues and communication needs.
4. Simulate stakeholder interactions to practice effective communication and negotiation skills.
5. Design and implement behaviour change experiments to promote sustainable practices.
6. Assess the effectiveness of conservation communication initiatives through surveys and data analysis.
7. Create artworks or written pieces that convey conservation messages creatively.
8. Initiate partnerships with local organizations to support conservation communication efforts.
9. Develop and implement a campaign to advocate for conservation policies or initiatives.
10. Organize and execute events (workshops, exhibitions) to engage the community in conservation activities.
11. Produce short documentaries showcasing local conservation efforts and their impact.
12. Conduct an audit of local environmental issues and present findings to the community.
13. Analyze social media data to evaluate the effectiveness of conservation campaigns.
14. Develop and deliver educational programs in schools or community centers to raise awareness about conservation.
15. Interview professionals working in conservation communication to gain insights and perspectives.

RESEARCH METHODOLOGY

Course Code No.: MCB/RM/513-T	No. of Credits: 04	Hours: 60
Course Title: **Research Methodology**		

Learning Objectives:

1. Understand some basic concepts of research and its methodologies.
2. Select and define appropriate research problem and parameters.
3. Organize and conduct research (advanced project) in a more appropriate manner.
4. Student will know the different research approaches, scientific methods, criteria for good research and innovation.
5. Students will get the knowledge of data collection, presentation of data, data analysis and presentation of samples.

Unit	Course Content	Periods
I	**Introduction:** Meaning, Objectives, Types, Approaches, Research process, and Research methods.	12
II	**Scientific Method and Indian system of logic:** The Scientific Method: Positivism and Post Positivism, Empiricism, Nature of Reality. The Critical Theory and Interpretative Approaches. Indian system of Logic: Origins, Vaisheshika, Catuskoti, Nyaya, Jain Logic, Buddhist logic, Navya- Nyaya	12
III	**Research Design, Data Collection, Survey and Observation, Sampling Methods:** Research Design, Meaning, need, features, Concepts in research design, types of research design, Data Collection, Techniques of data collection; Sources of data – primary and secondary; methods and tools of data collection, Survey and Observation, Survey-Purpose and principles, Steps in survey-Types of survey: Mail and online survey, Cross-sectional and longitudinal studies-Interview schedules and questionnaires for data collection-Analysis of survey data and draw of inferences-Merits and limitations of survey–Observation-Types of observation: Natural, participant and non-participant-Observation skills-Planning for observation, recording and analysis of observation data, Sampling Methods, Probability Sampling Method and Non Probability Sampling Method.	12
IV	**Case Study and Focus Group:** Case Study: Scope and significance-Concept: Social microscope–Types: Explanatory, Exploratory, Retrospective and Prospective case studies-Sources of evidence, steps in conduct of case analysis, advantages, and limitations. Focus Groups-How to conduct-Role of respondents and moderator in focus group-Client participation in focus group-Mini focus group, Teleconference focus group and Online focus groups-Analysis of focus group data -Benefits, strength, and limitations of focus group.	12
V	**Hypothesis, Interpretation and Report Writing:** Meaning, Null Hypothesis and Alternate Hypothesis, Type I and Type II errors, Level of significance, Two-tailed and one tailed test. Hypothesis testing (mean, proportion, variance, and difference of two means, proportion, variance) P- value approach limitation for hypothesis testing. Interpretation and Report Writing	12

Learning Outcome- At the end of the course, students should be able to:

1. Understand the scope and nature of research.
2. State components related to scientific enquiry.

3. Explain key differences between qualitative and quantitative approach.
4. Examine case studies which followed different research approaches. Discuss importance of literature review and data collection while pursuing research.
5. Write a research report and specify methodology and approach which has been followed.

Suggested Reading:

1. Ahuja, Ram. 2001. Research Methods. Jaipur: Rawat Publications.
2. Best J. W. and J. V. Kahn. 1989. Research in Education. New Delhi: Prentice Hall of India Pvt Ltd.
3. Bryman, Alan. 2004. Social Research Method. New York: Oxford University press.
4. Carol, Grbich. 2000. New Approaches in Social Research, Sage publications
5. Creswell, J. W. 2003. Research Design: Qualitative, Quantitative, and Mixed Methods Approaches. Thousand Oaks, CA: Sage Publications
6. Durkheim, Emile. 1895. The Rules of Sociological Method. London: Collier Macmillan 1938; New York: The Free Press,1964.
7. Festinger, L and D. Katz. 1976. Research methods in the Behavioural Sciences. New York: The Dryden Press.
8. Goode, W. J. and Hatt.P.K.1981. Methods in Social Research McGraw Hill, New York,
9. Gary, Thomas. 2011. How to do your Case Study, New Delhi: Sage.
10. Leonard, Cargan. 2008. Doing Social Research, Jaipur: Rawat Publications.
11. Jayaram, N. 1989: Sociology: Methods and Theory, Madras, Macmillan
12. Kerlinger F.N. 1978. Foundations of Behavioural Research. New Delhi. Surjeet Publications.
13. Kothari and Garg. 2014. Research Methodology: Methods and Techniques, New Delhi: New Age International Publishers.
14. Mukherji, P.N. (ed) 2000. Methodology in social Research, New Delhi: Sage Publications.
15. Mulay.S.and V.E. Sabarathinam, 1980. Research Methods in Extension Education. New Delhi; Mansayan Publishers.
16. Neuman, W. L. 1991, Social Science Research Methods: Qualitative and Quantitative Approaches. Needleham Heights, Allyn and Bacon.
17. Sarandakos, Soritios.1998. Social Research. London: MacMillan Press Ltd.
18. Somekh B. and Cathy Lewin (eds.). 2005. Research Methods in the Social Sciences, New Delhi: Vistaar.
19. Wilkinson, T. S. And Bhandarkar, P. L. 1997.Methodology and Techniques of Social Research. Bombay: Himalaya Publishing House.
20. Young P.V. 1973. Scientific Social Surveys and Research. New Delhi: Prentice Hall of India Pvt Ltd.
21. Babbie, Earl. 2006. The Practice of Social Research (10th edition). Chennai: Chennai Micro Print Pvt. Ltd.
22. Bose, Pradip Kumar. 1985. Research Methodology: A Trend Report ICSSR, New Delhi.

15. CURRICULUM FOR SEMESTER-II

(MANDETORY SUBJECT: I)

Course Code No: MCB/MJ/550-T	No. of Credits :02	Hours: 30

Course Title: Biotechnological and Phylogenetic approaches to Biodiversity Conservation

Learning Objectives:

1. Understand biotechnology's role in conserving biodiversity in rural areas.
2. Develop practical skills in basic molecular techniques for biodiversity assessment.
3. Explore phylogenetic principles and their application in evolutionary analysis.
4. Apply molecular techniques to propose conservation strategies for local biodiversity.
5. Engage in community-based projects to actively contribute to biodiversity conservation.

Unit	Course Content	Periods
I	**Introduction to Biodiversity Conservation and Biotechnology**: Importance of biodiversity in rural communities, Basics of biotechnology and its potential applications in biodiversity conservation, Simple techniques for monitoring and conserving local biodiversity, Ethical considerations in utilizing biotechnology for conservation purposes.	06
II	**Basic Molecular Techniques for Biodiversity Assessment**: Explanation of PCR in a simplified manner with hands-on demonstrations, Concept of genetic markers through practical examples from local flora and fauna, Importance of cryopreservation in preserving genetic diversity.	06
III	**Unit 3: Exploring Phylogenetics in day to day Life:** Introduction to the concept of phylogenetics using familiar examples like family trees, Constructing simple phylogenetic trees based on observable traits of local plants or animals, Hands-on activities to understand the basics of character analysis and cladogram construction, Importance of understanding phylogenetic relationships for conservation decisions in rural areas.	06
IV	**Community-based Biodiversity Conservation Projects:** Engaging students in community-based projects aimed at conserving local biodiversity, Applying biotechnological and phylogenetic approaches learned in class to real-life conservation challenges, Develop innovative solutions to conservation issues in the villages, Promotion of a sense of ownership and responsibility towards biodiversity conservation in rural areas.	06
V	**Applied Conservation Genetics**: Genetic management strategies for captive breeding programs, Genetic rescue and translocation of endangered populations, Conservation genomics and landscape genetics approaches, Ethical considerations and challenges in applied conservation genetics.	06

Learning Outcome- At the end of this course students should be able to:

1. Explain the importance of biotechnology in rural biodiversity conservation.
2. Perform PCR for biodiversity assessment.
3. Construct phylogenetic trees to analyze evolutionary relationships.
4. Propose effective conservation strategies based on molecular data.
5. Collaborate with local communities to implement biodiversity conservation initiatives.

