

ENVIRONMENTAL SCIENCE

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 carrying 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.

Modern schools of ecological thought; definition and basic understanding of Deep Ecology as opposed to Shallow Ecology; Stewardship, Social Ecology - Marxist environmentalism and Socialist Ecology, Eco feminism, Green political movements of Germany and England and Sustainable Development (basic concepts).

A brief look at the above in terms of definition, origin, basic principles and environmental orientations.

Special reference to principles of Deep Ecology (Gary Snyder) and Laws of Ecology (Barry Commoner)

Gary Snyder, Barry Commoner, Wendell Berry - a short biographical sketch particularly with reference to their work on the environment.

Earth First – a brief understanding of the organization's ethos and work.

World Wide Fund for Nature – organisation, mission, strategy for conservation.

Greenpeace – organisation, mission statement, core values, objectives and strategy.

2. Population and Conservation 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.

Factors causing population change (birth, death, immigration and emigration); relation between the factors; Age structure and its significance; Population Pyramids – interpretation and implications. Rate of change of population – the three general shapes of Survivorship Curves, r and K strategies and differences between the two.

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

Definition of Carrying Capacity; Malthusian view: concept of 'over-population' and shortage of resources; Questioning Malthus. Population Growth vs. Disparate Consumption of resources within and amongst nations. Definition and understanding of Demographic Transition; Factors influencing 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).

Basic understanding of the Exponential growth curve (J – shaped) and Logistic growth curve (S - shaped); 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.

*Strategies for human population control with emphasis on women's empowerment. (Details of methods of family planning **not required**.)*

- (v) Threats to the ecosystem: habitat destruction; genetic erosion; loss of diversity; expanding agriculture; impound water; waste from human societies; increasing human consumption.

Only a brief understanding of the causes and consequences of threats to provisioning and regulatory functions of the ecosystem with suitable examples.

- (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.

Definition of: Conservation, in situ and ex situ conservation. Importance of Conservation.

In-situ conservation: Wildlife sanctuaries, National parks, Biosphere reserves (definition, objectives, features, advantages and disadvantages).

Ex-situ conservation: zoos, aquaria, plant collection (objectives, features, advantages and disadvantages).

Conflicts in managing and conserving Forests: India's forest cover, issues concerning people living in and around forests with particular reference to tribal rights; threats to forests: poaching, developmental projects like roads and dams, over exploitation of forest resources (direct and indirect).

The role of the forest department and NGOs in managing forests.

Some management measures: scientific forestry, social forestry (various types of social forestry), Joint Forestry Management (JFM), ecotourism.

Definition, scope, advantages and disadvantages of each of the above.

Project Tiger as a case study in conservation: Origin, aims, and objectives, successes, failures.

3. Monitoring Pollution

- (i) Pollution monitoring.

Primary and secondary pollutants. Importance of monitoring air pollution including Ambient Air Quality Monitoring (gaseous and particulate). Concept of carbon credits and carbon trading in regulating emissions. Causes for excessive vehicular pollution and various steps taken to regulate pollution-emission standards for new vehicles, implementation of CNG programme, inspection & maintenance programme for in-use vehicles, phasing out of old commercial vehicles and promotion of public transport.

- (ii) Monitoring the atmosphere: techniques.

Monitoring at emission source and of ambient air quality, criteria for monitoring stations, types of stations, number of stations, frequency of data collection, characteristics of ambient air sampling, basic consideration for sampling (to be dealt with in brief). Classification of techniques- manual and instrumental. Manual-Passive samplers, High Volume Samplers and Bubbler Systems. Instrumental-photometric techniques-NDIR, Chemiluminescence - principle and use.

- (iii) International and national air quality standards.

National Ambient Air Quality Monitoring (NAAQM); the main functions of the Central Pollution Board and the State Pollution Control Board, objectives of air quality standards, New name of NAAQM, National Air Monitoring Programme (NAMP) objectives of the NAMP.

Definition of air quality standards and importance; National air quality standards for gases/particulate matter covered under WHO guidelines.

- (iv) Water testing: indicators of water quality.

