UNIVERSITY GRANTS COMMISSION
NET BUREAU

Code No. : 89

Subject : ENVIRONMENTAL SCIENCES

SYLLABUS AND SAMPLE QUESTIONS

Note :

There will be two question papers. Paper–II will cover 50 Multiple Choice Questions (Multiple choice, Matching type, True/False, Assertion-Reasoning type) carrying 100 marks and Paper–III will have two Parts—A and B. Part-A will have 10 short essay type questions (300 words) carrying 16 marks each. There will be one question from each unit with internal choice from the same unit. Total marks will be 160. Part-B will be compulsory and questions will be set from Unit-I to Unit-X. The candidate will attempt one question from Part-B (800 words) carrying 40 marks. Total marks of Paper-III will be 200.

PAPER—II and PAPER—III (Part–A & B)

Unit—I

Definition, principles and scope of Environmental Science.

Earth, Man and Environment. Ecosystems, Pathways in Ecosystems.

Physico-chemical and Biological factors in the Environment.

Geographical classification and zones.

Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Mass and Energy transfer across the various interfaces, material balance. First and Second law of thermodynamics, heat transfer processes. Scale of Meteorology, pressure, temperature, precipitation, humidity, radiation and wind. Atmospheric stability, inversions and mixing heights, windroses.

Natural resources, conservation and sustainable development.

Unit—II

Fundamentals of Environmental Chemistry : Stochiometry, Gibbs' energy, Chemical potential, chemical equilibria, acid base reactions, solubility product, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radionuclides.

Chemical composition of Air : Classification of elements, chemical speciation. Particles, ions and radicals in the atmosphere. Chemical processes for formation of inorganic and organic particulate matter. Thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, Chemistry of air pollutants, Photochemical smog.

Water Chemistry : Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.

Soil Chemistry : Inorganic and organic components of soil, Nitrogen pathways and NPK in soils.

Toxic Chemicals in the environment—Air, Water : Pesticides in water. Biochemical aspects of Arsenic, Cadmium, Lead, Mercury, Carbon Monoxide, O_3 and PAN Pesticides, Insecticides, MIC, carcinogens in the air.

Principles of Analytical Methods : Titrimetry, Gravimetry, Colourimetry, Spectrophotometry, Chromatography, Gas Chromatography, Atomic Absorption Spectrophotometry, GLC, HPLC, Electrophoresis. X-ray fluorescence, X-ray diffraction, Flame photometry.

Unit—III

Definition, Principles and scope of ecology, Human ecology and Human settlement, Evolution, Origin of life and speciation.

Ecosystems : Structure and functions, Abiotic and Biotic components, energy flows, Food chains, Food web, Ecological pyramids, types and diversity.

Ecological Succession, Population, Community ecology and Parasitism, Prey-predator relationships.

Common flora and fauna in India

Aquatic : Phytoplankton, Zooplankton and Macrophytes

Terrestrial : Forests

Endangered and Threatened Species

Biodiversity and its conservation : Definition, 'Hotspots' of Biodiversity, Strategies for Biodiversity conservation. National Parks and Sanctuaries. Gene pool.

Microflora of Atmosphere : Air Sampling techniques. Identification of aeroallergens. Air-borne diseases and allergies.

Environmental Biotechnology : Fermentation Technology, Vermiculture technology, Biofertilizer technology.

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Unit—IV

Environmental Geosciences—Fundamental concepts.

The earth systems and Biosphere : Conservation of matter in various geospheres—lithosphere, hydrosphere, atmosphere and biosphere. Energy budget of the earth. Earth's thermal environment and seasons. Ecosystems flow of energy and matter. Coexistence in communities—food webs., Earth's major ecosystems—terrestrial and aquatic. General relationship between landscape, biomes and climate. Climates of India, Indian Monsoon, El Nino, Droughts. Tropical cyclones and Western Disturbances.

Earth's Processes and Geological Hazards : Earth's processes; concept of residence, time and rates of natural cycles. Catastrophic geological hazards. Study of floods, landslides, earthquakes, volcanism and avalanche. Prediction and perception of the hazards and adjustments to hazardous activities.

Mineral Resources and Environment : Resources and Reserves, Minerals and Population. Oceans as new areas for exploration of mineral resources. Ocean ore and recycling of resources. Environmental impact of exploitation, processing and smelting of minerals.

Water Resources and Environment : Global Water Balance. Ice sheets and fluctuations of sea levels. Origin and composition of seawater. Hydrological cycle. Factors influencing the surface water. Types of water. Resources of oceans. Ocean pollution by toxic wastes. Human use of surface and groundwaters. Groundwater pollution.

Landuse Planning : The landuse plan. Soil surveys in relation to landuse planning. Methods of site selection and evaluation.

Environmental Geochemistry : Concept of major, trace and REE. Classification of trace elements, Mobility of trace elements, Geochemical cycles. Biogeochemical factors in environmental health. Human use, trace elements and health. Possible effects of imbalance of some trace elements. Diseases induced by human use of land.