Suggested Readings:

1. Chandrashekara, U. M., and Subash Chandran, M. D. (2014). *Biodiversity Conservation and Utilisation in a Diverse World.* Springer.
2. Sodhi, N. S., and Gibson, L. (Eds.). (2018). *Conservation Biology: Voices from the Tropics.* Oxford University Press.
3. Joshi, J. (2010). *Applied Wildlife Genetics.* Springer.
4. Ramakrishnan, P. S., and Prakash, A. (2016). *Conservation Biology: Concepts and Applications.* S. Chand and Company Ltd.
5. Kumar, D. K. K. (Ed.). (2012). *Genetics and Conservation of Rare Plants.* CRC Press.
6. Van Dyke, F. (2018). *Conservation Biology: Foundations, Concepts, Applications.* Springer.
7. Groom, M. J., Meffe, G. K., and Carroll, C. R. (2013). *Principles of Conservation Biology.* Sinauer Associates.
8. Amato, G., and DeSalle, R. (Eds.). (2017). *Conservation Genetics in the Age of Genomics.* Columbia University Press.
9. Wiley, E. O., and Lieberman, B. S. (2011). *Phylogenetics: Theory and Practice of Phylogenetic Systematics.* Wiley-Blackwell.
10. Forey, P. L., Humphries, C. J., and Vane-Wright, R. I. (Eds.). (2015). *Biodiversity Conservation and Phylogenetic Systematics: Preserving our evolutionary heritage in an extinction crisis.* Cambridge University Press.
11. Benson, E.E. (1999). *Plant Conservation Biotechnology.* Taylor and Francis, London.
12. Henry, R. J. (1997). *Practical Application of Plant Molecular Biology.* Chapman and Hall Publication, London.
13. Pandit, M. W., Shivaji, S., and Singh, L. (2007). *You Deserve, We Conserve-A Biotechnological Approach to Wild Life Conservation.* I.K. International Publishing House Pvt.Ltd. New Delhi.
14. Glick, B. R., and Pasternak, J. J. (2003). *Molecular Biotechnology: Principles and Application of Recombinant DNA.* ASM Press, Washington, D.C.
15. Primrose, S. B., Twyman, R. M., and Old, R. W. (2001). *Principles of Gene Manipulation.* Blackwell Science Ltd.
16. Abbott et al. (1985). *Taxonomic analysis in biology: computers, models, and databases.* New York, NY: Columbia University Press.
17. Wiens, J. J. (Ed.). (2000). *Phylogenetic Analysis of Morphological Data.* Smithsonian Institution Press, Washington, D.C.
18. Simpson, M. G. (2006). *Plant Systematics.* Elsevier Academic Press.

(MANDETORY SUBJECT: II)

Course Code No: MCB/MJ/551-T	No. of Credits :02	Hours: 30

Course Title: Quantitative Biology

Learning Objectives :

1. Understand statistical concepts and computational techniques for analyzing biological data.
2. Develop proficiency in applying statistical tests and bioinformatics tools in biological research.
3. Gain practical skills in sequence analysis and phylogenetic studies using computational methods.
4. Explore the applications of quantitative biology in addressing rural challenges like agriculture and conservation.
5. Foster critical thinking and problem-solving abilities through hands-on projects and community engagement.

Unit	Course Content	Periods
I	**Statistical Fundamentals:** Introduction to Standard Deviation, Coefficient of Range, and Interquartile Range; Frequency Distribution and its practical applications; Simplified Statistical Tests: Sampling, t-Tests, and Chi-Square Test; Practical examples from rural settings for better comprehension; Student involvement in data collection and analysis.	06
II	**Advanced Statistical Methods:** Regression and Correlation Analysis with agricultural or environmental data; Probability Distributions explained through everyday rural scenarios; Understanding F-Tests and Analysis of Variance using farming analogies; Introduction to Multivariate Statistics with examples relevant to rural communities; Field trips for hands-on experience in statistical data collection.	06
III	**Computational Tools and Bioinformatics Basics:** Basic computer skills training with a focus on spreadsheet usage; Discussion on the importance of Bioinformatics in rural sectors; Accessing biological databases and online resources for data analysis; Application of local examples in teaching sequence analysis concepts; Project-based learning for students to develop bioinformatics projects.	06
IV	**Sequence Analysis and Phylogenetics:** Simplified explanations of Sequence Analysis techniques using every day analogies; Hands-on activities for sequence alignments and constructing phylogenetic trees; Involvement of local experts or community members in discussions on biodiversity conservation; Interactive learning sessions using visual aids for understanding Genome Information; Collaborative projects focusing on local biodiversity conservation using computational methods.	06

V	**Applications of Computational Methods:** Practical applications of statistical and computational methods in real-life scenarios; Integration of computational techniques in rural development projects; Community-based projects for applying statistical analyses to local issues; Presentations and discussions on the impact of computational biology in rural settings; Encouragement for students to explore career opportunities in quantitative biology in rural sectors.	**06**

Learning Outcome- At the end of this course students should able to:

1. Demonstrate proficiency in statistical analysis and hypothesis testing for biological datasets.
2. Utilize computational tools effectively to retrieve, analyze, and interpret biological sequences.
3. Construct and interpret phylogenetic trees to elucidate evolutionary relationships among organisms.
4. Apply quantitative biology techniques to address real-world issues in rural communities.
5. Enhance critical thinking and collaborative skills through project-based learning and engagement with stakeholders.

Suggested Readings:.

1. Joshi, A. R., and Gadgil, M. (2010). *Ecological Niches and Geographic Distributions.* Oxford University Press.
2. Kushwaha, S. P. S. (2011). *Ecology and Diversity of Indian Freshwater Fishes.* Springer.
3. Ramakrishnan, U., and Hadly, E. A. (2009). *Ecology and Evolution of the Indian Region.* World Scientific Publishing Company.
4. Lal, R. (2013). *Ecosystem Services and Carbon Sequestration in the Biosphere.* Springer.
5. Sarkar, S. (2010). *Biodiversity and Environmental Philosophy: An Introduction.* Cambridge University Press India.
6. Jorgensen, S. E. (2001). *Fundamentals of Ecological modeling.* Elsevier, New York.
7. Batschetelet, E. (1979). *Introduction to Mathematics for Life Scientists* (3rd ed.). Springer-Verlag Berlin and Heidelberg GmbH and Co. KG.
8. Swartzman, G. L., and Kaluzny, S. P. (1987). *Ecological Simulation Primer* (Biological Resource Management). New York, NY: Macmillan.
9. Clark, C. W., and Mangel, M. (1989). *Dynamic Modeling in Behavioral Ecology* (Monographs in Behavior and Ecology, Vol. 8). Princeton University Press.
10. Snedecor, G. W., and Cochran, W. G. (1989). *Statistical methods.* New Delhi, India: Affiliated East West Press. (India Ed.)
11. Green, R. H. (1979). *Sampling design and statistical methods for environmental biologists.* New York, NY: John Wiley and Sons.
12. Murray, J. D. (1993). *Mathematical Biology.* Springer Berlin, Heidelberg.
13. Pielou, E. C. (1984). *The interpretation of ecological data: A primer on classification and ordination.* Wiley.
14. Womble, D. D., and Krawetz, S. A. (Eds.). (2003). *Introduction to Bioinformatics: A Theoretical And Practical Approach* (3rd ed.). Humana Press Inc.
15. Andrade, M. A. (Ed.). (2003). *Bioinformatics and Genomes: Current Perspectives* (1st ed.). Taylor and Francis.
16. Daniel, W. W. (2004). *Biostatistics: A Foundation for Analysis in the Health Sciences* (8th ed.). WileyVCH.

(MANDETORY SUBJECT: III)

Course Code No: MCB/MJ/552-T	No. of Credits :02	Hours: 30

Course Title: Taxonomy and Systematic of Plants, Animals and Microbes

Learning Objectives :

1. Understand the fundamental principles and significance of taxonomy and systematics in biodiversity conservation.
2. Develop proficiency in applying classification schemes and methods to categorize plants, animals, and microbes accurately.
3. Gain practical skills in microbial taxonomy, including culturing techniques and classification criteria.
4. Acquire knowledge of documentation methods for plants and their role in biodiversity conservation efforts.
5. Explore the future trends and advancements in systematic studies and their implications for conservation practices.

Unit	Course Content	Periods
I	**Introduction to Taxonomy and Systematics:** Understanding the significance of taxonomy and systematics in biodiversity conservation; Basic components including Identification, Description, Nomenclature, Phylogeny, and Classification; Historical overview and importance of taxonomy in conservation efforts.	06
II	**Theory and Practice of Biological Classification:** Exploration of binomial and trinomial nomenclature; Classification schemes: Artificial, Natural, and Phylogenetic; Major systems of plant classification and introduction to Phenetic and Phylogenetic Methods; The International Code of Nomenclature (ICN/ICBN) and Bacteriological Code (BC).	06
III	**Microbial Taxonomy:** Diversity and Ecological Study of microbial diversity, classification criteria, and classification of microorganisms; Culturing Microorganism's techniques, nutritional requirements, and exploration of microorganisms in extreme environments; Classification and Identification of Bacteria and Fungi: Morphology, Biochemical characterization, and ecological importance.	06
IV	**Methodology used in Animal Taxonomy:** Introduction to collection and preservation techniques in animals; Taxonomic keys: Types, merits, and demerits; Understanding The International Code of Zoological Nomenclature (ICZN) and rules of Zoological Nomenclature; Future trends in systematic studies.	06
V	**Documentation of Plants:** Process of Plant Identification including Herbaria, Data Information Systems, and Botanical Gardens; Taxonomic Literature and Identification tools such as Taxonomic Keys, Websites, and Internet resources; Measuring Diversity: Alfa, Beta, and Gamma diversity, and its analysis; Plant Geography: Physical Geography, Aims, and Scope, and Phytochoria; Taxonomy in biodiversity conservation efforts: Global Strategy for Plant Conservation (GSPC), Global Taxonomic Initiative (GTI), and National Biodiversity Strategy Action Plan (NBSAP).	06

Learning Outcome- At the end of this course students should able to:

1. Demonstrate a comprehensive understanding of taxonomy and systematics principles and their application in biodiversity conservation.
2. Apply classification schemes effectively to classify organisms and understand their evolutionary relationships.
3. Demonstrate proficiency in microbial taxonomy, including the ability to culture microorganisms and classify them based on morphological and biochemical characteristics.
4. Utilize documentation methods to identify plants accurately and contribute to biodiversity conservation initiatives.
5. Evaluate and discuss future trends in systematic studies, demonstrating awareness of their impact on conservation strategies in rural areas.

