

SYLLABUS FOR THE POST OF LECTURER (10+2)

Environmental Science

Unit-I: Fundamentals of Environmental Sciences and Basic Statistics

Definition, Principles and Scope of Environmental Science. Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere. Brief account of cryosphere and anthroposphere (built environment), Laws of thermodynamics, heat transfer processes, mass and energy transfer across various interfaces, material balance. Meteorological parameters - pressure, temperature, precipitation, humidity, mixing ratio, saturation mixing ratio, radiation and wind velocity, adiabatic lapse rate, environmental lapse rate, Wind roses. Distribution of water on Earth, Hydrological cycle, Components and Chemical composition of the Hydrosphere, Cryosphere depletion, origin of earth, Origin and evolution of life, Concept and limits of Biosphere. Remote Sensing and GIS: Principles of remote sensing and GIS. Digital image processing and ground truthing. Application of remote sensing and GIS in land cover/land use planning and management (urban sprawling, vegetation study, forestry, natural resource). Attributes and Variables: types of variables, scales of measurement, measurement of Central tendency and Dispersion, Standard error, Moments – measure of Skewness and Kurtosis, Basic concept of probability theory, Sampling theory, Distributions - Normal, log-normal, Binomial, Poisson, Correlation, Regression, tests of hypothesis (t-test, 2test ANOVA: one-way and two-way)

Unit-II: Environmental Chemistry

Fundamentals of Environmental Chemistry: Classification of elements, Stoichiometry, Gibbs' energy, chemical potential, chemical kinetics, chemical equilibria, solubility of gases in water, the carbonate system, unsaturated and saturated hydrocarbons, radioisotopes. Composition of air. Particles, ions and radicals in the atmosphere. Chemical speciation. Thermochemical and photochemical reactions in the atmosphere, Oxygen and Ozone chemistry. Photochemical smog. Water as a universal solvent. Concept of DO, BOD and COD. Sedimentation, coagulation, flocculation, filtration, pH and Redox potential (Eh). Physical, chemical and biological properties of soil and Biogeochemical Cycles (Carbon, Nitrogen, Phosphorus and Sulphur). Principles of analytical methods: Titrimetry, Gravimetry, Bomb Calorimetry, Chromatography (Paper Chromatography, TLC, GC and HPLC), Flame photometry, Spectrophotometry (UV-VIS, AAS, ICP-AES, ICP-MS), Electrophoresis, XRF, XRD, NMR, GC-MS, SEM, TEM.

Unit-III: Environmental Biology

Ecology as an inter-disciplinary science. Ecosystem Structure and functions: Structures - Biotic and Abiotic components. Functions - Energy flow in ecosystems, energy flow

models, food chains and food webs. Ecological succession. Species diversity, Concept of ecotone, edge effects, ecological habitats and niche. Ecosystem stability and factors affecting stability. Ecosystem services. Basis of Ecosystem classification. Types of Ecosystem: Desert (hot and cold), forest, rangeland, wetlands, lotic, lentic, estuarine (mangrove), Oceanic. Biomes: Concept, classification and distribution. Characteristics of different biomes: Tundra, Taiga, Grassland, Deciduous forest biome, Highland Icy Alpine Biome, Chapparral, Savannah, Tropical Rain forest. Population ecology: Characteristics of population, concept of carrying capacity, population growth and regulations. Population fluctuations, dispersion and metapopulation. Concept of 'r' and 'k' species. Keystone species. Community ecology: Definition, community concept, types and interaction - predation, herbivory, parasitism and allelopathy. Biological invasions. Biodiversity and its conservation: Definition, types, importance of biodiversity and threats to biodiversity. Concepts of hotspots and cold spots in biodiversity. Measures of biodiversity. Strategies for biodiversity conservation: in situ, ex situ and in vitro conservation. National parks, Sanctuaries, Protected areas and Sacred groves in India. Concepts of gene pool, biopiracy and bio-prospecting. Extinct, Rare, Endangered and Threatened flora and fauna of India. Flora and Fauna of Jammu and Kashmir. Toxicology: Definition, scope, goals and divisions. Factors influencing toxicity. Toxicity of chemical mixtures. Absorption, distribution and excretion of toxic agents, acute and chronic toxicity, concept of Bioassay and its applications in toxicology, threshold limit value, margin of safety, therapeutic index, Biotransformation: Principles and types. Biomagnification of pesticides, heavy metals and radioactive substances. Environmental Biotechnology: Bioremediation – definition, types and factors affecting Bioremediation. Bioindicators, Biofertilizers, Biofuels and Biosensors. Genetically modified organisms and biosafety.