Principles of Remote sensing and its application of Environmental Sciences. Application of GIS in Environmental Management.

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Unit—V

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. Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds; nuclear energy—fission and fusion; magnetohydrodynamic power, bio-energy—energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world.

Environmental implication of energy use; CO_2 emissions, global warming; air and

thermal pollution; radioactive waste and radioactivity from nuclear reactors; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

UNIT—VI

Air : Natural and anthropogenic sources of pollution. Primary and Secondary pollutants. Transport and diffusion of pollutants. Gas laws governing the behaviour of pollutants in the atmosphere. Methods of monitoring and control of air pollution SO_2, NO_x, CO, SPM. Effects of pollutants on human beings, plants, animals, materials and on climate. Acid Rain. Air Quality Standards.

Water : Types, sources and consequences of water pollution. Physico-chemical and Bacteriological sampling and analysis of water quality. Standards, sewage and waste water treatment and recycling. Water quality standard.

Soil : Physico-chemical as bacteriological sampling as analysis of soil quality. Soil Pollution Control. Industrial waste effluents and heavy metals, their interactions with soil components. Soil micro-organisms and their functions, degradation of different insecticides, fungicides and weedicides in soil. Different kinds of synthetic fertilizers (NP & K) and their interactions with different components of soil.

Noise : Sources of noise pollution, measurement of noise and Indices, effect of meteorological parameters on noise propagation. Noise exposure levels and standards. Noise control and abatement measures. Impact of noise on human health.

Marine : Sources of marine pollution and control. Criteria employed for disposal of pollutants in marine system—coastal management.

Radioactive and Thermal Pollution.

Unit—VII

Introduction to environmental impact analysis.

Environmental impact Statement and Environmental Management Plan.

EIA guidelines 1994, Notification of Government of India.

Impact Assessment Methodologies.

Generalized approach to impact analysis.

Procedure for reviewing Environmental impact analysis and statement.

Guidelines for Environmental audit.

Introduction to Environmental planning.

Base line information and predictions (land, water, atmosphere, energy, etc.)

Restoration and rehabilitation technologies.

Landuse policy for India.

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Urban planning for India.

Rural planning and landuse pattern.

Concept and strategies of sustainable development.

Cost-Benefit analysis.

Environmental priorities in India and sustainable development.

Unit—VIII

Sources and generation of solid wastes, their characterization, chemical composition and classification. Different methods of disposal and management of solid wastes (Hospital Wastes and Hazardous Wastes) Recycling of waste material. Waste minimization technologies.

Hazardous Wastes Management and Handling Rules, 1989, Resource Management, Disaster Management and Risk analysis.

Environment protection—issues and problems, International and National efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A).

Environmental Policy Resolution, Legislation, Public Policy Strategies in Pollution Control, Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988, The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986.

Scheme of labelling of environmentally friendly products (Ecomark), Public Liability Insurance Act, 1991 and Rules 1991.

Unit—IX

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Basic elements and tools of statistical analysis; Probability, sampling, measurement and distribution of attributes; Distribution—Normal, t and χ^2, Poisson and Binomial; Arithmetic, Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance.

Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting. Models of population growth and interactions—Lotka-Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

Unit—X

Environmental Education and Awareness.

Environmental Ethics and Global imperatives.

Global Environmental problems—ozone depletion, global warming and climatic change.

Current Environmental issue in India.

Context : Narmada Dam, Tehri Dam, Almetti Dam, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil.

Waste lands and their reclamation.

Desertification and its control.

Vehicular pollution and urban air quality.

Depletion of Nature resources.

Biodiversity conservation and Agenda-21.

Waste disposal, recycling and power generation, Fly ash utilization.

Water Crises—Conservation of water.

Environmental Hazards.

Eutrophication and restoration of Indian lakes.

Rain water harvesting.

Wet lands conservation.

Epidemiological issues (e.g., Goitre, Fluorosis, Arsenic).

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SAMPLE QUESTIONS

PAPER–II

1. What is the most abundant anion in river water?

(A) Cl^-

(B) SO_4^{2-}

(C) CO_3^{2-}

(D) HCO_3^-

2. Which one of the following places is likely to be affected by Chemical Weathering?

(A) Thar Desert

(B) Tibetan Plateau

(C) Western Ghats

(D) Siwalik

3. Night blindness in children is due to deficiency of

(A) Vitamin A

(B) Vitamin C

(C) Vitamin B complex

(D) Protein

PAPER–III (A)

1. Discuss the structure and composition of atmosphere.

Or

Define Environmental Science. Discuss Ecosystem with reference to man and environment.

2. Describe the biological role and structural features of tRNA. What will be the anticodon?

Or

Calculate stepwise the numbers of ATP molecules formed when one molecule of hexanoic acid is oxidised completely to CO_2 and water through B-oxidation and TCA cycle.

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11. India—a land of 'flora and fauna'. Discuss this statement indicating the methods of conservation of this natural wealth of the country.

Or

Write briefly the methodology and uses of cryopreservation of gametes and embryo.

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