

## SYLLABUS

### **M. Sc. Environmental Biology (Choice Based Credit System)**

#### **Schemes of Examination (Session- 2020-21)**

#### **Semester-I**

S.No.	Course Name & Code	Course Type	Theory	Internal Assessment	Total Marks	Credit
1.	Ecological Principles	Core	80	20	100	4
2.	*Basic Methods in Ecology	Generic Elective	80	20	100	4
3.	Populations and Biotic Community	Core	80	20	100	4
4.	Earth Environment and Climatology		80	20	100	4
5.	Practical	-	-	-	100	4
6.	Comprehensive Viva Voce	-	-	-	50	2
<b>Semester Total</b>					<b>550</b>	<b>22</b>

#### **Semester-II**

S.No.	Course Name & Code	Course Type	Theory	Internal Assessment	Total Marks	Credit
1.	Biodiversity Conservation	Core	80	20	100	4
2.	Ecological Statistics	Core	80	20	100	4
3.	Environmental Pollution	Core	80	20	100	4
4.	*Global Environmental Issues	Generic Elective	80	20	100	4
5.	Practical	-	-	-	100	4
6.	Comprehensive Viva Voce	-	-	-	50	2
<b>Semester Total</b>					<b>550</b>	<b>22</b>

#### **Semester-III**

S.No	Course Name & Code	Course Type	Theory	Internal Assessment	Total Marks	Credit
1.	Environmental Microbiology	Core	80	20	100	4
2.	Conservative & Management of Natural Resources	Core	80	20	100	4
3.	** (A). Pollution Control and Waste Management	Discipline Centric Elective	80	20	100	4
	** (B). Air Pollution Management	Discipline Centric Elective				
4.	*Environmental Law's and Policies	Generic Elective	80	20	100	4
5.	Practical	-	-	-	100	4
6.	Comprehensive Viva Voce	-	-	-	50	2
<b>Semester Total</b>					<b>550</b>	<b>22</b>

### Semester-IV

S.No	Course Name & Code	Course Type	Theory	Internal Assessment	Total Marks	Credit
1.	Ecotoxicology	Core	80	20	100	4
2.	Environmental Biotechnology	Core	80	20	100	4
3.	** (A). Forest Ecology	Discipline Centric Elective	80	20	100	4
	** (B). Water Pollution Management	Discipline Centric Elective				
4.	Environmental Impact Assessment	Generic Elective	80	20	100	4
5.	Practical	-	-	-	100	4
6.	Comprehensive Viva Voce	-	-	-	50	2
<b>Semester Total</b>					<b>550</b>	<b>22</b>
<b>Grand Total</b>					<b>2200</b>	<b>88</b>

\* Students may choose this course as a Generic Elective or may choose a Generic Elective offered by other UTDs or may choose a course offered by MOOCs through SWAYAM.

\*\* The department offers Two- Discipline Centric Elective Courses in III and IV semester with internal choices as A or B. Students of this program will have a choice to select one course from the available internal choice in each Discipline Centric Elective course in III and IV semester.

Generic Elective Courses of this program are also available to students of other discipline/ programs of the University Teaching Departments.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- I**  
**PAPER- I (Core course)**  
**ECOLOGICAL PRINCIPLES**

Preamble: This course aims to introduce the basics of ecological principles, ecosystem's structure and functions, and the ecosystem's services provided to society.

1. Ecosystem: Concept, trophic structure, structure and functions, food chains, food webs, ecological pyramids.
2. Energy flow through food chains, productivity; primary productivity of different ecosystems, secondary productivity.
3. Biogeochemical cycling: Concept, gaseous and sedimentary cycles, recycles pathways, Ecological factors; Leibigs and shelford laws of limiting factors.
4. Ecological characteristics of forest ecosystems, grassland ecosystems, desert ecosystems, aquatic ecosystems, urban ecosystems, agricultural ecosystems, natural and managed ecosystems.
5. Ecosystems services to the Society: maintenance of gaseous composition of the atmosphere, climate control by forests and ocean systems, natural pest control, pollination of plants by insect, birds and mammals, formation and protection of soil, conservation and purification of water.