Suggested Readings:

1. Simpson, M.G. (2006). *Plant Systematics.* Elsevier Academic Press.
2. Groom, M. J., Meffe, G. R., and Carroll, C. R. (2006). *Principles of Conservation Biology.* Sinauer Associates, Inc., USA.
3. Judd, W. S., Campbell, C. S., Kellogg, E. A., Stevens, P. A., and Donoghue, M.C. (2008). *Plant Systematics– A Phylogenetic Approach* (3rd Edition). Sinauer Publication.
4. Radford, A. E., Dickson, W. C., Massey, J. R., and Bell, C. R. (1974). *Vascular Plant Systematics.*
5. Singh, G. (2008). *Plant Systematics: Theory and Practice.* Oxford and IBH Publishing Co. Pvt. Ltd.
6. Atlas, R. M. (1995). *Principles of Microbiology.* St. Louis, MoS by Publication.
7. Hollingworth, P. M., Bateman, R. M., and Gornall, R. J. (1999). *Molecular Systematics and Plant Evolution.* Systematics Association Taylor and Francis.
8. Crawford, D. J. (2003). *Plant Molecular Systematics.* Cambridge University Press, Cambridge, UK.
9. Cronquist, A. (1981). *An Integrated System of Classification of Flowering Plants.* Columbia University Press, New York.
10. Victor, J. E., Fish, L., Smithies, S. J., and Mossmer, M. (2004). *Herbarium Essentials.* Southern African Botanical Diversity Network Report No. 25.
11. Felsenstein, J. (2004). *Inferring Phylogenies.* Sinauer Publication.
12. Abbott et al. (1985). *Taxonomic Analysis in Biology: Computers, Models, and Databases.* Columbia University Press, NY.
13. Kapoor, V. C. (1998). *Theory and Practice of Animal Taxonomy.* Oxford and IBH Publishing.
14. Mayr, E., and Ashlock, P. D. (1991). *Principles of Systematic Zoology.* McGraw-Hill, Inc., New Delhi.
15. Narendran, T. C. (2006). *An Introduction to Taxonomy.* Zoological Survey of India, Kolkata.
16. Simpson, G. G. (1962). *Principles of Animal Taxonomy.* Oxford Book Company, New York.

(MANDETORY SUBJECT: IV)

Course Code No: MCB/MJ/553-T	No. of Credits :02	Hours: 30

Course Title: Remote Sensing and GIS Application for Environmental Monitoring

Learning Objectives :

1. Understand the principles and technologies of aerial photography, photogrammetry, remote sensing, and GIS for environmental monitoring.
2. Develop proficiency in interpreting aerial photographs and satellite images to assess environmental features and changes.
3. Gain practical skills in using GIS software for spatial analysis and mapping of environmental data.
4. Explore the applications of remote sensing and GIS in environmental management and conservation.
5. Learn to apply remote sensing and GIS techniques to address environmental challenges in rural areas effectively.

Unit	Course Content	Periods
I	**Aerial Photography and Photogrammetry:** Understanding sensory organs and cameras, principles of aerial photography, historical overview, platforms, methods, and types of aerial photographs; Stereoscopic vision, photogrammetry, and mapping from aerial photographs.	06
II	**Remote Sensing Fundamentals:** Introduction and scope of remote sensing, electromagnetic spectrum interactions, principles of transmission, absorption, reflection, and atmospheric scattering; Platforms, active and passive sensors, and stages in remote sensing.	06
III	**Satellite Remote Sensing:** Types of satellites, including polar and geostationary, Landsat, Spot, IRS, ERS, JERS, and Quickbird; Sensors, data reception, archiving, and distribution; Radar and LIDAR systems, satellite and radar images.	06
IV	**Geographic Information System (GIS):** Definition and scope of GIS, capabilities, and advances; Spatial and temporal analysis, components, and software; Digital image processing, raster and vector data types, image enhancement, rectification, geo-referencing, classification, and interpretation; Introduction to GPS and its applications.	06
V	**Applications of RS and GIS:** Environmental applications including soil erosion, flood mapping, agricultural and natural resource studies; Environmental audit and management in soil conservation, watershed management, forest and wildlife conservation, and urban planning; Disaster management using RS and GIS technologies.	06

Learning Outcomes: At the end of the course students should be able to:

1. Demonstrate a comprehensive understanding of aerial photography, photogrammetry, remote sensing, and GIS principles and their applications in environmental monitoring.
2. Apply knowledge of remote sensing technologies to interpret aerial photographs and

satellite images for environmental assessment.
3. Utilize GIS software to analyze spatial data, create maps, and visualize environmental patterns and trends.
4. Evaluate the effectiveness of remote sensing and GIS techniques in environmental management and conservation efforts.
5. Apply remote sensing and GIS methods to address specific environmental challenges faced by rural communities, contributing to sustainable development and biodiversity conservation.

Suggested Readings:

1. Singh, A. (2014). *Remote Sensing of Environment* (2nd ed.). PHI Learning Pvt. Ltd.
2. Sharma, R. C. (2017). *Fundamentals of Remote Sensing and GIS* (4th ed.). New Age International Pvt Ltd Publishers.
3. Lillesand, T. M., and Kiefer, R. W. (2015). *Remote Sensing and Image Interpretation* (7th ed.). Wiley India Pvt. Ltd.
4. Jensen, J. R. (2016). *Remote Sensing of the Environment: An Earth Resource Perspective* (2nd ed.). Pearson Education, Inc.
5. Campbell, J. B. (2015). *Introduction to Remote Sensing* (5th ed.). The Guilford Press.
6. Mather, P. M. (2015). *Computer Processing of Remotely-Sensed Images: An Introduction* (4th ed.). Wiley-Blackwell.
7. Shanmugam, P., and Senthil Kumar, A. (2013). *Remote Sensing and GIS*. Anuradha Publications.
8. Govil, H., and Jayakumar, S. (2016). *Fundamentals of GIS*. IK International Publishing House Pvt Ltd.
9. Maji, A. K., and Kumar, A. (2015). *Environmental Monitoring Using Remote Sensing and GIS*. PHI Learning Pvt. Ltd.
10. Weng, Q. (2012). *Remote Sensing and GIS Integration: Theories, Methods, and Applications*. McGraw-Hill Education.
11. Campbell, J. B., and Wynne, R. H. (2011). *Introduction to Remote Sensing* (5th ed.). Guilford Press.
12. Jensen, J. R., and Cowen, D. C. (1999). *Remote Sensing of the Environment: An Earth Resource Perspective*. Pearson.
13. Richards, J. A., and Jia, X. (2006). *Remote Sensing Digital Image Analysis: An Introduction*. Springer.
14. Mather, P. M. (2004). *Computer Processing of Remotely-Sensed Images: An Introduction* (3rd ed.). John Wiley and Sons.

Lab course: MCB/MJ/554-P

based on

Biotechnological and Phylogenetic Approaches to Biodiversity Conservation

Lab Course: 04 Hrs./ week **Credit assigned: 02**

Total hours: 30

1. Collaborate with communities to map biodiversity hotspots, integrating local knowledge.
2. Conduct biotechnology workshops using locally available materials for conservation applications.
3. Discuss ethical dilemmas in biotechnology's role in biodiversity conservation.
4. Analyze stomatal structure to understand plant adaptation and biodiversity.
5. Document traditional medicinal plants for cultural and conservation significance.
6. Analyze genetic markers in threatened species to inform conservation strategies.
7. Set up vermicomposting systems with locally available materials.
8. Integrate traditional ecological knowledge into phylogenetic discussions for holistic conservation.
9. Report on the analyzing traits of endangered species to understand phylogenetic concepts.
10. Assess genetic diversity in protected areas to inform conservation management.
11. Explore species adaptation case studies to inform conservation strategies.
12. Develop conservation plans based on phylogenetic analyses for protected areas.
13. Implement habitat restoration projects in protected areas to enhance biodiversity.
14. Monitor endangered species populations in protected areas using molecular tools.
15. Conduct conservation education programs in local communities to foster awareness and participation.

