

Department for Environmental Studies, Visva-Bharati

Syllabus for Ph.D course work in Environmental Science

Paper-I Research Methodology and Techniques

100 marks

Unit-I Research: concepts, writing Research Proposal, Research Report, Literature Survey,

Unit II Fundamentals of Environmental Data Acquisition

Primary and Secondary Data, Environmental Survey & Questionnaire methods, Objectives of environmental sampling and analysis, Importance of Scientifically Reliable and Legally Defensible Data, Sampling Error Vs. Analytical Error,

Environmental Sampling Design, Planning and Sampling Protocols, Sampling Environmental Population, Environmental Sampling approaches: where and when, Estimating sampling numbers- how many samples are required

Standard Sampling methods for surface water, ground water, waste water soil, sediment, air and stack emission, biological, hazardous waste Field Quality Assurance and Quality control

Unit III Analytical Techniques

Common operations and chemical methods in environmental laboratory, Analytical principles for common chemical methods for environmental samples

Unit IV Statistical and Computer Analysis

Paper-II (Recent Advances in Environmental Science) (Optional)

100 marks

Optional-I: Air - Introduction to atmosphere and its interaction with living systems, Causes of air pollution, sources, primary (SPM, SO₂, NO_x, NH₃, HF, CL, Heavy metals) and secondary (VOC, O₃, Smog, PAN, Acid rain) air pollutants. Levels of air pollutant in India; Air pollution standards in India. Units of Air pollutants, air Pollution threshold levels and injury, Nature of SPM, smoke and their effect on plants. Effects of different air pollutants on living systems. Bioindicators; APTI; concept of critical load, air pollution and crop plants; air pollution and forest decline; effect of air pollutant at ecosystem level (direct and indirect), air pollution and biodiversity. Air pollution abatement by green plants and green belts.

Optional-II: Water - Introduction to hydrosphere and its interaction with living system, the hydrological cycle. Properties of water, different water resources; rainfall, infiltration,

evapotranspiration and runoff, springs, lakes, etc. Chemistry of water & water pollutants, Nature and type of water pollutants, Heavy metals, Metalloids, Organic Pollutants, Persistent organic pollutants, Pesticides in water, radioactive and thermal pollution. Water quality parameters and its standards (DO, BOD, COD, Acidity, Alkalinity, Hardness, Residual chlorine and Chlorine demand, coliform), Deoxygenating substances, Biochemical aspects of water pollutants. Waste water treatment and water uses. Monitoring (chemical & microbiological methods) and control of water pollution. River Action Plan; Source of marine pollution and control, Ground water pollution

Optional-III: Soil & Rock - Introduction to lithosphere and its interaction with living system, Surface features and Internal structure of earth; Weathering and Erosion; Mass wasting; Erosion, transportation and deposition by water, ice and wind; Fluvial processes and landforms; Drainage patterns; Coastal landforms and Processes; Plate tectonics as an unifying theory, Plate boundaries, Earthquake, volcanoes. Types of minerals and their use, Environmental problems associated with mining industries. Sources, behaviour and fate of soil pollutants; Effects of soil pollutants on living systems. Soil micro-organisms and their functions; Role of microorganisms in the biochemical cycles and degradation of different pollutants. Sources and generation of solid wastes, management of solid & other hazardous and toxic wastes.

Optional-IV: Flora & Fauna - Biodiversity and its significance; Species diversity & its measurement; Flora, Fauna and Biodiversity hotspots of India and world; Endangered, threatened, endemic & invasive species, Keystone species, Red Data book. Biosphere Reserves, National Parks, Sanctuaries & Wetlands; Strategies for biodiversity conservation. Traditional wisdom, Ecotourism. Classification of Xenobiotics, Basic principles in environmental toxicology, distribution & fate of toxicants in the environment and organisms. Biotransformation and detoxification mechanisms, types of toxicity: acute, chronic immediate and delayed; toxicity bioassays: static and continuous bioassay; Quantal dose response, LD₅₀, ED₅₀, LC₅₀. Toxicity of mixture of toxicants; Interaction of toxicants: synergism, antagonism, additive effect, bioaccumulation, biomagnification, Influence of ecological factors on the effects of toxicity.

Paper- III Review work in the relevant field of research followed by submission of a dissertation and viva-voce **100 marks**