Indicators (electrical conductivity, turbidity, pH, dissolved oxygen, faecal waste, temperature, hardness, nitrates and sulphates) the significance of each and their interpretations. B.O.D. and C.O.D., theoretical concept only (lab work for better understanding and not for testing)

- (v) Soil testing: indicators of soil type and quality and laboratory work.

Soil indicators- the characteristics of a good soil indicator, the three basic types of soil indicators- biological, physical and chemical, two examples of each. The information provided by each of these types of indicators. Definitions, effects and experiments to find out soil respiration, soil pH, soil aggregate, infiltration rate and simple methods of controlling each of these.

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.

Causes of migration - push and pull factors, consequences on rural and urban areas and ways to reduce migration. Future trends and projections.

- (ii) A critical appraisal of conventional paradigm of development from the viewpoints of

sustainability, environmental impact and equity.

Definition of Development.

An understanding that development has become synonymous with growth. This approach has the following impacts on the environment: (a) Ignoring negative environmental impacts; (b) Changing patterns of resource use due to market pressures; (c) Overuse and exploitation of resources; (d) Diversion of scarce resources to luxury goods; (e) Disparate access to resources; (f) Increasing wastes and pollution.

The above to be explained with suitable examples.

- (iii) A case study of Gandhian approach in terms of its aims and processes.

Local self-governance – basic principles behind village policy, Antodaya, Sarvodaya, Panchayati Raj; local self-sufficiency, local markets and environmental sustainability. Village as the basis of development; promotion of cottage industries and intermediate technologies; focus on employment.

The above to be contrasted with today's paradigm of growth.

- (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.

A basic understanding of the following urban environmental problems: problems of sanitation, water management, transport, energy; air quality and housing.

Awareness of some indigenous solutions: Rainwater harvesting, garbage segregation, composting, energy from solid and liquid wastes, sewage management (dry toilets, Decentralized Water Management System (DEWATS))

Features of new urbanism, goals of smart growth. The following examples of urban planning and management from the third world to be studied:

- *Bogota – Bolivia (Traffic Management);*
- *Cuba (Urban agriculture using organic methods);*
- *Curitiba – Brazil (Traffic planning and urban renewal using innovative measures);*
- *Cochabamba – (Water management and protests against privatisation of water supply).*

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 viewpoints 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.*

Definition of the following terms: traditional agriculture, natural farming, organic agriculture, modern agriculture (use of hybrid seeds, high yielding varieties, chemical fertilizers and pesticides), gene revolution (genetically modified seeds) and sustainable agriculture.

Irrigation systems:

Macro vs micro irrigation systems - canal irrigation/dam as compared to sprinkler/ drip/ trickle drip/dug wells. Basic features, advantages and disadvantages of each kind. Traditional rainwater harvesting- tankas,

khadins, ahar, pyne, zings, johads and eris (suitability of each type in the particular region).

Features of pre-colonial agriculture in India: growing for sustenance rather than market; multi-cropping, management of soil health, diversity in seed.

Colonial influence: punitive taxation, commercial crops for export and British industry, devaluation of sustainable traditional practices. Bengal famine. Comparative study of pre-colonial, colonial and post-colonial agriculture and their impact.

Green Revolution: Origin (food scarcity - food import - need for increasing production).

Basic principles of Green Revolution-Development of High Yielding Varieties (HYV); introduction of fertilizers and pesticides; mono cropping.

Environmental, social and economic impacts - advantages and disadvantages (from the viewpoints of agro-bio diversity; soil health; ecological impact of pesticides; energy use; input costs; benefits to small and medium farmers, community level and household level food security).

Land reform – need, advantages, failures and successes.

Elements of sustainable agriculture: Mixed farming, mixed cropping, inter-cropping, crop rotation, use of sustainable practices of water soil and pest management for improving soil fertility (organic fertilizers, bio-fertilizers, green manure, with two examples) and pest control (bio pesticides). Integrated Pest Management (IPM); eating local foods

- (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. Food Security.*

Meaning of Food Security, need for food security. The problems in attaining food security - those of production, storage and access. Integrated and sustainable approach to food security for the Third World including working for environmental sustainability and social and economic sustainability through

land reform, credit support to farmers, market support to farmers, inadequacies in the present marketing system, ways to improve marketing system, improving access to food, ownership of seeds.