Unit-IV: Environmental Geosciences

Composition and classification of Earth's interior, Basics of seismology, Types of seismic waves and their role in the study of Earth's interior. Geological time scale. Geomagnetism: Magnetic and gravitational fields of the Earth. Continental drift theory, evidences and contradictions, Plate tectonics and Neo tectonics, theory of isostasy and global isostatic adjustment. Major rock types and their classification, rock cycle, types of folds and faults. Concept of steady state and equilibrium, Energy budget of the earth. Earth's thermal environment and seasons. Coriolis force, pressure gradient force, frictional force, geo-strophic wind field, gradient wind. Major climates of the world (Equatorial, Savannah, Hot desert, Mediterranean, Steppe). Climate of India, western disturbances, Indian monsoon, droughts, El Nino, La Nina. Concept of residence time and rates of natural cycles. Geophysical fields. Weathering including weathering reactions, erosion, transportation and deposition of sediments. Factors affecting landform development. Geomorphological systems (Fluvial, Karst, Aeolian, Glacial), Natural Hazards: Catastrophic geological hazards - floods, landslides, earthquakes, volcanism, avalanche, tsunami and cloud bursts. Prediction of hazards and mitigation of their impacts.

Unit-V: Energy and Environment

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. Shale oil, Coal bed Methane, Gas hydrates. Gross-calorific value and net-calorific value. Principles of generation of hydro-power, tidal energy, ocean thermal energy conversion, wind power, geothermal energy, solar energy (solar collectors, photo-voltaic modules, solar ponds). Nuclear energy - fission and fusion, Nuclear fuels, Nuclear reactor – principles and types. Bioenergy: methods to produce energy from biomass. Green fuels, Waste Energy recovery and Environmental impacts of Energy production and consumption.

Unit-VI: Environmental Pollution and Management

Air Pollution: Sources and types of Pollutants - Natural and anthropogenic sources, primary and secondary pollutants. Criteria air pollutants. Indian National Ambient Air Quality Standards. Impact of air pollutants on human health, plants and materials. Acid rain. Dispersion of air pollutants. Mixing height/depth, lapse rates, Gaussian plume model, line source model and area source model. Control devices for particulate matter: Principle and working of: settling chamber, centrifugal collectors, wet collectors, fabric filters and electrostatic precipitator. Control of gaseous pollutants through adsorption, absorption, condensation and combustion including catalytic combustion. Indoor air pollution, Vehicular emissions and Urban air quality. Noise Pollution: Sources and effects on human health. Control of noise pollution. Water Pollution: Types and sources of water pollution. Impact on humans, plants and animals. Drinking water treatment: Coagulation and flocculation, Sedimentation and Filtration, Disinfection and Softening. Wastewater Treatment: Primary, Secondary and Advanced treatment methods. Soil Pollution, Soil forming minerals and process of soil formation, Inorganic and organic components of soils, Soil types. Analysis of soil quality. Causes, impacts and control of Soil Pollution. Thermal, Marine and Radioactive Pollution: Sources, impacts and control. Solid Waste - types and sources. Solid waste characteristics, generation rates, solid waste components, proximate and ultimate analyses of solid wastes. Solid waste management. Recycling, recovery of materials for recycling and direct manufacture of solid waste products. composting and vermicomposting, biomethanation of solid waste. Disposal of solid wastes – sanitary land filling and its management, incineration of solid waste. Hazardous waste – Types, characteristics and health impacts. Hazardous waste management: Treatment Methods – neutralization, oxidation reduction, precipitation, solidification, stabilization, incineration and final disposal. e-waste: classification, methods of handling and disposal. Fly ash: sources, composition and utilisation. Plastic waste: sources, consequences and management. Microplastics and Nanoplastics. Air borne diseases: Tuberculosis, Influenza, bronchial asthma Water borne diseases: Cholera, Hepatitis, Typhoid

Soil borne diseases: (Tetanus, Botulism)

