M.Sc. ENVIRONMENTAL SCIENCE
SYLLABUS BASED ON THE SEMESTER SYSTEM

ELIGIBILITY REQUIREMENTS (QUALIFYING EXAMINATION)

Candidates who have passed B.Sc. (Hons.)/B.Sc. (10+2+3) or M.B.B.S. or BE/B.Tech. with a minimum of 50% marks (equivalent GPA with a minimum 50% aggregate at 10 & 10+2 levels) shall be considered for admission to M.Sc. Course in Environmental Science.

General Guidelines

- There shall be four semesters of 90 credits and each semester will have 22.5 credits.
- There shall be 10 core courses (3 credits for theory and 1.5 credits for practical) with total 45 credits.
- There shall be 2 major elective courses (3 credits for theory and 1.5 credits for practical) with total 9 credits, and 2 minor elective courses (3 credits theory only) with total 6 credits.
- One day every week shall be kept free for seminar/library during each semester.

Guidelines for elective courses

- Four major elective papers will be offered out of which students will be asked to choose 2.

Guidelines for minor elective courses

- Four minor elective courses, only theory of three hour duration each, will be offered out of which students will be asked to choose 2.

DISTRIBUTION OF DIFFERENT COURSES AND CREDITS IN VARIOUS SEMESTERS

**SEMESTER 1**

<table>
<thead>
<tr>
<th>Paper Core Courses</th>
<th>Name</th>
<th>Credit</th>
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<tbody>
<tr>
<td>C-1</td>
<td>Foundation Course on Ecology and Environment</td>
<td>4.5</td>
</tr>
<tr>
<td>C-2</td>
<td>Environmental Biogeochemistry</td>
<td>4.5</td>
</tr>
<tr>
<td>C-3</td>
<td>Energy Resources and Conservation</td>
<td>4.5</td>
</tr>
<tr>
<td>C-4</td>
<td>Environmental Pollution</td>
<td>4.5</td>
</tr>
<tr>
<td>C-5</td>
<td>Environmental Management</td>
<td>4.5</td>
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<tr>
<td></td>
<td><strong>Total Credit</strong></td>
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**SEMESTER 2**

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<thead>
<tr>
<th>Paper</th>
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<th>Credit</th>
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<tbody>
<tr>
<td>C-6</td>
<td>Major Elective -two</td>
<td></td>
</tr>
<tr>
<td></td>
<td>i. Water Pollution Management</td>
<td>4.5</td>
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<tr>
<td></td>
<td>ii. Air Pollution Management</td>
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<td></td>
<td>iii. Ecological Impact Assessment</td>
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<td></td>
<td>iv. Environmental Hazards and Risk Management</td>
<td>4.5</td>
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<tr>
<td>C-7</td>
<td>Minor Elective-one</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(i) Restoration Ecology</td>
<td>3.0</td>
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<tr>
<td></td>
<td>(ii) Environmental Economics</td>
<td></td>
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<td>C-8</td>
<td>Industrial Training</td>
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<td></td>
<td>Industrial training report</td>
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<td></td>
<td>Seminar based on industrial training</td>
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</tr>
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SEMESTER 3

<table>
<thead>
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<th>Paper</th>
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<tbody>
<tr>
<td>C-9</td>
<td>Biodiversity Conservation</td>
<td>4.5</td>
<td></td>
</tr>
<tr>
<td>C-10</td>
<td>Environmental Legislation</td>
<td>4.5</td>
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<tr>
<td>C-11</td>
<td>Social issues and the Environment</td>
<td>4.5</td>
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<tr>
<td>C-12</td>
<td>Environmental Microbiology and Biotechnology</td>
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<tr>
<td>C-13</td>
<td>Environmental Health Management</td>
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SEMESTER 4

