Environmental Studies

Unit-I: Fundamentals of Environmental Sciences

Definition, Principles and Scope of Environmental Science.

Structure and composition of atmosphere, hydrosphere, lithosphere and biosphere.

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.

Interaction between Earth, Man and Environment. Biogeographic provinces of the world and agro-climatic zones of India. Concept of sustainable development.

Natural resources and their assessment. 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), waste management and climate change.

Environmental education and awareness. Environmental ethics.

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.

Hydrological cycle. Water as a universal solvent. Concept of DO, BOD and COD. Sedimentation, coagulation, flocculation, filtration, pH and Redox potential (Eh).


Toxic chemicals: Pesticides and their classification and effects. Biochemical aspects of heavy metals (Hg, Cd, Pb, Cr) and metalloids (As, Se). CO, O₃, PAN, VOC and POP. Carcinogens in the air.

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, FTIR, GC-MS, SEM, TEM.

**Unit-III: Environmental Biology**


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, Chapparal, Savanna, Tropical Rain forest.

Community ecology: Definition, community concept, types and interaction - predation, herbivory, parasitism and allelopathy. Biological invasions.


Concept of Industrial Ecology.

Toxicology and Microbiology: Absorption, distribution and excretion of toxic agents, acute and chronic toxicity, concept of bioassay, threshold limit value, margin of safety, therapeutic index, biotransformation. Major water borne diseases and air borne microbes.


Unit-IV: Environmental Geosciences


Weathering including weathering reactions, erosion, transportation and deposition of sediments. Soil forming minerals and process of soil formation. Identification and characterization of clay minerals, Soil physical and
chemical properties, soil types and climate control on soil formation, Cation exchange capacity and mineralogical controls.


Distribution of water in earth, hydrology and hydrogeology, major basins and groundwater provinces of India, Darcy’s law and its validity, groundwater fluctuations, hydraulic conductivity, groundwater tracers, land subsidence, effects of excessive use of groundwater, groundwater quality. Pollution of groundwater resources, Ghyben-Herzberg relation between fresh-saline water.

Natural resource exploration and exploitation and related environmental concerns. Historical perspective and conservation of non-renewable resources.

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**


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.

Environmental implications of energy use; energy use pattern in India and the world, emissions of CO₂ in developed and developing countries
including India, radiative forcing and global warming. Impacts of large scale exploitation of solar, wind, hydro and nuclear energy sources.

**Unit-VI: Environmental Pollution and Control**

**Air Pollution:**

**Noise Pollution:**

**Water Pollution:**
Soil Pollution:

Thermal, Marine Pollution and Radioactive:

**Unit-VII: Solid and Hazardous Waste Management**

Solid Waste - types and sources. Solid waste characteristics, generation rates, solid waste components, proximate and ultimate analyses of solid wastes.

Solid waste collection and transportation: container systems - hauled and stationary, layout of collection routes, transfer stations and transportation.


e-waste: classification, methods of handling and disposal.

Fly ash: sources, composition and utilisation.

Plastic waste: sources, consequences and management.

Unit-VIII: Environmental Assessment, Management and Legislation


and Control) Rules, 2000, Coastal Regulation Zones (CRZ) 1991 amended from time to time.


Unit-IX: Statistical Approaches and Modelling in Environmental Sciences

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, t, χ² and F-distribution. Correlation, Regression, tests of hypothesis (t-test, χ²-test ANOVA: one-way and two-way); significance and confidence limits.

Approaches to development of environmental models; linear, simple and multiple regression models, validation and forecasting. Models of population growth and interactions: Lotka-Volterra model, Leslie’s matrix model.

Unit-X: Contemporary Environmental Issues

Global Environmental Issues – Biodiversity loss, Climate change, Ozone layer depletion. Sea level rise. International efforts for environmental protection.


**Current Environmental Issues in India:** Environmental issues related to water resource projects - Narmada dam, Tehri dam, Almatti dam, Cauvery and Mahanadi. Hydro-power projects in Jammu & Kashmir, Himachal and North-Eastern States.

Water conservation-development of watersheds, Rain water harvesting and ground water recharge.


Eutrophication and restoration of lakes. Conservation of wetlands, Ramsar sites in India.

Soil erosion, reclamation of degraded land, desertification and its control.

Climate change - adaptability, energy security, food security and sustainability.

Forest Conservation – Chipko movement, Appiko movement, Silent Valley movement and Gandhamardhan movement. People Biodiversity register.


Carbon sequestration and carbon credits.

Waste Management – Swachha Bharat Abhiyan.

Sustainable Habitat: Green Building, GRIHA Rating Norms.

Vehicular emission norms in India.

Epidemiological Issues: Fluorosis, Arsenocosis, Goitre, Dengue.