## **M.Sc. ENVIRONMENTAL BIOLOGY**

### **SEMESTER- I**

#### **PAPER- II (Core Course)**

#### **BASIC METHODS IN ECOLOGY**

Preamble: This paper deals with various methods of sampling of plants, animals, air, water, and analysis of ecological materials.

1. Terrestrial vegetation sampling techniques: Sampling of plants, determination of minimum size and minimum number of quadrates, community analysis; density, frequency, abundance, Importance Value Index (IVI), indices of species diversity, richness, and similarity index.
2. Aquatic sampling techniques: Sampling of macrophytes, phytoplanktons and zooplanktons and aquatic insects. Animal Sampling: Sampling techniques of animal population
3. Estimation of productivity: Primary productivity (chlorophyll estimation, biomass, light and dark bottle methods) and secondary productivity.
4. Analytical methods: Air pollution monitoring techniques, Gaseous and particulate matters sampling, Air samplers, water sampling techniques, water quality analysis (DO, BOD, COD, Hardness).
5. Microbial Techniques: Microbial culture sterilization techniques, culture media preparation, colony counting techniques, determination of MPN.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- I**  
**PAPER- III (Core Course)**  
**POPULATIONS AND BIOTIC COMMUNITY**

Preamble: This course introduces major themes and ecological processes of biotic communities.

1. Concept of Population: Population attributes, population growth; population fluctuation, 'r' and 'k' selection, concept of density dependent and density independent action of population regulation, Ecade and Ecotypes.
2. Concept of Biotic Community: Attributes, structure and composition, stratification, Ecotone and Edge effect, keystone species induced community changes.
3. Interspecific Interactions : Positive and negative interspecific interactions (commensalism, mutualism, predation, competition, parasitism, antibiosis), co-evolution, cooperation and complexity, allelopathy.
4. Ecological Succession : Stages and mechanism of succession, Trends and stages of community development, concept of climax, climax theories.
5. Concept of Habitat and Ecological Niche, niche types, niche width and overlap, ecological equivalent, competition and niche, niche segregation.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- I**  
**PAPER- IV (Generic Elective Course)**  
**EARTH ENVIRONMENT AND CLIMATOLOGY**

Preamble: This course deals with dimensions of earth, atmosphere, soil, climate and major catastrophic climatic conditions confronting our present day from scientific perspective.

1. Lithosphere: Earth structure, Rocks- Sedimentary, Igneous and metamorphic rocks, weathering of rocks.
2. Soil : Soil characteristics ( mineral matter, organic matters, soil air and water),soil classification, soil distribution in India, Climate and soil profile, soil formation soil forming processes, factors affecting soil formation, ecological characteristics of soils of different ecosystems.
3. Hydrosphere: Global water balance, ice sheets and fluctuation of sea levels, factors influencing the surface water, freshwater shortage and associated problems, hydrological cycle.
4. Atmosphere : Compositions and divisions of atmosphere, atmospheric pressure, atmospheric winds, clouds and precipitation, atmospheric humidity, temperature and light, Carioles' effects, Solar radiation, Solar pond.
5. Climate : Weather and climate, air circulation and climate, ocean current and climate, Seasonal winds and monsoon, climate of India; Indian monsoon, EL Nino, Tropical cyclones, Western disturbance, Weather modification.

# **M.Sc. ENVIRONMENTAL BIOLOGY**

## **SEMESTER- II**

### **PAPER- I (Core Course)**

#### **BIODIVERSITY CONSERVATION**

Preamble: This course introduces the biodiversity at different levels of biological organization and the essential ecological and biological processes to ensure long term stability of ecosystems, and also scientific approaches of conservation of biodiversity.

