

CSJM UNIVERSITY, KANPUR
(FACULTY OF LIFE SCIENCES)
DEPARTMENT OF ENVIRONMENTAL SCIENCES
M.Sc. COURSE SYLLABUS

SEMESTER-I

ES-1: Basics of Environment

Definition, principles & scope of Environmental Sciences. Earth man & Environment. Structure, & Composition of Atmosphere, Hydrosphere, Lithosphere, & Biosphere. Food chain, Food web, Ecological pyramids. Biogeochemical Cycles-viz.: Carbon Cycle, Nitrogen Cycle, Hydrological Cycle, Phosphorus Cycle, and Sulphur Cycle. Interaction of Biological System with Physical Environment & among themselves. Common Flora & Fauna in India. Desertification, Forest-Fire, Soil-Erosion, & Desertification.

ES-2 FUNDAMENTALS OF ECOLOGY

Max.Marks:100

History and scope of Ecology, Autoecology, Synecology, Population characteristics and dynamics, Community, Biome, Environmental factors (Abiotic-medium, substratum, soil humidity, climate, water, light, temperature current & pressure , atmospheric gases, pH & nutrients- their importance & role). Limiting factors (Liebig's law of minimum, Shelfords law of tolerance, combined concept of limiting factors). Biotic factors. Distinguishing characters of forest grasslands, wetlands and arid lands, community organization-concept of habitat functional role and niche, dominant species, keystone species, ecotone, edge effect. Ecological succession, primary and secondary processes in successions, models of successions, climax community and types of climax

ES-3: Natural Resources and Their Management

Max.Marks:100

Definition and classification of natural resources. The water: resources and management. The land: land use, management of land, soil conservation, nitrification, degraded lands and their management, integrated land planning. Mineral resources: major kinds, exhaustibility, development and preservation. Forests: Importance, depletion and degradation, National forest programme (NFP)-Aforestation social and agro forestry, forest conservation, management. Wild life: definition ecological balance, importance of wild life, causes of depletion and extinction of wild life, wild life management. Biological Diversity: Definition, types, natural and anthropogenic causes of depletion, red data book, rare, endangered, threatened and near extinct species, biodiversity conservation.

ES-4: Conventional And Non-Conventional Energy Resources

Max.Marks:100

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.

ES-5 Lab-1

Max.Marks: 100

SEMESTER-II

ES-6 ENVIRONMENTAL CHEMISTRY

Max.Marks:100

1. **Fundamentals of environmental chemistry:** Stoichiometry, Gibb's energy, chemical potential, chemical equilibrium, acid base reactions, solubility product, solubility of gasses in water, the carbonate system, unsaturated and saturated hydrocarbon, radionuclide.
2. **Chemical composition of air:** classification of air, chemical speciation, particles, ions, 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.
3. **Water chemistry:** Chemistry of water, concept of DO, BOD, COD, sedimentation, coagulation, filtration, Redox potential.
4. **Lithosphere:** Chemical composition of the earth, minerals, fossil fuels and soils.

ES-7: INSTRUMENTATION

Max.Marks:100

Microscopy: Compound, phase contrast, florescent, electron microscope. Spectrocolorimeter, spectrofluorimetry, atomic absorption spectrophotometer, flamephotometer, ion analyzer, oxygen and carbon dioxide electrode, biosensors. Radioactive techniques and scintillation counter, pH meter, refractometer, bomb calorimeter, nephelometer, paper chromatography, gas and high pressure liquid chromatography (HPLC), smoke meter. Samplers-types, methods of sampling preservation. NMR, ESR spectroscopy. Electrophoresis.

ES-8: SOIL SCIENCE

Max.Marks:100

Soil Genesis: Weathering processes and soil formation. Soil profile development, chemical mineralogical composition of soil. Soil classification.