Lab course: MCB/MJ/555-P

based on

Quantitative Biology

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Explore data variation in crop yields through standard deviation analysis.
2. Construct frequency distributions of family sizes in a rural village.
3. Use chi-square tests to analyze crop diversity across regions.
4. Conduct regression analysis on crop yields and environmental factors.
5. Simulate farming scenarios using probability distributions.
6. Perform analysis of variance on crop growth experiments.
7. Learn methods for counting and estimating local species abundance in the field.
8. Create diagrams or charts to represent population size changes over time based on field observations.
9. Observe and record animal behaviour such as foraging or mating, analyzing patterns using statistical methods.
10. Exploration of the organism's processed energy and nutrients using simple models and examples.
11. Collaborate with experts on biodiversity conservation projects.
12. Visualize genome information of local species.
13. Analyze socioeconomic data for rural development insights.
14. Analyze biological data sets, such as plant heights or animal sightings, using arithmetic and graphical methods.
15. Study of diseases spread in populations using simple models and examples.

Lab course: MCB/MJ/556-P

based on

Taxonomy and Systematics of Plants, Animals and Microbes

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Field trip for biodiversity observation and taxonomy discussion.
2. Visit a herbarium for specimen identification and classification practice.
3. Construct a simple phylogenetic tree using household items.
4. Study of skeletal specimens of different animal species to understand anatomical adaptations and phylogenetic relationships.
5. Compare artificial, natural, and phylogenetic classification schemes.
6. Examine plant reproductive structures to understand reproductive strategies and classification criteria.
7. Set up microbial cultures from local samples for diversity exploration.
8. Explore extreme environments and culture microorganisms adapted to them.
9. Identify bacteria and fungi using morphological and biochemical tests.
10. Conduct an ethical animal collection field trip and preservation workshop.
11. Perform staining techniques on microbial samples to observe cell structures and classify bacteria.
12. Seminar on the rules of the International Code of Zoological Nomenclature.
13. Digitize herbarium specimens to understand data management.
14. Practice plant identification using taxonomic keys and specimens.
15. Conduct a plant diversity survey in the local area to understand distribution and conservation needs.

(ELECTIVE PAPER- I)

Course Code No: MCB/DSE/557-T	No. of Credits :02	Hours: 30
Course Title: **Natural Resources and their conservation**		

Learning Objectives :

1. Understand the concepts and classifications of natural resources and their significance for rural development.
2. Develop skills in assessing factors influencing resource availability, distribution, and economic value.
3. Gain knowledge of conservation strategies for forest, land, water, energy, and food resources in rural contexts.
4. Explore approaches to resource management and conflict resolution, considering ecological, economic, and ethnological perspectives.
5. Understand the legal policy instruments governing natural resource management and their implications for rural communities.

Unit	Course Content	Periods
I	**Introduction to Natural Resource:** Understanding the concept and classification of natural resources; Factors influencing resource availability, distribution, and interrelationships; Economic value of natural resources, relevance of environmental economics, and ecosystem services; Valuation and accounting methods, cost-benefit analysis, and pricing examples.	06
II	**Natural Resources and their Conservation: Forest resources:** status, distribution, use, over-exploitation, deforestation, and management strategies; Land resources: classification, degradation, landscape impact analysis, and wetland ecology; Water resources: utilization, conflicts, dams, ecology, and management; Energy resources: renewable and non-renewable sources, conservation, and global energy scenario; Food resources: agriculture impacts, fertilizer-pesticide problems, and challenges in fisheries.	06
III	**Resource Management and Conflict Resolution:** Mineral resources: exploitation, environmental effects, and management paradigms; Evolution and history of resource management paradigms, conflicts, and control systems; Approaches in resource management: ecological, economic, and ethnological, integrated strategies, and poverty implications.	06
IV	**Livelihood and Natural Resource Management:** Concepts and scope of livelihood, livelihood framework analysis, and traditional livelihoods; Non-Timber Forest Products (NTFP) as a source of rural livelihood: types, classifications, policies, and sustainable management.	06
V	**Legal Policy Instruments and Conflict Resolution:** Overview of legal policy instruments in Natural Resource Management: Forest Policy, Environment Policy, Conservation Policy, etc.; Non-Timber Forest Products (NTFP) related policies and acts: PESA, FRA, sustainable harvesting rules, taxation, and institutional arrangements; Conflicts in	06

	resource management: planning, protecting traditional knowledge, and benefit sharing.	

Learning Outcome- At the end of the course, student should able to:

1. Demonstrate a comprehensive understanding of natural resource concepts, classifications, and their role in rural development.
2. Apply analytical skills to assess factors influencing resource availability, distribution, and economic value in rural areas.
3. Evaluate conservation strategies for forest, land, water, energy, and food resources, considering sustainability and rural livelihoods.
4. Analyze and propose solutions for resource management and conflict resolution, integrating ecological, economic, and ethnological perspectives.
5. Evaluate the effectiveness of legal policy instruments in governing natural resource management and their impact on rural communities.

Suggested Readings:

1. Ganeshaiah, K. N., Shaanker, R. Uma, and Bawa, K. S. (2019). *Biodiversity Conservation and Utilization in a Diverse World.* Springer.
2. Gadgil, M., and Guha, R. (1995). *Ecology and Equity: The Use and Abuse of Nature in Contemporary India.* Routledge.
3. Singh, M.K. Ranjit. (2019). *Conservation Biology: Concepts and Applications.* Oxford University Press.
4. Sukumar, R. (1992). *The Asian Elephant: Ecology and Management.* Cambridge University Press.
5. Groom, M. J., Meffe, G. K., and Carroll, C. R. (2019). *Principles of Conservation Biology.* Sinauer Associates.
6. Primack, R. B. (2014). *Essential Readings in Wildlife Management and Conservation.* Oxford University Press.
7. Soule, M. E., and Orians, G. H. (2001). *Conservation Biology: Research Priorities for the Next Decade.* Island Press.
8. Van Dyke, F. (2008). *Conservation Biology: Foundations, Concepts, Applications.* Springer.
9. Wilson, E. O. (2016). *Half-Earth: Our Planet's Fight for Life.* Liveright.
10. Ramade, F. (1984). *Ecology of Natural Resources.* John Wiley and Sons Ltd.
11. Odum, E.P. (1971). *Fundamentals of Ecology.* W.B. Saunders Co. USA.
12. Mann, K.H. (2000). *Ecology of Coastal Waters with Implications for Management* (2nd Edition).
13. Agarwal, K.C. (2001). *Environmental Biology.* Nidhi Publication Ltd. Bikaner.
14. Cunningham, W.P., Cooper, T.H., Gorhani, E., and Hepworth, M.T. (2001). *Environmental Encyclopedia.* Jaico Publishing House.
15. Heywood, V.H., and Watson, R.T. (1995). *Global Biodiversity Assessment.* Cambridge Univ. Press.
16. Miller, T.G. (2010). *Environmental Science.* Wadsworth Publishing Co.

Lab course: MCB/DSE/558-P

based on

Natural Resources and their conservation

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Conduct a field survey to classify local natural resources based on their characteristics and uses.
2. Analyze case studies to understand the economic value of natural resources in rural contexts.
3. Assessment of costs and benefits of resource management strategies using real-world examples.
4. Organize a forest inventory field trip to assess forest resources and discuss management strategies.
5. Study wetland ecology to analyze ecological functions and impacts of land use.
6. Simulate water resource conflicts and management scenarios to understand complexities.
7. Set up demonstrations of renewable energy technologies in rural settings.
8. Collaborate with farmers to assess environmental impacts of agricultural practices.
9. Organize fisheries management workshops to discuss challenges and solutions.
10. Visit Brick Kiln sites to observe environmental effects and discuss management strategies.
11. Analyze historical case studies of resource management conflicts and control systems.
12. Engage in planning and implementing ecological restoration projects in degraded areas.
13. Conduct livelihood framework analyses in local rural communities to understand livelihood sources.
14. Collaborate with communities to discuss policies and sustainable management of Non-Timber Forest Products (NTFPs).
15. Provide training sessions on sustainable harvesting practices for NTFPs.

(ELECTIVE PAPER- II)

Course Code No: MCB/DSE/559-T	No. of Credits :02	Hours: 30
Course Title: **Soil Conservation and Management**		

Learning Objectives :

1. Develop an understanding of soil as a vital natural resource and its role in sustaining agricultural productivity and ecosystem health.
2. Identify the various processes of soil erosion and degradation and assess their impacts on land productivity and environmental quality.
3. Evaluate soil conservation and restoration techniques, including their effectiveness and suitability for different soil types and land uses.
4. Demonstrate practical skills in implementing soil conservation practices within agricultural systems, promoting sustainable soil management.
5. Analyze the policy frameworks and socioeconomic factors influencing soil conservation decision-making and develop strategies for promoting soil conservation at local and national levels.

