

# 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 permit 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 the 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 a written paper of 3 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. Students 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.
- (ii) Their impact on natural resource base: energy resources; material resources; scale of catchment; quantity of resources used.
- (iii) Their social organisation: size of group; kinship; division of labour; access to resources.

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

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

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

(vii) Ecological conflicts arising therein.

#### 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.
- (ii) Habitats and niches: Gause's competitive exclusion principle; resource partitioning.
- (iii) Flow of energy: efficiencies - photosynthetic - trophic - assimilation - production; trophic levels; generalised model of the ecosystem;

ecological pyramid (numbers and biomass); food webs.

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

### 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.
- (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.
- (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.

## 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.

- (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).

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

## 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.
- (ii) Human environment interactions: quality 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.

(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.

(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.

## PAPER II - PRACTICAL/PROJECT WORK

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

## CLASS XII

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 of 70 marks divided into two parts.*

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

**Part 2 (50 marks)** will consist of three sections. Each section will have **three** questions. The candidate will be expected to answer **five** questions in all choosing at least one from each section.

**Project work** will carry 30 marks. The project needs to be done under the supervision of the teacher. The project work will be evaluated by a Visiting Examiner (who has expertise in that specific area), appointed locally and approved by the Council.

### SECTION A

#### 1. Human Beings and Nature

- (i) Modern schools of ecological thought.
- (ii) Deep ecology (Gary Snyder, Earth First) vs. shallow ecology.
- (iii) Stewardship of land (e.g. Wendell Berry).

(iv) Social ecology [Marxist environmentalism and socialist ecology (Barry Commoner)].

(v) Feminism.

(vi) Green politics (e.g. Germany and England).

(vii) Sustainable development.

#### 2. Population and Conservation of Ecology

(i) Population dynamics: factors causing population change (birth, death, immigration and emigration); relation between the factors; age structure and its significance; population pyramids; survivorship curves; three general shapes r and K strategies.

(ii) Human populations (Malthusian model and demographic transition).

(iii) Population regulation: growth without regulation (exponential); simple population regulation (logistic growth curve); factors regulating population size (space, food and water, territories, predators, weather and climate, parasite and diseases, disasters and self-regulation).

(iv) Human population control: family planning; education; economic growth; status of women.

(v) Threats to the ecosystem: habitat destruction; genetic erosion; loss of diversity; expanding agriculture; impound water; waste from

human societies; increasing human consumption.

- (vi) Conservation: importance; the critical state of Indian forests; conflicts surrounding forested areas - populations and tribals and their rights - tourism - poaching - roads - development projects - dams; scientific forestry and its limitations; social forestry; the role of the forest department; NGOs; joint forestry management; wild life - sanctuaries, conservation and management in India; Project Tiger as a case study in conservation.

### **3. Monitoring Pollution**

- (i) Pollution monitoring.
- (ii) Monitoring the atmosphere: techniques.
- (iii) International and national air quality standards.
- (iv) Water testing: indicators of water quality (including B.O.D. and C.O.D.); standards of water quality; laboratory work - determination of pH, B.O.D., C.O.D. and dissolved pollutants.
- (v) Soil testing: indicators of soil type and quality and laboratory work.

## **SECTION B**

### **4. Third World Development**

- (i) Urban-rural divide: urbanisation - push and pull factors; consequences on rural and urban sectors; future trends and projections.
- (ii) A critical appraisal of conventional paradigm of development from the viewpoints of sustainability, environmental impact and equity.
- (iii) A case study of Gandhian approach in terms of its aims and processes.
- (iv) Urban environmental planning and management: problems of sanitation; water management; transport; energy; air quality; housing; constraints (economic, political) in tackling the problems; inapplicability of solutions that have worked in the First World

and the need for indigenous approach to urban environment.

### **5. Sustainable Agriculture**

- (i) Traditional agriculture in India: irrigation systems; crop varieties; techniques for maintaining soil fertility; impact of colonialism; Indian agriculture at independence - food scarcity - food import - need for increasing production - the need for land reform; green revolution - HYVs - fertilizers - pesticides - large irrigation projects (dams); critical appraisal of the green revolution from the view points of agro-bio diversity; soil health; ecological impact of pesticides; energy (petroleum and petrochemicals); ability to reach the poorer sections of the rural communities; sustainability - need for sustainable agriculture - characteristics for sustainable agriculture; techniques of water soil and pest management.
- (ii) Food: the twin problems of production and access; food situation in the world; integrated and sustainable approach to food security for the Third World.

## **SECTION C**

### **6. Environmental and Natural Resource Economics**

- (i) Definition: resources; scarcity and growth; natural resource accounting.
- (ii) GNP vs. other forms of measuring income.
- (iii) Economic status and welfare (net economic welfare, nature capital, ecological capital, etc.)
- (iv) Externalities: cost benefit analysis (social, ecological).
- (v) Natural capital regeneration.

### **7. International Relations and the Environment**

- (i) Trans-national characteristics of environmental issues using case study of Amazonia, trade in wild life and ozone depletion.

- (ii) Impact of international politics, national sovereignty and interest.
- (iii) International trade: a theoretical perspective; free trade vs. protectionism; import barriers; domestic industry vs. free trade; trans-national companies - a historical perspective (colonialism and its lasting impact today); trade between the first and the third world - characteristics - terms of trade; India's international trade - characteristics - major imports and exports - foreign exchange crises - the export imperative and its impact on the environment; the case study of aquaculture in India; diversion of scarce resource from production of subsistence needs to commercial products; toxic waste trade - extent and impact; Globalisation - trade regimes (WTO, GATT, IPR, etc.) and their impact on third world.
- (iv) International aid: agencies; advantages; limitations; need for re-orienting aid; aid vs. self-reliance.

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

### **(Classes XI and XII)**

The practical/project work carrying 30 marks needs to be undertaken under the guidance of the teacher. The project will be evaluated by a Visiting Examiner (who has specific expertise in the content of the project work) appointed locally and approved by the Council.

The project work could take one of the five forms:

1. Address a current environmental problem (preferably at local or regional scale) and should include problem identification and analysis, use of secondary data as well as some collection of primary data, design of solution, documentation of the entire process in the form of a solution proposal.
2. Design and conduct an environment impact assessment. The candidates may use secondary data, demonstrate their capacity to collect and analyse primary data by incorporating some primary data collected and use it in a few sectors of their work.
3. Systematic monitoring of an aspect of the local environment over a period of at least six months. The candidate must use quantitative techniques of monitoring, sampling scientifically. The data collected must be interpreted and presented in the report.
4. Field work and training in an environmental organisation (NGOs, Industrial Pollution Control Firms, Testing Laboratories, etc.) for a period of not less than one month. This work should be focused on one area in the syllabus. The candidate will produce a paper on the area of his/her work and training which will include his/her experience and the special expertise that she/he has acquired.
5. Conduct a study on the density and population of plants growing in a particular area using the quadrat method.

**NOTE: No question paper for Practical work will be set by the Council.**