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<tbody>
<tr>
<td>C-14</td>
<td>Minor Elective- one</td>
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</tr>
<tr>
<td></td>
<td>(i) Biostatistics and Computer application</td>
<td>3.0</td>
</tr>
<tr>
<td></td>
<td>(ii) Human population and Environment</td>
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<tr>
<td>C-15</td>
<td>Project work</td>
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<tr>
<td></td>
<td>Dissertation based on project work</td>
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<tr>
<td></td>
<td>Seminar based on project work</td>
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<tr>
<td></td>
<td>Environmental Diary</td>
<td>2.0</td>
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<td></td>
<td>Field survey report</td>
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<td></td>
<td>Total Credit</td>
<td>22.5</td>
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SEMESTER 1

CORE COURSES

C-1: Foundation Course on Ecology & Environment
Organizational level of ecological systems, Abiotic and biotic environment, limiting factors, adaptation, habitat and niche, holocoenotic nature of environment, concept of biosphere, population parameters, structure, growth regulation, interactions between populations, life history strategies (r and k species), the concept of carrying capacity.

Synecological principles, species area relations, methods of sampling and describing plant community, analytic and synthetic characters, community coefficients, association analysis, cluster analysis, gradient analysis, vegetation mapping, ecological succession, succession models, concept of climax.

Structure and function of ecosystems, productivity, decomposition, energy flow, ecological efficiencies, global pattern of productivity, nutrient cycling (Carbon, Nitrogen and Phosphorus), major biomes of India and the world.

C-2: Environmental Biogeochemistry
Structure and composition of the atmosphere, radiation budgets, general circulation of the atmosphere, prevailing and adiabatic lapse rates, air masses and fronts, monsoon, vertical profiles of major and trace gases, atmospheric photochemistry, reaction of nitrogen, oxygen, ozone, chlorides etc., properties of dust and aerosols in the atmosphere.
Geomorphology and natural hazards, major ore and rock forming minerals, physico chemical properties of rocks and minerals, chemistry of ground water, environmental management of ground water, water storage, global distribution of water, global precipitation, evaporation, hydrological cycle, effect of geological, ground water regime and climatic changes on hydrological cycle.

**C-3: Energy Resources and Conservation**

Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, composition.

Physico-chemical characteristics and energy content of coal, petroleum and natural gas.

Principle of generation and conservation of conventional and non-conventional energy.

Energy from biomass and biogas, anaerobic digestion, energy use pattern and future need projection in different parts of the world, energy conservation policies.

**C-4: Environmental Pollution**

Types and major sources of air pollutants, effects of air pollutants on physico-chemical and biological properties surrounding atmosphere, air born diseases and their effects on health.

Types and major sources of water pollutants, effects of water pollutants on physico-chemical and biological properties of water bodies, water born diseases with special reference to water pollution.

Types and major sources of soil pollutants, effects of soil pollutants on physico-chemical and biological properties of soil.

Air, drinking water and waste water quality standard.

Major sources of noise pollution, effects of noise pollution on health, noise level standard in industrial, commercial, residential and silence zones.

Radioactive and thermal pollution sources and their effects on surrounding environment.

Solid waste disposal and its effects on surrounding environment.

**C-5: Environmental Management**

Introduction and scope of environmental management, basic concepts of sustainable development, industrial ecology and recycling industry.

Role of natural products and bio-diversity in international trade, fundamentals of fossil fuels use, energy production and trade, energy balance and energy audit. Eco-marketing.

Environmental Impact Assessment (EIA), general guidelines for the preparation of environmental impact statement (EIS), scope and types of environmental audit, cost benefit analysis, environmental management plan (EMP), international organization for standardization (ISO), ISO 14000 standards and certification, environmental clearance for establishing industry, environmental safety, risk management and emergency preparedness, international summit and treaties, important dates dedicated to environmental management.

( 15 )
SEMESTER 2

MAJOR ELECTIVES

C-6: (i) Water Pollution Management

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; quality of industrial effluents produced from textile, dairy, leather, thermal power and chemical industries, changes in water quality due to discharge of city sewage, changes in water quality due to discharge of industrial effluents from textile, dairy, leather, thermal power and chemical industries, effects of water pollutants on phytoplankton productivity; bio-indicators of water pollution.