Unit	Course Content	Periods
I	**Introduction to Soil Conservation and Management:** Overview of soil as a natural resource; Importance of soil conservation for sustainable agriculture and ecosystem health; Major threats to soil (e.g., erosion, degradation, pollution); Principles and objectives of soil conservation and management.	06
II	**Soil Erosion Processes and Control Measures:** Types and causes of soil erosion (e.g., water, wind, tillage); Soil erosion modeling and prediction techniques; Soil erosion control measures (e.g., terracing, contour farming, cover cropping); Sustainable soil erosion management practices.	06
III	**Soil Degradation and Restoration:** Processes and indicators of soil degradation (e.g., salinization, acidification, compaction); Impacts of soil degradation on ecosystem services and food security; Soil restoration techniques (e.g., soil amendments, organic farming, agroforestry); Case studies of successful soil restoration projects.	06
IV	**Soil Conservation Practices in Agriculture:** Conservation tillage systems (e.g., no-till, reduced tillage); Crop rotation and diversification strategies; Integrated pest management (IPM) approaches; Nutrient management practices (e.g., precision farming, cover cropping); Role of soil conservation in sustainable agriculture.	06
V	**Policy and Socioeconomic Aspects of Soil Conservation:** National and international policies related to soil conservation and land use planning; Economic incentives for soil conservation adoption; Socioeconomic factors influencing farmer decision-making in soil conservation; Community-based approaches to soil conservation and participatory management strategies.	06

Learning Outcome- At the end of the course, student should able to:

1. Apply knowledge of soil conservation principles to design and implement effective soil management strategies in diverse agricultural and ecological contexts.
2. Evaluate the effectiveness of soil erosion control measures and restoration techniques through field-based assessments and data analysis.
3. Demonstrate proficiency in implementing sustainable agricultural practices that mitigate soil degradation and enhance soil health and fertility.
4. Communicate effectively with stakeholders to advocate for soil conservation policies and practices that promote long-term environmental sustainability and food security.
5. Collaborate with local communities and organizations to develop and implement soil conservation projects that address local environmental challenges and support community livelihoods.

Suggested Readings:

1. Singh, D. K. (2018). *Soil Conservation Principles and Practices*. New Delhi: New Age International.
2. Lal, R. (2015). *Soil Carbon Sequestration and the Greenhouse Effect*. Oxford: Blackwell Publishing.
3. Karlen, D. L., and Stott, D. E. (2016). *Soil Management: Building a Stable Base for Agriculture*. Boca Raton, FL: CRC Press.
4. Singh, M., and Ghosh, A. (2017). *Soil Health and Climate Change*. New Delhi: Springer India.
5. Gupta, R. K., and Deshpande, S. B. (2014). *Soil and Water Conservation Engineering*. New Delhi: PHI Learning Pvt. Ltd.
6. Brady, N. C., and Weil, R. R. (2016). *The Nature and Properties of Soils*. Upper Saddle River, NJ: Pearson.
7. Hillel, D. (2004). *Introduction to Environmental Soil Physics*. Amsterdam: Academic Press.
8. Helgason, B. L., Walley, F. L., and Beyaert, R. P. (2017). *Soil Fertility and Nutrient Management*. Boca Raton, FL: CRC Press.
9. Wilding, L. P., and Smeck, N. E. (2015). *Pedogenesis and Soil Taxonomy: Concepts and Interactions*. Boca Raton, FL: CRC Press.
10. Lal, R., and Stewart, B. A. (2018). *Soil Management: Experimental Basis for Sustainability and Environmental Quality*. Boca Raton, FL: CRC Press.
11. Lal, R. (2018). *Soil Health and Climate Change*. Amsterdam: Springer.
12. Hillel, D. (2013). *Introduction to Environmental Soil Physics*. Amsterdam: Academic Press.
13. Helgason, B. L., and Walley, F. L. (2015). *Soil Fertility and Nutrient Management*. Boca Raton, FL: CRC Press.
14. Brady, N. C., and Weil, R. R. (2014). *The Nature and Properties of Soils*. Upper Saddle River, NJ: Pearson.

Lab course: MCB/DSE/560-P

based on

Soil Conservation and Management

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Soil health assessment through basic soil testing kits in nearby agricultural fields.
2. Measurement of soil erosion rates and discussion of control measures in erosion-prone areas.
3. Demonstration of terracing construction for water erosion control.
4. Implementation of contour farming techniques in suitable fields.
5. Experimental setup to monitor the effects of cover crops on soil erosion and nutrient cycling.
6. Comparison of no-till and conventional tillage methods on soil moisture, erosion, and crop yield.
7. Application of soil restoration techniques like composting and mulching in degraded areas.
8. Field trip to successful soil restoration projects for observation and discussion.
9. Demonstration of crop rotation sequences and monitoring of soil health and crop productivity.
10. Workshop on integrated pest management strategies and environment friendly pest control methods.
11. Implementation of nutrient management practices such as precision farming and cover cropping in experimental plots.
12. Analysis of national and international policies related to soil conservation and their implications.
13. Simulation of economic incentives and discussion on financial benefits of soil conservation practices.
14. Role-playing exercise exploring socioeconomic factors influencing farmer decision-making in soil conservation.
15. Report writing of a community-based soil conservation project involving local farmers in planning, implementation, and monitoring.

(ELECTIVE PAPER- III)

Course Code No: MCB/DSE/561-T	No. of Credits :02	Hours: 30

Course Title: **Water Resource Management**

Learning Objectives :

1. Foster an understanding of the principles and challenges of water resource management within the context of biodiversity conservation.
2. Develop expertise in assessing hydrological processes and implementing sustainable watershed management practices.
3. Equip students with the knowledge and skills to evaluate water quality, identify sources of pollution, and implement effective pollution control measures.
4. Enhance awareness of the importance of conserving aquatic ecosystems and implementing strategies to mitigate threats to aquatic biodiversity.
5. Cultivate proficiency in integrated water resource management approaches, including stakeholder engagement, policy analysis, and implementation of best practices.

Unit	Course Content	Periods
I	**Introduction to Water Resource Management:** Overview of water resources; Importance of water for biodiversity conservation; Global water challenges and trends; Principles and approaches of water resource management.	06
II	**Hydrological Processes and Watershed Management:** Hydrological cycle and its components; Watershed delineation and characterization; Land use impacts on hydrology; Sustainable watershed management practices.	06
III	**Water Quality Assessment and Pollution Control:** Water quality parameters and indicators; Sources and types of water pollution; Monitoring and assessment techniques; Pollution control measures and regulations.	06
IV	**Aquatic Ecosystem Conservation:** Importance of aquatic ecosystems for biodiversity; Threats to aquatic biodiversity; Conservation strategies for rivers, lakes, wetlands, and coastal ecosystems.	06
V	**Integrated Water Resource Management:** Integrated approach to water resource management; Stakeholder engagement and participatory management; Water governance frameworks and policies; Case studies in sustainable water management.	06

Learning Outcome- At the end of the course, student should able to:

1. Apply principles of water resource management to address real-world challenges in biodiversity conservation.
2. Implement sustainable watershed management practices to protect and enhance water resources and biodiversity.
3. Evaluate water quality and implement pollution control measures to mitigate impacts on aquatic ecosystems.
4. Design conservation strategies to preserve and restore aquatic biodiversity in diverse ecosystems.
5. Advocate for integrated water resource management approaches that promote biodiversity conservation and community well-being.

Suggested Readings:

1. Lal, R. (2015). *Soil Carbon Sequestration and the Greenhouse Effect*. Oxford: Blackwell Publishing.
2. Karlen, D. L., and Stott, D. E. (2016). *Soil Management: Building a Stable Base for Agriculture*. Boca Raton, FL: CRC Press.
3. Singh, M., and Ghosh, A. (2017). *Soil Health and Climate Change*. New Delhi: Springer India.
4. Gupta, R. K., and Deshpande, S. B. (2014). *Soil and Water Conservation Engineering*. New Delhi: PHI Learning Pvt. Ltd.
5. Brady, N. C., and Weil, R. R. (2016). *The Nature and Properties of Soils*. Upper Saddle River, NJ: Pearson.
6. Hillel, D. (2004). *Introduction to Environmental Soil Physics*. Amsterdam: Academic Press.
7. Helgason, B. L., Walley, F. L., and Beyaert, R. P. (2017). *Soil Fertility and Nutrient Management*. Boca Raton, FL: CRC Press.
8. Lal, R., and Stewart, B. A. (2018). *Soil Management: Experimental Basis for Sustainability and Environmental Quality*. Boca Raton, FL: CRC Press.
9. Wilding, L. P., and Smeck, N. E. (2015). *Pedogenesis and Soil Taxonomy: Concepts and Interactions*. Boca Raton, FL: CRC Press.
10. Singh, D. K. (2018). *Soil Conservation Principles and Practices*. New Delhi: New Age International.
11. Lal, R. (2018). *Soil Health and Climate Change*. Amsterdam: Springer.
12. Hillel, D. (2013). *Introduction to Environmental Soil Physics*. Amsterdam: Academic Press.
13. Helgason, B. L., and Walley, F. L. (2015). *Soil Fertility and Nutrient Management*. Boca Raton, FL: CRC Press.
14. Lal, R. (2017). *Principles of Soil Conservation and Management*. Boca Raton, FL: CRC Press.
15. Karlen, D. L., and Stott, D. E. (2017). *Soil Management: Building a Stable Base for Agriculture*. Boca Raton, FL: CRC Press.
16. Weil, R. R., and Brady, N. C. (2016). *The Nature and Properties of Soils*. Upper Saddle River, NJ: Pearson.
17. Singh, M., and Ghosh, A. (2019). *Soil Health and Climate Change*. New Delhi: Springer India.

Lab course: MCB/DSE/562-P

based on

Water Resource Management

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Visit a local water treatment facility to observe water management processes.
2. Analyze a case study on water scarcity and mitigation strategies.
3. Present the significance of water for biodiversity conservation.
4. Use geographical tools to delineate and study a local watershed.
5. Conduct rainfall-runoff simulations to understand land use impacts.
6. Develop a watershed management plan integrating sustainable practices.
7. Collect and analyze water samples to assess quality parameters.
8. Identify sources of water pollution through field surveys.
9. Demonstrate pollution control technologies in lab or field.
10. Evaluate the ecological health of a wetland ecosystem through a field trip.
11. Survey biodiversity in a river or lake ecosystem.
12. Design a habitat restoration project for a degraded aquatic ecosystem.
13. Facilitate a stakeholder workshop to address water management issues.
14. Analyze water governance frameworks and policies.
15. Present case studies of successful water management projects globally.

