

# ENVIRONMENTAL SCIENCE (877)

## Aims:

1. To help the student appreciate man's place in the natural systems.
2. To provide a wide understanding of knowledge resources relevant to environment protection and conservation.
3. To provide an in-depth study of certain environment related areas.
4. To place environmental concerns in a technological, social, political and economic context.
5. To provide a context for understanding the role of individual values in conservation.
6. To provide a context for the individual student to reflect on his/her beliefs and values in relation to the environment.
7. To provide an opportunity to acquire interdisciplinary skills, knowledge and understanding and to apply this logically and coherently in the field of environmental conservation.
8. To encourage student initiative and resourcefulness in action leading to environmental protection and conservation.
9. To present environmental concerns in a challenging way and thereby encourage students to consider careers in the environmental field.

## CLASS XI

There will be **two** papers in the subject:

**Paper I:** Theory - 3 hours ... 70 marks

**Paper II:** Practical/ Project Work - ... 30 marks

### PAPER I - THEORY

There will be one written paper of three hours duration carrying 70 marks divided into two parts.

**Part 1 (20 marks)** will consist of **compulsory** short answer questions from the entire syllabus.

**Part 2 (50 marks)** will be divided into three sections. Each section will consist of **three** questions. Candidates will be expected to answer **five** questions choosing at least **one** from each section.

### SECTION A

#### 1. Modes of Existence

- (i) Modes of existence and resource use: hunting - gathering; pastoral; agricultural; industrial.

*Modes of existence and resource use: hunting - gathering; pastoral; agricultural; industrial.  
Two features defining each mode of existence.*

- (ii) Their impact on natural resource base: energy resources; material resources; scale of catchment; quantity of resources used.

*Impact of each mode on the available natural resources.*

- (iii) Their ecological impact: land transformation; habitat; diversity; modification of biogeochemical cycles; modification of climate; substantial use.

*The scale of catchment; quantity of resources used, land transformation; impact on habitat, biodiversity, modification of biogeochemical cycles, modification of climate, substantial use to be taught only to create a better understanding and **not for testing***

- (iv) Their social organisation: size of group; kinship; division of labour; access to resources.

*Self-explanatory.*

- (v) Their ideology and idiom of man-nature relationship.

*Self-explanatory.*

- (vi) An appreciation of the coexistence of all four modes of existence in contemporary India.

*Self-explanatory.*

- (vii) Ecological conflicts arising therein.

*Self-explanatory.*

## 2. Ecology

- (i) Concept of an ecosystem: definition; relationships between living organism, e.g. competition, predation, pollination, dispersal, food chains, webs; the environment - physical (soil, topography, climate); biotic - types of relationships (competition, mutualism, parasitism, predation, defence); soil types and vegetation; co-evolution and introduction of species.

*Definition of ecology and ecosystem. Structure of an ecosystem: biotic and abiotic components.*

*Trophic relationships: food chains and food webs. Biomagnification and bioaccumulation of toxic wastes.*

*Relationships between living organisms: competition, predation, mutualism, parasitism, commensalism. Examples of each type.*

*Coevolution - Definition and types with examples.*

- (ii) Habitats and niches: Gause's competitive exclusion principle; resource partitioning.

*Definition and a basic understanding of the above.*

- (iii) Flow of energy: efficiencies - photosynthetic - trophic - assimilation - production; trophic levels; generalised model of the ecosystem; ecological pyramid (numbers and biomass); food webs.

*An understanding that a small fraction of the sun's energy is captured by the primary producers and thereafter, at every trophic level, assimilation efficiency reduces. Pyramid of flow of energy.*

- (iv) Nutrient cycles: generalised model; a study of carbon, nitrogen cycles (biological and geological); man's intervention; pollution as disruption of these cycles; ecosystem as a source of material and sink waste for human

societies; ecological succession - causes (autogenic and allogenic) - patterns of successions.

*An understanding of hydrological, carbon, nitrogen and phosphorous cycles showing the linkages between the biotic and abiotic elements (An understanding that different species thrive under different conditions – a basic understanding of the Law of Tolerance).*

*Definition of Ecological succession. Classification as primary and secondary. Causes (autogenic and allogenic). Understanding of the stages of succession.*

- (v) Biomes: terrestrial; fresh water; marine; a survey of the biomes of India and their inhabitants.

*Examples of Biomes - Tropical rain forests, deserts, grasslands, coral reefs, lakes. Any five biomes to be explained with reference to climate, topography, flora, fauna and their adaptations.*

## 3. Pollution

- (i) Disruption of nutrient cycles and habitats: atmospheric pollution; human activities that change the composition of the atmosphere; connection between pollution and development; local and global effects (greenhouse effect, ozone depletion) and their impact on human life; burning of fossil fuel products - effect on ecosystem and human health.