1. Introduction to biodiversity: The global perspective, biogeographically regions of India, values of biodiversity, biodiversity as a sources of food and improved variety, sources of drugs and medicines, aesthetic and cultural benefits.
2. Levels of biodiversity: Community diversity (alpha, beta, and gamma diversity, genetic diversity, pattern diversity), Gradients of biodiversity (altitudinal, insular), Ecosystems diversity (biomes, mangroves, coral reefs, wetlands, and terrestrial diversity), factors related to tropical and temperate species diversity.
3. Regions of Biodiversity: Mega diversity regions of India, Hot spots of biodiversity, diversity trends of different ecosystems, diversity and distribution of wild life in India, habitat specific endemic plants and animals of India.
4. Threats to biodiversity: Human interventions and biodiversity loss, global environmental changes and biodiversity, introduction of exotic species and biodiversity, natural calamities and biodiversity, extinction of species, threatened plants and animals of India.
5. Conservation of biodiversity: Importance of biodiversity conservation, methods of biodiversity conservation; in-situ and ex-situ modes of biodiversity conservation, In-vitro conservation; germplasm and gene bank, pollen and spore bank, DNA bank.



## **M.Sc. ENVIRONMENTAL BIOLOGY**

### **SEMESTER- II**

#### **PAPER- II (Core Course)**

#### **ECOLOGICAL STATISTICS**

Preamble: Environmental studies require statistical approach for data analysis. This paper introduces the students about various statistical methods used in the collection of ecological data and analysis for environmental studies.

1. Collection and Representation of Data: Collection of Data; Classification of Data; Tabulation of Data; Graphical Representation of Data Histogram, Frequency polygon, Frequency curve, Relative frequency map, cumulative frequency curve and dot (Scatter) diagram. Diagrammatic Representation of Data-Line diagram, Bar diagrams and Pie diagrams.
2. Measuring of Central Tendency: Mean, Median, Mode.
3. Measuring dispersion: Range, Standard Deviation, Mean deviation, Coefficient of variation, Normal Distribution; Measuring Standard deviation for grouped Data.
4. Standard Error, Standard Deviation, confidence limits, Correlation, Coefficient of Correlation.
5. Null hypothesis, Gaia Hypothesis, Test of Significance: Student's 't' test, Chi-square test and F-test, Analysis of variance.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- II**  
**PAPER- III (Core Course)**  
**ENVIRONMENTAL POLLUTION**

Preamble: The course deals with air, water, and soil pollution, solid wastes disposal techniques, pesticide pollution, and their impacts on environment, ecosystems and human health and other living organisms.

1. Environmental pollution and pollutants: Concept, definition and characteristics.
2. Air pollution : Natural and anthropogenic sources and types of air pollutants, photochemical reactions, acid rains, PAN, concept of Fog and Smog, effect of air pollution on human beings, plants and animals. Air quality standards, vehicular pollution.
3. Water pollution : Sources and types of water pollutants, Effect of water pollutants on living organisms, water pollution linked human diseases, ground water pollution, heavy metals and their effects on biota, thermal pollution, characteristics of industrial effluents.
4. Solid wastes: Source and generation of solid wastes; composition , classification and disposal techniques of solid wastes, municipal and industrial wastes, biomedical wastes, Electronic wastes, and their environmental effects.
5. Pesticides: Classification, properties, effects on living organisms.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- II**  
**PAPER- IV (Generic Elective Course)**  
**GLOBAL ENVIRONMENTAL ISSUES**

Preamble: This paper introduces various global as well as national environmental issues and problems, and their dimensions, causes and effects.