OJT/FP-1: MCB/FP/563-P

Field Project

Lab Course: 08 Hrs./ week **Credit assigned: 04**
Total hours: 30

Additional field project ideas for the subject area

1. Assessment of Microbial Diversity in Soil Profiles along Altitudinal Gradients
2. Evaluation of Plant-Insect Interactions in Agro ecosystems: Implications for Pest Management
3. Investigating the Role of Keystone Species in Maintaining Ecosystem Stability
4. Characterization of Fungal Endophytes in Medicinal Plants: Potential for Drug Discovery
5. Analysis of Bird Diversity and Habitat Preferences in Urban vs. Rural Landscapes
6. Comparative Study of Traditional vs. Molecular Taxonomic Approaches in Species Identification
7. Assessment of Genetic Variation in Wild and Cultivated Populations of Medicinal Plants
8. Mapping Wetland Ecosystems and Assessing Their Contribution to Biodiversity Conservation
9. Exploring the Impact of Urbanization on Wildlife Corridors and Connectivity
10. Evaluation of Remote Sensing Techniques for Monitoring Coral Reef Health
11. Investigating the Effects of Land Use Change on Soil Microbial Community Composition
12. Quantifying Carbon Sequestration Potential of Forest Ecosystems Using Remote Sensing
13. Assessment of Genetic Diversity and Population Structure of Amphibians in Fragmented Habitats
14. Comparative Analysis of Traditional Ecological Knowledge and Scientific Understanding of Biodiversity
15. Monitoring Changes in Plant Phenology and Its Relationship with Climate Variability
16. Mapping Hotspots of Biodiversity and Endemism for Conservation Prioritization
17. Investigating the Role of Microbial Communities in Soil Nutrient Cycling and Productivity
18. Assessing the Impacts of Invasive Plant Species on Native Flora and Fauna
19. Exploring the Relationship Between Landscape Connectivity and Genetic Diversity in Wildlife

***Any other areas relevant to the concerned subject**

Note: These additional project ideas cover various aspects of biodiversity conservation, ecosystem dynamics, and the application of biotechnological and phylogenetic approaches in understanding and managing natural systems. Students can select or modify these topics based on the interest, available resources and research objectives. "Students are encouraged to propose their own field project topics within the course's scope, focusing on biodiversity conservation, taxonomy, remote sensing, and quantitative biology. Projects should align with personal interests and contribute to understanding ecological dynamics or conservation efforts. Approval from the Subject Teacher is required for project selection."

OJT-1: MCB/OJT/563-P

On Job Training-I

Lab Course: 08 Hrs./ week **Credit assigned: 04**
Total hours: 30

For M.Sc. Conservation of Biodiversity students, hands-on training or experiences are crucial for honing their skills and preparing them for the field.
Following are some job training ideas tailored for them:

1. Field Research Assistantships: Partner with local research organizations, NGOs, or governmental agencies to provide students with opportunities to assist in on-going field research projects related to biodiversity conservation. This could involve habitat surveys, biodiversity assessments, or monitoring endangered species.

2. Internships with Conservation NGOs: Collaborate with conservation-focused non-profit organizations to offer internships where students can get involved in conservation projects, community outreach programs, and policy advocacy initiatives.

3. Wildlife Rehabilitation Centres: Students can gain valuable experience by volunteering or interning at wildlife rehabilitation centres. Here, they can learn about wildlife handling, rehabilitation techniques, and the challenges faced in wildlife conservation first-hand.

4. Botanical Gardens or Arboreta Internships: Botanical gardens and arboreta often have conservation-focused programs where students can assist in plant conservation efforts, learn about seed banking, rare plant propagation, and habitat restoration.

5. GIS and Remote Sensing Training: Offer training workshops or courses in Geographic Information Systems (GIS) and remote sensing techniques specific to biodiversity conservation. These skills are highly valuable for analyzing and mapping habitats, tracking species distributions, and identifying conservation priorities.

6. Community-based Conservation Projects: Encourage students to collaborate with local communities on conservation initiatives. This could involve organizing environmental education workshops, conducting biodiversity surveys with community participation, or implementing sustainable livelihood projects.

7. Conservation Genetics Laboratories: Provide opportunities for students to work in conservation genetics laboratories where they can learn about DNA sequencing, population genetics analysis, and its applications in conservation biology.

8. Conservation Policy and Advocacy: Offer training sessions or workshops focused on conservation policy and advocacy, where students can learn about environmental law, policy-making processes, and strategies for effective advocacy on biodiversity conservation issues.

9. Ecotourism and Interpretation Programs: Partner with eco-lodges, nature reserves, or ecotourism operators to provide training in ecotourism management and interpretation techniques. This can help students understand the importance of sustainable tourism in conservation efforts and develop skills in environmental education and interpretation.

10. Environmental Impact Assessment (EIA) Training: EIA is a critical component of many conservation projects. Providing training in EIA methodologies and procedures can equip students with skills necessary for assessing the potential environmental impacts of development projects and proposing mitigation measures.

***Any other areas relevant to the concerned subject**

Note: These training opportunities enhance student's practical skills but also provide them with valuable networking opportunities and real-world experiences that can boost their career prospects in the field of biodiversity conservation.

(MANDATORY SUBJECT: III)

Course Code No: MCB/MJ/602-T	No. of Credits: 02	Hours: 30

Course Title: Animal Ecology and Behavior

Learning Objectives:

1. Understand fundamental principles and significance of animal ecology.
2. Analyze population dynamics, community structure, and ecosystem productivity.
3. Explain the basics of animal behavior, including foraging, mating, and social behaviors.
4. Identify communication modalities and their functions in animal communication.
5. Describe adaptations, life history strategies, and evolutionary mechanisms in animal ecology.

Unit	Course Content	Periods
I	Introduction to Animal Ecology Concepts and Principles: Definitions, scope, and significance of animal ecology. Population Ecology: Population dynamics, growth models, and regulation factors. Community Ecology: Species interactions (predation, competition, mutualism), community structure, and dynamics. Ecosystem Ecology: Energy flow, nutrient cycling, and ecosystem productivity.	06
II	Behavioral Ecology Basics of Animal Behavior: Ethology, proximate and ultimate causes of behavior. Foraging Behavior: Optimal foraging theory, food selection, and risk management. Mating Systems and Reproductive Behavior: Sexual selection, mate choice, and parental investment. Social Behavior: Altruism, cooperation, social hierarchies, and group living benefits.	06
III	Animal Communication and Sensory Ecology Communication Modalities: Visual, auditory, chemical, and tactile communication. Functions of Communication: Mate attraction, territory defense, alarm calls, and social bonding. Sensory Systems: Mechanisms of vision, hearing, olfaction, and electroreception. Signal Evolution: Honest signaling, deception, and evolution of communication systems.	06
IV	Adaptations and Evolutionary Ecology Adaptive Strategies: Camouflage, mimicry, and anti-predator defenses. Life History Strategies: r/K selection theory, trade-offs in life history traits. Evolution of Behavior: Natural selection, genetic basis of behavior, and behavioral plasticity. Phylogenetic Approaches: Comparative methods and evolutionary relationships.	06
V	Applied Animal Ecology and Conservation Conservation Behavior: Behavioral approaches to conservation, reintroduction, and habitat restoration. Human-Wildlife Conflict: Causes, management strategies, and mitigation techniques. Impact of Climate Change: Effects on animal behavior and ecology, adaptive responses. Biodiversity and Ecosystem Services: Role of animals in maintaining ecosystem functions and services.	06

Learning Outcome- At the end of this course Students should be able to :

1. Articulate key concepts in animal ecology with clarity.
2. Apply analytical skills to assess population dynamics and community interactions.
3. Demonstrate comprehension of animal behavior principles and their applications.
4. Evaluate communication modalities and their evolutionary significance.
5. Analyze adaptive strategies and evolutionary processes in animal ecology.

Suggested Readings:

1. Agarwal, V. K. (2012). *Animal Ecology and Distribution of Animals*. S. Chand Publishing.
2. Sharma, P. D. (2010). *Ecology and Environment*. Rastogi Publications.
3. Begon, M., Townsend, C. R., & Harper, J. L. (2006). *Ecology: From Individuals to Ecosystems*. Wiley-Blackwell.
4. Gadgil, M., & Guha, R. (1995). *Ecology and Equity: The Use and Abuse of Nature in Contemporary India*. Routledge.
5. Alcock, J. (2013). *Animal Behavior: An Evolutionary Approach*. Sinauer Associates.
6. Krebs, J. R., & Davies, N. B. (1993). *An Introduction to Behavioural Ecology*. Wiley-Blackwell.
7. Krebs, C. J. (2001). *Ecology: The Experimental Analysis of Distribution and Abundance*. Benjamin Cummings.
8. Dugatkin, L. A. (2004). *Principles of Animal Behavior*. W. W. Norton & Company.
9. Wilson, E. O. (1975). *Sociobiology: The New Synthesis*. Harvard University Press.