Various stages of treatment of sewage with special reference to secondary treatments, (activated sludge, oxidation ponds, trickling filter), advanced waste water treatments, biological treatment of waste waters, treatment of industrial effluents released from textile, dairy, leather, thermal power and chemical industries; ozonization of secondary treated waste water; chemical and other methods for disinfection.


C-6: (ii) Air Pollution Management

Basic principles of air pollution management, ambient concentrations of air pollutants and trace gases, national environmental policies, implementation of policies and organization of management agencies, national air monitoring programme, effects of air pollution on human health, air quality criteria and case study, emergency preparedness, safety planning and management, vehicular pollution, monitoring and abatement technologies.

Air pollution control equipments, objectives and types of control equipments, efficiency of separating devices, control of particulate emission settlers, cyclones, filters, scrubbers and esps; control of sulphur dioxide from lean and rich waste gases (recovery of sulphur and sulphuric acid); control of NOx through absorption and other newer methods; control of vehicular emission (catalytic conversion devices); Indoor air pollution and its control; Hazardous air pollutants and their management.

Biological abatement of air pollution, scope of green belt development, economical aspect of air pollution abatement technologies.

C-6: (iii) Ecological Impact Assessment

Principles and practices of ecological assessment, carrying capacity of environment and earth, environmental quality, ecological and social impact of man, resource depletion, loss of biological diversity, land degradation and deforestation, impact assessment methods through case studies at organism, community and ecosystem levels, detailed criteria, survey methods and evaluation, cost benefit analysis, prediction of impacts on physical environment and biotic communities through modeling, developing impact statement.

Bio-monitoring, active and passive monitoring, concept of bioaccumulation, bio-indicator parameters, bio-air conditioning and bio-purifiers, pollution tolerance index of plants, green belt development, plant
protection and protective substances to pollution stress, data-gathering techniques, organization of the survey and data analysis.

**C-6: (iv) Environmental Hazards and Risk Management**

Natural disasters; nature, causes and effects; cyclone, tornadoes, floods, earthquakes, avalanche, landslides, drought, diseases, fire, volcanism, case study of disasters, for casting and warning systems of disasters, measurements of responses of disasters, community reaction to disaster, coping mechanism, classes of victims, disaster management, predisaster phase, actual disaster phase, postdisaster phase, disaster assistance: technological assistance, relief camps, organization, camp layout, food requirement, water needs, sanitation, security, information administration, fire fighting camping and tent pitching, rope, knots and their use, rescue, emergency rescue, disaster education, alternatives and new directions: conceptualizing disaster recovery, mitigation and preparedness, programme planning and management.

Occupational risk analysis survey and health evaluation, behavioural studies, occupational injury, disease reporting, investigation: monitoring and control of environmental hazards, occupationally induced illness, non-occupational illness, discomfort at work, the epidemiological approach, occupational health practice: investigation, monitoring, control, characteristics and hazards of radioactive materials, dispersion of radioactive materials, risk assessment techniques for accidental release of toxic and inflammable materials, hazard analysis, potential risk, conceivable release mechanisms and release rates, fire and explosion hazards and simplified models for their assessment, examples of occupational health hazards: nasal cancer, asbestosis, bronchitis, heart disease: occupational health services.

**MINOR ELECTIVE**

**C-7: (i) Restoration Ecology**

Ecology of Disturbed Ecosystems: disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems.

Aims and strategies of restoration: Concepts of restoration, single vs. multiple end-points; ecosystem reconstructions; physical, chemical, biological and biotechnological tools of restoration.

Restoration of biological diversity: Acceleration of ecological succession, reintroduction of biota.

Degradation and restoration of natural ecosystems: Forests, grassland, Savanna, aquatic.

Restoration of degraded soils: Restoration of contaminated soils and soil fertility, mine spoil restoration.

**C-7: (ii) Environmental Economics**

World environmental history and economic development, valuation of natural resources, sustainable agriculture and development, cost benefit analysis, current moral and philosophical problems of traditional and technological societies, investment projects and natural resources.

Integrated economic modeling at scales from local to regional to global, alternative principles for valuing natural wealth.