An understanding that national level food security may not translate into household and community level food security or long term environmental sustainability unless the above factors are addressed. Main features of the Food Security Law 2013.

SECTION C

6. Environmental and Natural Resource Economics

- (i) Definition: resources; scarcity and growth; natural resource accounting.

Classification of natural resources - on the basis of origin (abiotic and biotic), on the basis of renewability (renewable and non-renewable), on the basis of development (potential and actual), on the basis of distribution (ubiquitous and localized); scarcity and growth, natural resource accounting.

Classification of resources as renewable and non-renewable.

Definition, basic principles, advantages and disadvantages of Physical accounting.

- (ii) GNP vs. other forms of measuring income.

GDP, GNP – definitions, advantages and disadvantages of using them as tools for measuring growth.

- (iii) Economic status and welfare (net economic welfare, nature capital, ecological capital, etc.)

A broad overview of the purpose of environmental economics.

Definition and classification: Defensive expenditure (its classification); natural/ecological capital.

- (iv) Externalities: cost benefit analysis (social, ecological).

Externalities – definition, kinds (positive and negative), impacts.

Cost Benefit analysis - Definition, the process in brief, advantages and disadvantages.

- (v) Natural capital regeneration.

What is natural capital? Kinds of natural capital; classification of ecosystem services, causes of degradation (acid deposition, air pollution, deforestation, loss of biodiversity and emission of carbon dioxide), ecological footprint and man's disproportionate use of natural resources, importance of preserving and regenerating natural capital.

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.

Case study of Amazonia - causes for exploitation of forests, reasons for acceleration of deforestation, effects of government policies, ecological value of rainforests and possible solutions to the problem.

Case study of ivory trade in Africa - reasons for flourishing trade of ivory in the past, steps taken to curb the trade and the consequences of ban in trade.

Case study of ozone depletion - what is meant by ozone layer and how does it get depleted, (Chapman's cycle), potential effects of ozone depletion, common ozone depleting substances (halons, carbon tetrachloride, CFCs, methyl chloroform, methyl bromide and HCFCs) and their life span in the atmosphere; Ozone hole; steps taken to control 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; transnational 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) and their impact on third world.

Definition, advantages and disadvantages of globalization, free trade, protectionism.

Transnational Companies (TNCs) – definition; TNCs and environment – conflict of interest.

History of third world countries' trade with the developed countries (with special reference to India) with regards to composition and terms of trade (export of primary goods and import of finished goods at higher cost- tapping of primary goods leading to environment degradation- open cast mining, agriculture, aquaculture, etc.).

Case study of aquaculture in India to understand the impact of free trade.

Economic allocation of scarce resources and its impact on environment.

Toxic waste trade – definition, origin, factors sustaining, impact on third world countries (example – health and environmental impacts) and steps to mitigate it (Bamako and Basel Conventions).

GATT – the organization and its metamorphosis into WTO.

Principles and functions of WTO: creating a level playing field for international trade through MFN (Most Favoured Nation), NT (National Treatment) and reduction of import barriers - tariff and non tariff barriers and trading to comparative advantages.

Full forms of and areas addressed in the WTO GATT, TRIPS, TRIMS, Agreement on Agriculture (AOA). A brief understanding of how these agreements impacted India's trade, food security, economic well-being, environmental sustainability.

Definition of IPR and its categories: copyrights, patents, trademarks, industrial design rights, geographical indicators and trade secrets.

A brief understanding of each of the above categories.

(iv) International aid: agencies; advantages; limitations; need for re-orienting aid; aid vs. self-reliance.

International aid – advantages and disadvantages; Types of Aid: Tied and Untied Aid - advantages and limitations of each.

PAPER II

PRACTICAL/PROJECT WORK – 30 MARKS (FOR CLASSES XI & 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.