1. Current environmental issues in India: Air pollution in Indian cities, soil quality deterioration in Indian crop fields, pollution in major rivers of India, Namami Gange project, surface water crisis in India, forest fire, Threats to Indian forests by exotic plant species.
2. Global environmental problems: Ozone depletion, Deforestation, Green house gases and their increasing trends. Global warming, Global warming and climate change, recent records of climate change, Extreme weather events, Impact of climate change on ecological systems, Measures to cope with climate change.
3. Environmental Hazards: Geological hazards - volcanoes, Earthquakes, Tsunami, Hydrological hazards -Floods, Droughts, Hurricanes, Cyclones.
4. Disaster and Hazard management : Human and ecological impacts, risk assessment and vulnerability, analysis, National preparedness and adaptation strategies, Hazards policies and agencies, Role of GIS and remote sensing in surveillance, monitoring, risk assessment.
5. Recent international conventions on environmental problems.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- III**  
**PAPER- I (Core Course)**  
**ENVIRONMENTAL MICROBIOLOGY**

Preamble: The course is aimed at providing comprehensive information on microbial habitats and applicability of microbes in various fields of ecosystems and human well beings.

1. Introduction to Microbiology: Characterization and Classification of Micro-organisms, environmental factors affecting microbial growth and microbial adaptations to extreme environments (like arctic and hot springs).
2. Soil Microbiology: Microbes in soil, role of microbes in nitrogen fixation, Microbes of waste water treatment and solid waste management, microbial biogeochemical process of nutrient cycling and biodegradation.
3. Food Microbiology: Microbial flora of foods, Microbial Spoilage and examination, preservation of foods, Fermented foods, Microorganisms as food (SCP), Micro-organism in Milk and Milk products, Pasteurization of Milk, examination of milk micro-organisms
4. Industrial Microbiology : Industrial use of Bacteria - Lactic Acid Production, Vinegar Production, Biogas Production, Industrial use of Molds - Penicillin Production, Industrial use of Yeast - Alcohol Production; Vaccine Production
5. Microbial habitats (air, freshwater, marine and deep sea), natural microbial communities with emphasis on biofilms, plants and animals as microbial habitats and human microbiome.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- III**  
**PAPER- II (Core Course)**  
**CONSERVATION AND MANAGEMENT OF NATURAL RESOURCES**

Preamble: This course deals with dimension and issues of natural resources and environment. It also aims to provide adequate insight on management and conservation of natural resources.

1. Resources: Renewable and non-renewable energy resources, major resources - Surface/subsurface water in India, forest, wildlife. Bio-energy (biomass, biogas), clean energy.
2. Identification and description of various threats to different ecosystems with particular reference to Fresh water, Forest, Grassland, Estuary, and Wetlands.
3. Principles of environmental conservation and management, ecological accounting. Sustainable development: environment and development, concept of sustainability, dimension of sustainable development, framework for achieving sustainability and assessment of sustainable development.
4. Conservation and management of natural resources - Wild life; In-situ (national parks, sanctuaries) and Ex-situ conservation, energy conservation, biodiversity conservation (Biospheres Reserves), biological control and integrated pest management, aquaculture, rainwater harvesting, wild life habitat conservation.
5. Environmental Administration: Role of government and non-government organizations, environmental education and awareness.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- III**  
**PAPER- III (Discipline Centric Elective Course - A)**  
**POLLUTION CONTROL AND WASTE MANAGEMENT**

Preamble: This course aims to provide the students an orientation to technologies that are applied to monitor and mitigate environmental pollution and solid waste.

1. Air Pollution management and control technology: Air pollution sampling and measurement, air pollution control methods, control of particulates and gaseous air pollutants, disaster management.
2. Water pollution management and control technology: Waste water sampling and analysis, waste water treatment, primary, secondary and advanced waste water treatment.
3. Marine pollution management and control technology: Sampling and measurement of marine pollution control of marine pollution, technologies to minimize and combat climate change, carbon credits and carbon trading, carbon sequestration, conventions of climate change
- .
4. Solid Waste Management: Municipal waste management, Hazardous waste management, recycling, characterization of hospital wastes and their management, Methane production, landfill, microbes and soil waste management, concept of 5 'R'.
5. Concept and types of bioremediation, Bio-augmentation, bioremediation of sludge, biodegradation of toxic substances by microbes, Phytoremediation of air and water pollution, Phytoextraction and Biofiltration techniques for- waste management.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- III**  
**PAPER- III (Discipline Centric Elective - B)**  
**AIR POLLUTION MANAGEMENT**

Preamble: This course aims to introduce the students about techniques of sampling and analysis of air pollutants, and management and control of air pollution.