- *Air pollution: definition and causes.*
- *Human activities that disrupt hydrological, carbon, phosphorus and nitrogen cycles. The effects of these disruptions. An understanding of how developmental activities lead to air pollution. A few examples at local and global level.*
- *An understanding of greenhouse effect. Human sources of greenhouse gases. Explanation of the local and global effects of:*
  - *burning fossil fuel products (any two)*
  - *global warming with particular reference to the ecosystem, human health, sea level, biodiversity and forests.*

(ii) Pollution control approaches - prevention and control: as applied to fossil fuel burning; the role of PCBs; industrial pollution control - principles - devices - costs - policy incentives; combating global warming; the international political dimensions; third world interest; impact on economic growth.

- *Need for pollution control. Pollution prevention and control measures – Role of Pollution Control Boards; one example of a PCB in a metropolitan city.*
- *Approach: correction at source (prevention), pollution cleanup – study of any two common devices. [As applied to fossil fuel burning]*
- *Industrial pollution: removal of particulate pollutants (cyclone collector, electrostatic precipitator) – removal of gaseous pollutants by wet dry system.*
- *Indoor pollution: Common pollutants, sources and effect.*
- *Subsidies and incentives for green automobiles, green architecture, green energy and green technology in the Indian context.*
- *Problems related to combating global warming – lack of international cooperation, long term issue, effect not uniform, impact on lifestyle and economy as a reason for resistance.*
- *International political dimensions – developing countries not prepared to take steps at the cost of development, demand for cheap green technology to reduce emissions.*

(iii) Water pollution: water cycle; pollution of surface water, ground water, ocean water; industrial pollution and its effects; domestic sewage and its treatment - techniques and appropriate technology; marine ecosystem protection and coastal zone management; soil pollution - sources - effects.

- *Definition of water pollution.*
- *Understanding water cycle.*

- *Causes of pollution of surface, ground and ocean water and their effects. Point and non-point sources of water pollution.*
- *Difficulty in dealing with ground water pollution.*
- *Industrial pollution – heat and radioactive substances and their effects – early hatching of fish eggs, failure to spawn, decrease in species diversity, migration of aquatic forms.*
- *Domestic sewage treatment – primary and secondary treatment and treatment by working with nature.*
- *Protective measures taken for conserving marine ecosystems and coastal zone management.- establishment of protective marine sanctuaries, integrated coastal management, regulated coastal development, ban on dumping waste and sewage in coastal water, ban on dumping sludge in oceans, protection of sensitive areas from oil drilling, double hull for oil tankers.*
- *Soil pollution – sources, effects and mitigation.*

## **SECTION B**

### **4. Legal Regimes for Sustainable Development**

(i) National legislative frameworks for environment protection and conservation; survey of constitutional provisions (including directive principles); national laws; state laws in India.

- *Constitutional provisions- the Article 48A and 51 A of Directive Principles of State Policy. 73<sup>rd</sup> and 74<sup>th</sup> constitutional amendment act (Main objectives of the above).*

▪ *Legislative framework:*

#### *1. Environmental Protection Act 1986.*

*The Bhopal Gas Tragedy and how it influenced Environmental Legislation in India – The passing of an Umbrella Environmental Legislation - The Environmental Protection Act 1986;*

2. *Forest (Conservation) Act 1981;*
3. *Wildlife Protection Act 1972;*
4. *Biological Diversity Act 2002;*
5. *Water (Prevention and Control of Pollution) Act 1974;*
6. *Air (Prevention and Control of Pollution) Act 1981.*

**Two main objectives of each of the above Acts to be studied.**

- (ii) International legal regimes: on trade and environment (GATT, WTO, IPR, TNC's, regional arrangements and preferential trade arrangements); on climate; on common resources (forests, bio-diversities, oceans and space); international institutions (UNEP, UNCTAD, WHO, UNDP, etc.); international initiatives (Earth Summit, Agenda 21).

*GATT: historical perspective (origin and objectives and transformation into WTO); WTO: Principles and functions (Case study of disputes, examples); IPR : Types: (a) Patents (Products vs Process), (b) Trademark, copyright, geographical indicators and industrial designs; Transnational Corporations (TNC) – definition, impact of TNC on the environment, use of resources, waste disposal, manmade ecological disaster. Case study of EXXON and BP oil spills*

*International institutions (UNEP, UNCTAD, WHO, UNDP, etc.); international initiatives (Earth Summit, Agenda 21) – a brief understanding of their role in environmental protection.*

## 5. Technology and Environment

- (i) Technological evolution and models: hi-tech; low-tech; intermediate; appropriate; traditional; interaction between technology, resources, environment and development; energy as a binding factor; the need for reorienting technology.
- *Definition of technology, a brief overview of the evolution of technology and its impact on human societies.*
  - *Definitions of hi-tech, low-tech. and intermediate technology – their impacts on natural resources.*

- *Understanding the difference between appropriate and traditional technology.*
- *Industrial revolution - genesis of ongoing technological revolution leading to development and degradation of environment. Dependence on energy for all development.*
- *How technology can be used to generate a more equitable use of resources and build environmental sustainability.*

- (ii) Renewable energy: limitations of conventional sources; sources of renewable energy and their features (solar, wind, biomass, micro-hydel and muscle power).