Soil Organic Matter: Sources, composition, microbial decomposition of organic matter, Humus formation. Nature and properties of humus. Clay-Humus complex, significance of C:N ratio. Soil colloidal system, cation and anion exchange phenomena. Soil reaction: Soil pH, Buffering capacity. Soil acidity, alkalinity, salinity-nature, formation and control. Soil major nutrients and Trace elements. Soil, water-Different forms, Hydroscopic, capillary and gravitational. Movement of soil water under saturated and unsaturated conditions. Soil Air: composition and gaseous exchange between atmosphere and soil air.

Soil Temperature, Absorption and loss of heat, Thermal conductivity through a soil profile.

ES-9: BIostatISTICS AND COMPUTER APPLICATIONS **Max.Marks:100**

Application of biostatistics in the environmental study. Basic idea of probability. Measures of central tendency (mean, median, mode), standard error deviation. Distribution pattern: normal, binomial, poisson, sampling methods and sampling errors. Chi-square test, test of significance, analysis of variance. Correlation and regression.

Introduction and history of computer. Computer basics, data representation. Input and output units, computer memory, processor, machine language programme, operating system, ecomodelling and forecasting of environmental problems with the help of computer.

ES-10: Lab-2

Max.Marks:100

SEMESTER-III

ES-11: Environmental Toxicology

Max.Marks:100

Principles in toxicology; Animal management in toxicological evaluation; Animal toxicity tests; Statistical concepts of LD₅₀; Dose-effect and Dose response relationship; Frequency response and cumulative response; Biological and chemical factors and influence toxicity; Bio-transformation and Bio-accumulation. Influence of ecological factors on the effects of toxicity, Pollution of the Ecosphere by industries; Global dispersion of toxic substance; Dispersion and circulating mechanisms of pollutants; degradable and non-degradable toxic substances; food chain. Eco-system influence on the fate and transport of toxicants. Aquatic toxicity tests; Statistical tests; Response of planktons to toxicants; EC₅₀; Photosynthetic bacteria; Bio-absorption of heavy metals. Information management system in Eco-toxicology.

ES-12: Environmental Microbiology & Biotechnology

Max.Marks:100

Waste land and their reclamation, fermentation technology, Vermiculture technology, Biofertilizers technology. Microflora of atmosphere: Air sampling techniques, identification aeroallergens, air borne disease and allergies, GEMs. Tolerance ranges, carrying capacity, bioaccumulation, control of air pollution by plants, response of plants and animals to change in physiochemical characteristics and distributions of plants in relation to pollution (microphytes, phytoplankton, periphyton and moorophytes)

Biodeterioration of Leather, Fiber & Wood.

ES-13: Environmental Law & Sustainable Development

Max.Marks:100

Natural environment policy statement on abatement of pollution legislation-Forest Conservation Act: 1982, Water (Prevention and Control of Pollution) Act 1974, Environmental Act, 1986. Wild life protection Act, 1972. Hazardous waste (management and handling) rules 1989.

Manufacture, use, import, export and storage of hazardous microorganism. Scheme for labeling of environmental friendly products (Eco-mark scheme). Public liability Insurance Act 1991. National and international organizations dealing with environmental issues. Famous environmental conventions.

ES-14: Pollution Monitoring & Bioremediation

Max.Marks:100

Concepts: Pollutants vs. resources; cycling of materials, tolerance ranges, carrying capacity, Bioaccumulation. Air Pollution: Responses of plants and animals, monitoring air pollution by plants (for example, lichens); control of air pollution by plants. Water pollution: Responses of plants and animals to changes in physico-chemical characteristics; distribution of plants in relation to pollution (microphytes; Phytoplankton, periphyton and moorophytes); Biological monitoring of pollution in water, Biological control. Soil pollution: Responses of plants to soil pollution, changes in soil characteristics, by waste disposal, sanitary land fills, mining wastes, and human activities, plants and animals in degraded soil; soil pollution.

Bioremediation, Factors affecting Bioremediation. Biodegradation of Pesticides, Hydrocarbons etc.