1. Sources of air pollution, principles of air pollution management, effect of meteorological parameters on transport and diffusion of air pollutants, wind roses, and ambient concentrations of air pollutants.
2. Strategies of sampling and analysis of air pollutants; sampling of particulate matters (TSPM, PM10, and PM2.5) and gaseous pollutants, ambient air quality monitoring, stack monitoring, bio-monitoring, indices in air quality monitoring.
3. Measurement of air pollutants; dust fall measurement, measurement of particulate matters, SO<sub>2</sub>, NO<sub>x</sub>, oxidants, ozone, carbon monoxide, hydrocarbons and smoke density.
4. Air pollution control; control at source, control of particulate matters (Settling chambers, Cyclones, Settling towers, Scrubbers, Electrostatic precipitator), control of gaseous air pollutants (Absorption, Adsorption, Combustion, Collection and Recovery system), control of vehicular emission (catalytic recovery devices).
5. Air quality management; identification of specific problems, source-emission inventory, air quality criteria, air quality standards, legislation in India, environmental criteria for sitting industries and green belts.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- III**  
**PAPER- IV (Generic Elective Course)**  
**ENVIRONMENTAL LAWS AND POLICIES**

Preamble: The aim of this course is to introduce the students about various laws to protect the environment from damage and also to explain the legal consequences of such damages.

1. Environmental protection issues and problems. international and national efforts of environmental protection, environment and constitution.
2. Environmental policy resolutions and legislation, The water (Prevention and Control of Pollution) Act 1974 as amended up to 1988 and Rules 1975, The Air (Prevention and Control of Pollution) Act 1981 as amended by 1987 and rules 1982, Motor Vehicle Act 1988.
3. The Environmental Protection Act 1986 and Rules 1986, Hazardous waste management and handling rules 1989 amendments thereof 2000, Disaster Management Act 2005.
4. Hospital waste management and Handling rules 1998, Solid Waste Management Rules 1999, Public Liability Insurance Act 1991 and Rules 1991, Electronic Waste Management Rules 2016.
5. Wildlife Protection Act 1972, Amended 1991, Forest Conservation Act 1980, Indian forest Act (revised) 1982, Biodiversity Rules 2004.



**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- IV**  
**PAPER- I (Core Course)**  
**ECOTOXICOLOGY**

Preamble: The course introduces the students on natural and anthropogenic toxic chemicals, their transport and toxicity to the constituents of ecosystems, and their fate in ecosystems.

1. Principles and mechanisms of toxicity, Basic problems of toxicology, factors affecting concentration of Toxicants in environment, Toxicity test, Dose-effect and dose response.
2. General aspects of fate and effects: Media and compartments, entry pathways, environmental fate, sinks, surface water compartment, soil compartment, bioavailability, effects, uptake, types of effects; Acute and chronic.
3. Cellular response profile to chemical stress: Interaction with membrane process, Intracellular fate of chemicals, Intracellular receptors, reaction with nuclear structures and functions, protective molecules and processes, Cell injury and death.
4. Fate of pollutants in Ecosystems : Biotransformation, bioaccumulation, biomagnifications, ecotoxicology of pesticides and herbicides, toxicity of hydrocarbons, target and non-target organ toxicity, hepatotoxicity, nephrotoxicity, neurotoxicity, respirotoxicity.
5. Toxicity of heavy metals : Pb, Hg, Cd, AS, CO and Ni, carcinogens and carcinogenesis and mutagens, Immunotoxic agents.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- IV**  
**PAPER- II (Core Course)**  
**ENVIRONMENTAL BIOTECHNOLOGY**

Preamble: This course is aimed at providing comprehensive knowledge to develop potential solution for remedy of environment using microbes and molecular technologies.