Unit-VII: Natural Resources, Environmental Economics and Sustainable Development

Natural resources: concept and classification, forest resources, water resources, mineral resources, Energy resources (Renewable and Non-renewable), Environmental economics: definition and scope, Natural capital and flow, Concept of intangibles and externalities, Carbon credits and carbon market, Ecosystem Services and its Typologies, Valuation and accounting of ecosystem services, Methods of environmental valuation, (empirical approaches, revealed preference methods and direct methods), Incentives for ecosystem services (IES) in the Himalayas, Concept of sustainable development, Sustainable development goals, Circular economy, Green infrastructure, Sustainable cities and globalization, green technology, 3 R's of green technology: recycle, renew and reduce, Green buildings, history of green buildings, need and relevance of green buildings over conventional buildings, LEED certified building, Eco-mark certification, establishment of Eco-mark in India, its importance and implementation, Carbon capture and storage (CCS) technologies, Life cycle assessment (LCA), Compact florescent light (CFL) and cogeneration.

Unit-VIII: Environmental Assessment, Management and Legislation

Aims and objectives of Environmental Impact Assessment (EIA). Environmental Impact Statement (EIS) and Environmental Management Plan (EMP). EIA Guidelines. Impact Assessment Methodologies. Procedure for reviewing EIA of developmental projects. Life-cycle analysis, cost-benefit analysis. Guidelines for Environmental Audit. Environmental Planning as a part of EIA and Environmental Audit. Environmental Management System Standards (ISO14000 series). EIA Notification, 2006 and amendments from time to time. Eco-labeling schemes. Overview of Environmental Laws in India: Constitutional provisions in India (Article 48A and 51A). Wildlife Protection Act, 1972 amendments 1991, Forest Conservation Act, 1980, Indian Forest Act, Revised 1982, The Plastic Waste Management Rules, 2016, The Bio-Medical Waste Management Rules, 2016, The Solid Waste Management Rules, 2016, The e-waste (Management) Rules 2016, The Public Liability Insurance Act, 1991 and Rules 1991, Noise Pollution (Regulation and Control) Rules, 2000, National Environmental Policy, 2006. Environmental Conventions and Agreements: Stockholm Conference on Human Environment 1972, Montreal Protocol, 1987, Conference of Parties (COPs), Basel Convention (1989, 1992), Ramsar Convention on Wetlands (1971), Earth Summit at Rio de Janeiro, 1992, Agenda-21, Global Environmental Facility (GEF), Convention on Biodiversity (1992), UNFCCC, Kyoto Protocol, 1997, Clean Development Mechanism (CDM), Earth Summit at Johannesburg, 2002, Copenhagen Summit, 2009, Paris Agreement, IPCC, UNEP, IGBP, Agenda 2030.

Unit-IX: Environmentalism and Environmental Education

Environmentalism: Concept and history, Interaction between Earth, Man and Environment, Environmental ethics, Environmental justice, The monetization frontier, Environmental politics, Environment-Development Divide, Environmental organizations (EPA, UNEP, IUCN, WHO), Environmental education: Aims, objectives and principles, Environmental protection and religious teachings, Environmental literacy and activism, Environmental policy and public attitude, Concept of Environmental Governance-Global and Indian Perspective, issues and challenges in Environmental Governance, Role of institutions in Governance and policy, The Environmental Kuznets Curve (EKC), Corporate Environmental Responsibility (CER).

Unit-X: Emerging Environmental Issues and Challenges

Climate change vulnerability and risk, Biodiversity loss, Desertification and land degradation, Acidification, deforestation, pollution, Waste management, Human population growth and environment, Epidemics, Zoonotic diseases and pandemics, Water and food security linkages, Hazardous Waste, and waste, Radioactive waste, Emerging Environmental Contaminants, Environmental Disasters: Minnamata Disaster, Exxon Valdez Oil Spill, 1989, Bhopal Gas Disaster, 1984, Chernobyl Disaster, 1986, Fukushima Daiichi nuclear disaster, 2011. **Current Environmental Issues in India:** Environmental issues related to water resource projects - Narmada dam, Tehri dam, Hydro-power projects in Jammu & Kashmir, Rain water harvesting. Conservation of wetlands, Ramsar sites in India. Soil erosion, reclamation of degraded land, desertification and its control. Forest Conservation – Chipko movement, Appiko movement, Wildlife conservation projects: Project Tiger, Project Elephant.