ES-15: Lab-3

Max.Marks:100

SEMESTER-IV

ES-16 Environmental Impact Assessment & Auditing

Max.Marks:100

Environmental impact assessment: Introduction, concept and aims, impact statement, methods and processes, mitigation process. Predictions and assessment of impact on air, water and noise. Public participation in environment decision making. Environmental education and awareness, environmental economics, economics of pollution control, cost benefit analysis. Prediction and assessment of impacts on the biological, cultural and socioeconomic environment, introduction and basic concepts. Environmental impact assessment of major developmental projects, industries: mining, thermal power plants, atomic power stations, transport and tourism, water resource and disaster management.

Environmental audit, introduction, concepts, steps, methodology. EIA of different xenobiotics (chemicals, fertilizers, heavy metals)

ES-17: Meteorology & Remote Sensing

Max.Marks:100

Meteorology fundamentals- Pressure, Temperature, Wind, Humidity, Radiation, Atmospheric stability, Adiabatic processes, Turbulence & Diffusion. Scales of Meteorology. Application of Meteorological principles to transport & Diffusion of Pollutants. Scavenging processes. Effect of Meteorological parameters on Pollutants & Vice-versa. Wind Roses, Topographic effects, Seasons in India, Monsoons, El-Nino, ENSO, Global Warming, Ozone Depletion, Acid Rain, Earth Summit, Kyoto Protocol.

Principles of Remote sensing & its Application of Environmental Sciences.

Fundamental concept of GIS with its Application in Environmental Management.

ES-18.1 Environmental Pollution and Control

Natural and anthropogenic sources of pollutions. Primary and secondary pollutants. Transport and diffusion of pollutants. Methods of monitoring and control of air pollution (SO_x, NO_x, CO_x, SPM), effect of pollution on human beings, plants, animals, material and on climate. Air Quality Standards.

Type, sources and consequence of water pollution. Physico-chemical and bacteriological sampling and analysis of water quality standards. Sewage and waste water treatment and recycling. Water quality standards.

Physico-chemical as bacteriological sampling as analysis of soil quality. Soil pollution control. Industrial based effluent and heavy metals their interaction with soil components, soil microorganism and their function, degradation of different biocides in soil.

Sources of noise pollution, measurement of noise and indices, effect of meteorological parameters of noise propagations. Impact of noise on human health.

ES-18.2 Environmental Hazards

River Flooding: Causes, nature and frequency of flooding; nature and extent of flood hazard; urbanization and flooding; environmental effects of flooding; flood mitigation methods; landslides: causes; human use and landslides; prevention and correction. Coastal hazards: tropical cyclone and tsunamis; coastal erosion; sea level changes and its impact on coastal areas. Earthquakes: causes, intensity and magnitude of earthquakes; geographic distribution of earthquake zones seismic waves, travel-time and location of epicentre; nature of destruction; ground subsidence; protection from earthquake hazards; volcanism: nature, extent and causes of volcanism, volcanic materials geographic distribution of volcanoes; volcanism and climate.

ES-18.3 Environmental and Occupational Health

Basic principle of environmental health. Physiological responses of man to relevant stresses in the environment. Cases and effects of pollution. Industrial Toxicology: Study of environmental dose effect relationships. Evaluation of toxicity and threshold limits. Principles and methods of occupational health. The relationship of occupation of hygiene and safety and disease. Health maintenance: Survey, analysis and recommendations regarding health and safety problems in the working and living environment. Biostatistics, epidemiology: Application of statistical methods to medical records in the study of health problems of human population in a given environment. Treatment of variation, with demographic, vital statistics and epidemiological data. Hazard evaluation in polluted environment with specific emphasis on radiological health. Industrial hygiene technology-laboratory remains illustrating the principles, methods of recognizing evaluating and controlling environmental hazards like air pollution, etc.

ES-19&20: Dissertation/Project/Summer Training/
Review Article

Max.Marks:200