(MANDATORY SUBJECT: II)

Course Code No: MCB/MJ/603-T	No. of Credits: 02	Hours: 30

Course Title: Environmental Monitoring and Audit

Learning Objectives:

1. Understand the concepts and significance of environmental monitoring across different domains.
2. Learn the techniques and methodologies used in air, water, soil, and noise quality monitoring.
3. Explore the process of Environmental Impact Assessment (EIA) and environmental auditing.
4. Familiarize with national and international regulations and standards governing environmental monitoring and audit.
5. Examine the applications of emerging technologies such as drones, IoT, and AI in environmental monitoring and conservation.

Unit	Course Content	Periods
I	Introduction to Environmental Monitoring Concepts and Importance: Definitions, objectives, and significance of environmental monitoring. Types of Monitoring: Air, water, soil, and biological monitoring. Monitoring Techniques: Remote sensing, GIS, and in-situ monitoring. Environmental Indicators: Selection and use of indicators for environmental assessment.	06
II	Air and Water Quality Monitoring Air Quality Monitoring: Pollutants, sampling methods, and analytical techniques. Water Quality Monitoring: Parameters, sampling methods, and analytical techniques. Standards and Guidelines: National and international standards for air and water quality. Case Studies: Examples of air and water quality monitoring programs.	06
III	Soil and Noise Monitoring Soil Quality Monitoring: Parameters, sampling methods, and analytical techniques. Noise Pollution Monitoring: Sources, measurement methods, and impact assessment. Data Analysis and Interpretation: Statistical tools and techniques for data analysis. Case Studies: Examples of soil and noise pollution monitoring programs.	06
IV	Environmental Impact Assessment (EIA) and Audit EIA Process: Stages of EIA, methodologies, and public participation. Environmental Auditing: Types, objectives, and methodologies. Regulations and Policies: National and international EIA and audit guidelines. Case Studies: Examples of EIA and audit in various sectors.	06
V	Emerging Technologies and Applications in Environmental Monitoring Advanced Monitoring Technologies: Use of drones, IoT, and AI in environmental monitoring. Applications in Conservation: Monitoring biodiversity, habitat assessment, and conservation planning. Climate Change Monitoring: Tracking climate variables, greenhouse gas emissions, and impacts. Sustainable Practices: Implementing sustainable practices based on monitoring data.	06

Learning Outcome- At the end of this course Students should be able to build :

1. Ability to apply various monitoring techniques effectively to assess environmental parameters.

2. Proficiency in interpreting and analyzing data obtained from environmental monitoring programs.
3. Competence in conducting Environmental Impact Assessments (EIA) and environmental audits.
4. Understanding of compliance requirements and adherence to national and international environmental standards.
5. Capability to implement advanced technologies for efficient environmental monitoring and conservation practices.

Suggested Readings:

1. Gupta, P. K. (2004). *Methods in Environmental Analysis: Water, Soil and Air*. Agrobios.
2. Trivedy, R. K., & Goel, P. K. (1986). *Chemical and Biological Methods for Water Pollution Studies*. Environmental Publications.
3. Sharma, P. D. (2005). *Environmental Biology and Toxicology*. Rastogi Publications.
4. Bhattacharya, T., & Chakrabarti, C. (2012). *Environmental Monitoring and Assessment*. Capital Publishing Company.
5. Anastas, P. T., & Warner, J. C. (1998). *Green Chemistry: Theory and Practice*. Oxford University Press.
6. Gilbert, M. (2017). *Environmental Monitoring and Characterization*. Elsevier.
7. Manahan, S. E. (2004). *Environmental Chemistry*. CRC Press.
8. Gray, N. F. (2008). *Environmental Monitoring and Assessment*. Springer.
9. Barrow, C. J. (2006). *Environmental Management for Sustainable Development*. Routledge.

Lab course: MCB/MJ/604-P

based on

Biodiversity Conservation and Climate Change

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Analyze ecosystem services provided by local habitats to understand their importance
2. Conduct field surveys to assess biodiversity and habitat fragmentation patterns
3. Use GIS software to map habitats and assess their vulnerability to climate change.
4. Debate conservation ethics and principles to understand different perspectives.
5. Simulate protected area management to balance conservation goals and human needs.
6. Assess climate change impacts on local biodiversity using models and data.
7. Develop adaptation strategies for vulnerable species and ecosystems.
8. Measure carbon sequestration in forests and wetlands to understand their role in climate change mitigation.
9. Analyze conservation policies and advocate for policy changes.
10. Establish community-based biodiversity monitoring programs.
11. Plan conservation strategies considering integrated approaches and landscape/seascape perspectives.
12. Develop biodiversity action plans for specific areas or species.
13. Assess urban biodiversity and propose conservation strategies.
14. Organize a symposium on emerging issues in biodiversity conservation.
15. Conduct practical sessions on conservation technology and its future implications.

Lab course: MCB/MJ/605-P

based on

Conservation Policies and Laws

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Conduct a simulation of international conservation conventions to understand global policy frameworks.
2. Engage in a debate on ethical foundations of conservation to explore diverse philosophical perspectives.
3. Map out the structure of conservation policy-making institutions at various levels to understand their functions.
4. Review major environmental laws in India to analyze their objectives and provisions.
5. Analyze the Biological Diversity Act, 2002, discussing its implementation challenges and regulatory bodies' roles.
6. Assess the impact of the Forest Rights Act, 2006, on conservation and biodiversity management.
7. Conduct water and air quality monitoring exercises to discuss pollution control acts' role in conservation.
8. Simulate management practices in different categories of protected areas, discussing challenges and best practices.
9. Design integrated conservation and development projects considering community needs and conservation goals.
10. Engage with local communities to understand their role in conservation, discussing successful community-based initiatives.
11. Implement ecosystem-based approaches to conservation, discussing principles and outcomes.
12. Assess regulatory mechanisms and enforcement agencies, discussing challenges in enforcement and compliance.
13. Analyze environmental impact assessment processes for selected projects, discussing legal requirements and public participation.
14. Organize a symposium on emerging issues and future directions in conservation policy, discussing climate change responses and innovative policy approaches.
15. Conduct a policy innovation symposium to discuss climate change responses, SDGs integration, and innovative policy approaches.

Lab course: MCB/MJ/606-P

based on

Animal Ecology and Behaviour

Lab Course: 04 Hrs./ week **Credit assigned: 02**
Total hours: 30

1. Analyze predator-prey dynamics using mathematical models to understand population fluctuations.
2. Investigate species interactions in a local ecosystem to assess community structure.
3. Measure terrestrial ecosystem productivity to evaluate energy flow dynamics.
4. Test foraging efficiency in simulated environments to validate optimal foraging theory.
5. Study mate choice in a species to elucidate mechanisms of sexual selection.
6. Observe cooperative behaviors to evaluate the advantages of altruism in social species.
7. Explore pheromonal communication's role in mate attraction in specific animal species.
8. Compare visual adaptations in animals to understand mechanisms of vision.
9. Assess the efficacy of camouflage strategies in predator evasion.
10. Contrast life history traits in species to understand r/K selection theory.
11. Conduct breeding studies to elucidate the genetic basis of behavior.
12. Design reintroduction plans for locally extinct species to restore ecosystems.
13. Evaluate strategies for mitigating human-wildlife conflicts to ensure coexistence.
14. Monitor behavioral changes in response to climate variability to predict impacts on species.
15. Assess the contribution of specific animal species to ecosystem services like pollination or seed dispersal.

(ELECTIVE PAPER- I)

Course Code No: MCB/MJ/607-T	No. of Credits: 02	Hours: 30

Course Title: Environmental Chemistry

Learning Objectives:

1. Understand the foundational principles and significance of environmental chemistry.
2. Identify and analyze chemical reactions occurring in the environment and their kinetics.
3. Recognize the major environmental compartments and their roles in biogeochemical cycles.
4. Describe atmospheric composition, photochemical reactions, and pollutants.
5. Analyze water chemistry, pollutants, and treatment methods for water quality management.

Unit	Course Content	Periods
I	Fundamentals of Environmental Chemistry Basic Concepts: Definitions, scope, and importance of environmental chemistry. Chemical Reactions in the Environment: Types of reactions, thermodynamics, and kinetics. Environmental Compartments: Atmosphere, hydrosphere, lithosphere, and biosphere. Biogeochemical Cycles: Carbon, nitrogen, phosphorus, sulfur, and water cycles.	06
II	Atmospheric Chemistry Composition of the Atmosphere: Major and trace components. Photochemical Reactions: Mechanisms and implications of photochemical smog. Atmospheric Pollutants: Sources, types (particulate matter, NOx, SOx, VOCs, ozone), and effects. Greenhouse Effect and Climate Change: GHGs, global warming potential, and climate modeling.	06
III	Aquatic Chemistry Water Chemistry Basics: Properties of water, pH, and redox reactions. Chemical Speciation in Water: Metal ions, complexation, and solubility. Water Pollutants: Types (organic, inorganic, and biological), sources, and effects. Water Treatment Processes: Physical, chemical, and biological treatment methods.	06
IV	Soil Chemistry Soil Composition and Properties: Minerals, organic matter, soil pH, and cation exchange capacity. Soil Pollution: Sources, types (pesticides, heavy metals, industrial waste), and effects. Soil Remediation Techniques: Phytoremediation, bioremediation, and chemical remediation. Soil Organic Matter: Decomposition, humus formation, and nutrient cycling.	06
V	Environmental Toxicology and Risk Assessment Principles of Toxicology: Dose-response relationships, toxicokinetics, and toxicodynamics. Environmental Toxicants: Types (pesticides, heavy metals, POPs), sources, and effects. Bioaccumulation and Biomagnification: Mechanisms and ecological impacts. Risk Assessment and Management: Hazard identification, exposure assessment, risk characterization, and management strategies.	06

Learning Outcome – At the end of this course students should be able to:

1. Apply environmental chemistry principles to address environmental challenges effectively.
2. Predict and assess the outcomes of chemical reactions in environmental systems.
3. Understand the interconnectedness of environmental compartments in biogeochemical cycles.