1. Gene morphology and structure, concept of genetic engineering, DNA technology, application of biotechnology in environmental management.
2. Pollution control using engineered microorganisms, Role of microbes in control of air pollutants, Biomass and Biofuel, biofilters for air pollution control, Biosensors.
3. Waste water Treatment : Anaerobic and aerobic process, Methanogenesis, bioreactors, cell and protein immobilization techniques, treatment scheme for waste water, dairy, distillery, tannery, sugar and antibiotic industries.
4. Biodegradation of xenobiotics, hydrocarbons, Oil spills, pesticides, vermiculture and vermicomposting, biopesticides, biofertilizers.
5. Plant and animal tissue culture, organ culture, applications of tissue culture, in vitro conservation of germplasm, gene bank, clean gene technology.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- IV**  
**PAPER- III (Discipline Centric Elective Course - A)**  
**FOREST ECOLOGY**

Preamble: This paper introduces the students about different forest types, their distribution, structure, functions and ecological characters.

1. Forest types of India, distribution of Indian forests, factor governing distribution of Indian forests.
2. Forest as an ecosystem: Structural attributes: Dominant plant species of different forests, phytosociological attributes; density and dominance relations of different forest communities, forest stratification and canopy structure, microclimate.
3. Functional Attributes:
  - (a) Energy flow: process, importance of food chains, , productivity of different forests.
  - (b) Material cycling: Process of nutrient cycling in forests, nutrient cycling in temperate and tropical forests, litter production and decomposition.
4. Forest Ground floor ecology: Ecology of seed placement and germination in forests, seedlings growth, seedling establishment strategies, characteristics of soils of different forests.
5. Ecological characteristics of tropical and temperate forests of India, important wild life of India, man-forest interactions.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- IV**  
**PAPER- III (Discipline Centric Elective -B)**  
**WATER POLLUTION MANAGEMENT**

Preamble: This course introduces the aspects of water pollution of aquatic ecosystems, characteristics of sewage and industrial effluents, various techniques applied for treatment of sewage and effluents, and water management strategies.

1. Classification of water bodies, physico-chemical and biological properties of fresh water, water quality standards, major sources of water pollution, physico-chemical and biological properties of sewage.
2. Quality of industrial effluent produced from textile, leather, dairy, thermal power and chemical industries, changes in water quality due to discharge of city sewage, industrial effluent from textile, leather, dairy, thermal power and chemical industries.
3. Effects of water pollutants on phytoplankton's productivity and other organisms of food chains, bio-indicators of water pollution.
4. Stages of treatment of sewage - primary treatment and secondary treatment (activated sludge, oxidation ponds, and trickling filters), advanced waste water treatment, biological treatment of waste water, treatment of industrial effluent released from textile, dairy, leather, thermal power and chemical industries.
5. Water management strategies, rain water harvesting, recharging of ground water, use of domestic waste water, recycling of ground water, recycling of effluent after treatment.

**M.Sc. ENVIRONMENTAL BIOLOGY**  
**SEMESTER- IV**  
**PAPER- IV (Generic Elective Course)**  
**ENVIRONMENTAL IMPACT ASSESSMENT**

Preamble: This course aims to give insight on systematic process that examines the environmental consequences of development actions, in advance. This process is firmly on the agenda of all environmental agencies as a result of introduction of legislations in various countries.

1. Nature and purpose of Environmental Impact Assessment, Origin and Development, EIA Development in India, Frame work of EIA, EIA guidelines 1994 and 2006
2. Requirement for Impact Assessment, main steps of Impact Assessment, the pre study, the study period and the post study period activities.
3. Methods of Environmental Impact Assessment (I) Adhoc method, Check lists, Matrix methods, Networks , (II) Evaluation systems, modelling and computer aided assessment
4. Prediction and Assessment of Impacts on air and water environment, energy, noise, socioeconomic and biological components
5. Concept of Environmental Auditing (EA), Environmental Impact Statement (AIS) and Environmental management plan (EMO), Cost - Benefit analysis, case studies with particular reference to mining project, cement industry, and thermal power plant.

