

Syllabus for Ph.D. (Environmental Sciences) Entrance Exam 2024

**SECTION-A
(RESEARCH METHODOLOGY)**

1. Principles and applications: Phase contrast microscopy, Fluorescence microscopy, scanning electron microscopy (SEM) and transmission electron microscopy.
2. Principles and applications: Paper Chromatography, Thin layer chromatography, Gas chromatography (GLC), High pressure liquid chromatography (HPLC), Ion exchange and affinity chromatography.
3. Principles of biophysical methods for structural analysis of biopolymers: X-ray diffraction, fluorescence, Infrared, UV and circular dichroism (CD) spectroscopy NMR, ESR and atomic absorption and plasma emission spectroscopy, Flame photometry.
4. Principles and applications of tracer techniques: Radioactive isotopes and half life of isotopes, Autoradiography, Liquid scintillation spectrometry.
5. Molecular techniques: Polymerase chain reaction; Southern, Northern, Western Blotting. Principle of Electrophoresis: Polyacrylamide gel electrophoresis, SDS-PAGE, Agarose gel electrophoresis. DNA sequencing.
6. Practice of statistical methods in biological research: Basic statistics-average, statistics of dispersion coefficient of variations, Probability distribution- binominal, poisson and normal, Arithmetic, Geometric and Harmonic means; moments; matrices, simultaneous linear equations; tests of hypothesis and significance. Models of population growth and interactions, Lotka-Volterra model, Leslie's matrix model, point source stream pollution model, box model, and Gaussian plume model. Tests of statistical significance –simple correlation of regression and analysis of variance.

**SECTION-B
(SUBJECT)**

ENVIRONMENTAL SCIENCES

1. 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, Natural resources, conservation and sustainable development.
2. Fundamentals of Environmental Chemistry: Stoichiometry, Gibb's 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: 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, Os and PAN Pesticides, Insecticides, MIC, carcinogens in the air.

3. 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. Aquatic: Phytoplankton, Zooplankton and Macrophytes. Terrestrial : Forests. Endangered and Threatened Species: Biodiversity and its conservation: Definition, 'Hotspot's 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.
4. Environmental Geosciences: The earth systems and Biosphere: Conservation of matter in various geospheres – lithosphere, hydrosphere, atmosphere and biosphere. Earth's thermal environment, energy budget and seasons. 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: concept of residence, time and rates of natural cycles, floods, landslides, earthquakes, volcanism and avalanche. 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. Hydrological cycle. Factors influencing the surface water. Types of water. Human use of surface and groundwaters. Groundwater pollution. Land-use Planning: The land-use plan. Soil surveys in relation to land-use planning. Methods of site selection and evaluation. Environmental Geochemistry: 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.
5. Pollution: 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 SO₂, 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: Physicochemical 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.

6. 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. Land-use policy for India, Urban and Rural planning.
7. 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.
8. 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.