*Limitations of conventional sources of energy such as - coal, natural gas and oil (extraction, transportation, storage, pollution and degradation of environment).*

*Renewable Energy: What is renewable energy; sources of renewable energy, their features and uses: biomass, solar energy, wind energy, hydel energy, geothermal energy – advantages and disadvantages of renewable energy sources.*

- (iii) Health: incidents of disease as an indicator of the health of the environment; prevention of diseases by better nutrition, sanitation, access to clean water, etc.; communicable and non-communicable diseases; techniques of low cost sanitation; policy and organisation to provide access to basic health service for all; the role of traditional and local systems of medicine.

- *Diseases as indicators of health of the Environment: Malaria – standing water, felling of trees. Enteric diseases – contaminated water. Respiratory diseases – air pollution.*
- *How diseases can be prevented by better nutrition, sanitation and access to clean water.*
- *Role of sanitation, water supply, good nutrition in maintenance of health and prevention of diseases: Prevention of deficiency diseases and water borne diseases.*

- *Definition of communicable and non-communicable diseases.*
- *Communicable diseases: HIV/AIDS, Tuberculosis, Malaria, Hepatitis as examples. Causative agents, transmission and prevention of each of the above.*
- *Non communicable diseases: Cardiovascular disease, diabetes, skin cancer, scurvy and rickets (mal nutrition), and Chronic Obstructive Pulmonary Diseases (COPD)- causes related to environment and lifestyle.*
- *Some techniques of low cost sanitation, eg. Decomposition system (pit latrine and ventilated improved pit latrines) and Dry sanitation method.*
- *Organization of health services in India. Facilities provided by the government for basic health services in India (to be covered briefly).*
- *A brief introduction to traditional systems of medicine, e.g.: ayurveda, unani and local health traditions. Their role in maintaining health of the community.*

(iv) Biotechnology: potential; limitations.

- *Explanation of the term “Biotechnology”.*
- *Use/potential of Biotechnology in the field of medicine, industry, manufacturing and agriculture.*
- *Any **five** limitations of biotechnology application.*
- *Bioremediation.*

## SECTION C

### 6. Design and Planning for Environmental Conservation and Protection

- (i) Ecosystem analysis: understanding complex systems; critical and state variables as system indicators; indicators of inter-relationships; successions and systems resilience; predicting and assessing system responses to impacts and their interventions; rapid appraisal methods.

- *Understanding of the term Ecosystem analysis.*
- *Composition of the ecosystem – multiple biotic and abiotic factors that influence each other. Understanding of limiting factors and zone of tolerance. Various factors which are considered as critical variables.*
- *Definition and components of state variables.*
- *Succession: primary and secondary – system resilience.*
- *What are indicator species – examples, trouts as indicators of water quality, butterflies as indicators of habitat loss and fragmentation.*

- (ii) Human environment interactions: quantity of life vs. quality of environment; environmental issues and problems; role of belief and values; analysing brief statements for underlying values; issues analysis - separating symptoms from problems; problem identification; identifying the players and their positions; understanding interacting problems and identifying critical control points; problems analysis; identifying variables (human behaviours, values, ecological, etc.); determining the relationships between variables; formulating questions for research; planning research; generating problems, solution, briefs and specifications.

- *Understanding the state of the environment and the major environmental problems of the 21st century.*
- *The role of belief and values in creating maintaining and solving environmental problems.*

*A case study to be done by the students based on the following points:*

- *Identification of an environmental issue in their city/ town/ village.*
- *Identification of the factors/ people responsible for this issue.*
- *Contribution of the local authority / government to curb this problem.*

- *Identification to the critical points that have led to the problem.*
- *Urban and rural variations.*
- *Steps to be followed in doing an 'Action Research' on any environmental problem.*

(iii) Evaluation and assessment of impacts: approaches and techniques of environment and social impact assessment; environment impact assessment as a planning tool and a decision making instrument; interpreting environment impact assessments.

- *Definition and objectives of 'Environment Impact Assessment' (EIA).*
- *EIA framework –*
  - *Necessity- screening*
  - *Key issues- scoping and focusing*
  - *What to study – assessment*
  - *Impact/ identification/evaluation of significance – evaluation*
  - *Identification of mitigating means – mitigation*
  - *Report preparation – documentation*
  - *Reviewing - monitoring*
- *Designing an EIA for the following:*
  - *Proposed construction of a dam (Social impact, Ecological impact).*

- *Proposed resort by the sea (Ecological impact).*
- *Proposed residential complex close to a forested area / national park in India (Ecological impact).*

*[Interpret the EIA as a good planning and decision making tool].*

(iv) Design of solutions: generating solution options; overcoming blocks in thinking; generative and lateral thinking; using criteria (social, political, ecological, technological, economic) to rank and prioritise solution ideas; check solutions for economic, social and technical viability; collation of solution into coherent plans; planning sequence and cost.

*Self-explanatory.*

*To be taught through case studies only. Students should be encouraged to think creatively and develop solutions for environmental problems. (For better understanding, not for testing).*

## **PAPER II - PRACTICAL/PROJECT WORK**

Guidelines for Practical/Project Work are given at the end of this syllabus.