Integrating natural resources and environmental services into national income and wealth accounts, methods of implementing efficient environmental policies, case studies of economic and ecological
conflict, economic and ecological consequences of genetically engineered organism and gene pool inventory and management, environmental indicators and their use in resource management, intellectual property rights.

C-8: Industrial Training
Industrial Training Report
Seminar based on Industrial Training

SEMESTER 3

CORE COURSES

C-9: Biodiversity Conservation
Introduction to biodiversity concepts, significance, magnitude and distribution.
Biodiversity trends, diversity gradients and related hypotheses methods for monitoring biodiversity trends.
Threats to biodiversity, major causes, extinction’s, vulnerability of species to extinction, IUCN threat categories, Red data book.
Strategies for biodiversity conservation, principles of biodiversity conservation in-situ and ex-situ conservation strategies, theory of reserve design.
Restoration of biodiversity, acceleration of ecological succession, reintroduction of biota.
Megadiversity zones and Hot spots, concepts, distribution and importance.
Uses of biodiversity, source of food, medicine, raw material, aesthetic, cultural and ecosystem services, strategies for sustainable exploitation of biodiversity.

C-10: Environmental Legislation
Definition of environment and pollutants, central and state boards for the prevention and control of environmental pollution, powers and functions of pollution control boards, penalties and procedure, duties and responsibilities of citizens for environmental protection.
Issues involved in enforcement of environmental legislation, public awareness, public interest litigations (PILs) and its role in control of environmental pollution in India.

C-11: Social Issues and the Environment
Basic concepts of sustainable development, social environmental issues and urban problems related to energy.
Water conservation, rain water harvesting and watershed management.
Resettlement, rehabilitation of people, its problems and concerns.

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, wasteland reclamation, consumerism and waste products, public awareness, population growth and family welfare programme, human rights, women and child welfare.

Role of information technology in environmental conservation, current environmental issues in India and environmental ethics.

C-12: Environmental Microbiology and Biotechnology

Classification, characteristics, occurrence, distribution and ecological importance of microorganism. Photoautrophs, chemolithotrophs, organotrophs, parasites and their environmental importance. Soil microorganisms and their interactions relative to soil fertility. Detection of microbial toxins. Brief account of important viral, bacterial and fungal diseases of plants and their ecosystem level effects.


C-13: Environmental Health Management

Environmental health criteria, Scope of International Programme on Chemical Safety (IPCS). Effects of mercury, lead, chromium, cadmium, arsenic and nitrate on human health. Water borne diseases; Prevention and protection of community health from water borne diseases. Air borne bio-allergents; present in the ambient air, seasonal changes, mode of dispersal, disease intensity and control.

Effects of Physical Environment on Accidents, Crime, Suicide and Diseases of Man: Effects of temperature, humidity, ionization, ultra violet radiation and acidity of air on skin, lungs, throat, nose, eye, nervous system. Effects of weather and climate on diseases, mental processes, working efficiency, traffic and industrial accidents, behaviour, suicide and suicide attempts, effect of thermal stress and altitude on the action of drug.

SEMESTER 4

MINOR ELECTIVE

C-14: (i) Biostatistics and Computer application

Introduction to sampling methodology, measures of central tendency and graphical representation of data, contingency tables and chi-square test, difference between sample means: t-test, range tests, correlation measurements and regression analysis, simple experimental design and analysis of variance, introduction to multivariate methods for biology.

Basic concepts of computer, hardware, operating systems: Windows, Unix and Linux, use of common application software in biology: word processing, spreadsheets, graphics and data base, introduction to web browsing software and search engines with special reference to online environmental resources.
C-14: (ii) Human Population and Environment

Problem of increasing population, population status in India and the world, population explosion, family welfare programme, environment and human health, human rights, value education, women and child welfare, role of environmental education in the management of environment.

Role of information technology in the management of human health, role of natural resources in the human development, role of human society in the conservation of forest, river, ponds and other natural resources, role of plants to control the human population from disease, case studies.

C-15: Project Work

Dissertation based on project work
Seminar based on project work
Environmental Diary
Field survey report