4. Evaluate atmospheric composition and its implications for air quality and climate change.
5. Implement appropriate treatment methods for maintaining water quality and managing pollutants.

Suggested Readings:

1. De, A. K. (2003). *Environmental Chemistry*. New Age International Publishers.
2. Dara, S. S. (2007). *A Textbook of Environmental Chemistry and Pollution Control*. S. Chand Publishing.
3. Manahan, S. E. (2000). *Environmental Chemistry*. CBS Publishers & Distributors.
4. Singh, J. P., & Sinha, S. (2010). *Environmental Chemistry*. Scientific Publishers.
5. Manahan, S. E. (2005). *Environmental Chemistry*. CRC Press.
6. Baird, C., & Cann, M. (2012). *Environmental Chemistry*. W. H. Freeman.
7. Harrison, R. M. (2007). *Principles of Environmental Chemistry*. Royal Society of Chemistry.
8. Stumm, W., & Morgan, J. J. (1996). *Aquatic Chemistry: Chemical Equilibria and Rates in Natural Waters*. Wiley-Interscience.
9. Schwarzenbach, R. P., Gschwend, P. M., & Imboden, D. M. (2002). *Environmental Organic Chemistry*. Wiley-Interscience.

Lab course: MCB/MJ/608-P

based on

Environmental Chemistry

Lab Course: 04 Hrs./ week **Credit assigned: 02**

Total hours: 30

1. Measure pH and redox potential of water samples to understand water chemistry basics.
2. Analyze metal ion speciation in water through complexation reactions.
3. Investigate the effectiveness of physical, chemical, and biological methods in water treatment processes.
4. Determine soil pH and cation exchange capacity to assess soil composition and properties.
5. Test soil samples for pesticide and heavy metal contamination to evaluate soil pollution.
6. Implement phytoremediation and bioremediation techniques to remediate contaminated soils.
7. Monitor decomposition rates to understand soil organic matter dynamics.
8. Study dose-response relationships to comprehend principles of toxicology.
9. Analyze pesticide and heavy metal concentrations in environmental samples to identify toxicants.
10. Investigate bioaccumulation and bio magnification using ecological models.
11. Assess hazard identification and exposure levels to characterize environmental risks.
12. Measure pollutants in air samples to understand atmospheric chemistry.
13. Analyze photochemical smog formation through laboratory simulations.
14. Study the effects of greenhouse gases on climate using climate modeling software.
15. Evaluate the efficacy of different soil remediation techniques in reducing pollutant levels.

(ELECTIVE PAPER- II)

Course Code No: MCB/DSE/609-T	No. of Credits: 02	Hours: 30

Course Title: Plant Reproductive Ecology

Learning Objectives:

1. Grasp the fundamental concepts and importance of plant reproductive ecology.
2. Identify and describe reproductive structures and strategies in plants.
3. Understand pollination mechanisms, efficiency, and pollination networks.
4. Analyze seed dispersal mechanisms, dormancy, and seed bank dynamics.
5. Explore conservation and restoration techniques based on reproductive ecology principles.

Unit	Course Content	Periods
I	Introduction to Plant Reproductive Ecology Basic Concepts: Definitions, scope, and significance of plant reproductive ecology. Reproductive Structures: Flowers, inflorescences, and reproductive organs. Reproductive Strategies: Outcrossing vs. selfing, breeding systems, and reproductive barriers. Life History Theory: Allocation of resources to reproduction, trade-offs, and life history strategies.	06
II	Pollination Biology Pollination Mechanisms: Abiotic vs. biotic pollination, pollinator types (insects, birds, bats), and coevolution. Pollination Syndromes: Floral traits associated with different pollinators. Pollination Efficiency: Factors affecting pollen transfer, pollen limitation, and reproductive success. Pollination Networks: Interactions between plants and pollinators in ecological communities.	06
III	Breeding Systems and Mating Patterns Outcrossing Mechanisms: Mechanisms to promote outcrossing (herkogamy, dichogamy, self-incompatibility). Selfing Mechanisms: Self-pollination, autogamy, and geitonogamy. Mixed Mating Systems: Examples of plants exhibiting both outcrossing and selfing. Mating Patterns: Spatial and temporal patterns of mating, pollen dispersal, and gene flow.	06
IV	Seed Dispersal and Seed Banks Seed Dispersal Mechanisms: Animal-mediated dispersal (endozoochory, ectozoochory) and abiotic dispersal (wind, water). Seed Dormancy: Types of dormancy, ecological significance, and dormancy-breaking mechanisms. Seed Banks: Formation, longevity, and role in plant population dynamics. Regeneration Ecology: Seedling establishment, seedling recruitment, and factors affecting seedling survival.	06
V	Reproductive Ecology in Conservation and Restoration Conservation Genetics: Genetic diversity, population structure, and implications for conservation. Reproductive Success in Fragmented Habitats: Edge effects, pollinator limitation, and reproductive assurance. Assisted Reproductive Techniques: Seed banking, ex situ conservation, and reintroduction programs. Ecological Restoration: Role of reproductive ecology in restoring degraded habitats and conserving rare and endangered plant species.	06

Learning Outcome- At the end of this course students should be able:

1. Apply knowledge to understand reproductive patterns in plant populations.
2. Demonstrate proficiency in identifying reproductive structures and strategies.
3. Evaluate the role of pollination biology in plant reproduction.
4. Analyze seed dispersal mechanisms and their ecological significance.
5. Implement conservation and restoration strategies informed by plant reproductive ecology.

Suggested Readings:

1. Gadgil, M., & Meher-Homji, V. M. (1990). *Ecology and Evolution of Plant Reproduction: New Approaches*. Oxford University Press.
2. Shivanna, K. R., & Johri, B. M. (2003). *The Angiosperm Pollen: Development and Function*. Wiley.
3. Krishna, A. P., & Reddy, K. J. (2003). *Plant Reproductive Ecology: Patterns and Strategies*. Narosa Publishing House.
4. Singh, Gurcharan. (2004). *Plant Systematics: An Integrated Approach*. Science Publishers.
5. Lovett Doust, L. (1981). *Plant Reproductive Ecology: Patterns and Strategies*. Oxford University Press.
6. Primack, R. B., & Lloyd, D. G. (1980). *Reproductive Ecology of Plants*. Chapman and Hall.
7. Fenster, C. B., & Dudash, M. R. (2001). *Specialization and Generalization in Plant Reproductive Ecology*. University of Chicago Press.
8. Herrera, C. M. (2002). *Seed Dispersal by Vertebrates: Ecological Aspects of Spatial Pattern Formation*. CRC Press.

Lab course: MCB/MJ/610-P

based on

Plant Reproductive Ecology

Lab Course: 04 Hrs./ week **Credit assigned: 02**

Total hours: 30

1. Investigate floral traits associated with different pollination syndromes to understand plant-pollinator interactions.
2. Analyze factors influencing pollen transfer efficiency and reproductive success in a plant population.
3. Study mechanisms promoting outcrossing and selfing in plant species to assess breeding systems.
4. Examine spatial and temporal patterns of mating to understand pollen dispersal and gene flow.
5. Experiment with seed dispersal mechanisms to determine their effectiveness in plant population dynamics.
6. Assess seed dormancy types and dormancy-breaking mechanisms to understand their ecological significance.
7. Investigate the formation and longevity of seed banks and their role in plant population persistence.
8. Monitor seedling establishment and recruitment to evaluate factors affecting seedling survival.
9. Evaluate genetic diversity and population structure to inform conservation strategies.
10. Study reproductive success in fragmented habitats to understand edge effects and pollinator limitation.
11. Implement assisted reproductive techniques such as seed banking and reintroduction programs for conservation.
12. Analyze the role of reproductive ecology in ecological restoration and habitat conservation.
13. Conduct field surveys to assess plant reproductive success in degraded habitats.
14. Experiment with pollinator exclusion to evaluate its impact on plant reproductive output.
15. Investigate the effectiveness of different restoration strategies in conserving rare and endangered plant species.

14. **Ecological and Socio-Economic Impact Evaluation**: Evaluate the ecological and socio-economic impacts of conservation interventions through participatory monitoring and evaluation.
15. **Environmental Education Programs**: Collaborate with local schools to organize environmental education programs on biodiversity conservation and sustainable development.

Note:-These project ideas cover a wide range of topics, from traditional knowledge preservation to environmental justice analysis and sustainable development initiatives, providing students with opportunities for interdisciplinary research and community engagement.