

Dr. K.N. Modi University, Newai, Rajasthan

SYLLABUS FOR Ph.D. ENTRANCE EXAMINATION (ENVIRONMENTAL SCIENCES)

UNIT I- ENVIRONMENTAL GEO-SCIENCE AND ATMOSPHERE: Definition, evolution, and history of Environment and environmental Sciences, primary differentiation and formation of core, mantle, crust, magma generation, dynamics of earth, plate tectonics; Continental drift theory; earth's magnetic field, types of seismic waves; formations and classification of rocks rock cycle, fold, and fault, major types of fold and faults; weathering and their types; soil profile, soil classification, soils of India; geochemical cycles; different layers and their characteristics of atmosphere; meteorological aspects; electromagnetic radiations, solar radiation and terrestrial radiation; heat budget, temperature measurements and controls, environmental lapse rate, humidity, mixing ratio, dry and wet adiabatic lapse rate, clouds-types and their characteristics and atmospheric stability; elements of weather and climate, classification, energy balance in atmosphere, atmospheric general circulation; precipitation and types of storms, Indian monsoon, El Nino, La Nina effect, and western disturbances, geostrophic wind and gradient wind, cyclones; forms of cloud condensation; global climate variability and climate change, weather forecasting models.

UNIT II- ECOSYSTEM CONCEPTS AND POPULATION DYNAMICS AND NATURAL RESOURCES: Principle and concept of ecosystem, types of ecosystems; components of ecosystem, biomes, eco-tones and edge effect, ecological niche and equivalents, ecotype, ecophene and ecological indicator; biogeochemical cycling Carbon, Nitrogen, Phosphorus and Sulphur, C3 and C4 pathways and their significance; ecological pyramids of number, biomass and energy, food chain, food web and trophic levels, ecological amplitude and ecological niches, ecological energetics, decomposition, ecosystem stability, ecological succession; primary and secondary productivity and the factors affecting productivity; forest ecosystem, grassland ecosystem, desert ecosystem and wastelands, aquatic ecosystem, wetland ecosystem.; characteristics of population, concept of carrying capacity, population growth and regulation, population fluctuation, dispersion and meta- population; concept of r and k species, key stone species; community, its characteristics, diversity, dominance, structure, stratification, periodicity, fluctuation within community, interdependence within community; Natural resources (characteristics and classification, concept of endemic, extinct and threatened species); plants as a natural resource, degradation of plant resources; wild life as natural resources, depletion of wildlife; fisheries; soil as a natural resource, wind and water erosion in soil degradation; impact of exploitation of minerals on environment, methods of conserving the mineral resources; energy, demand and supply scenario in India, energy conservation measures; coal, oil, natural gas, hydro energy, wind energy, tidal energy, solar energy, nuclear energy, biogas, firewood, petero-plants, dendro-thermal energy and their application; Natural Resource Conservation Strategies & Management (in-situ conservation of plants and animal species; ex-situ conservation; Conservation of forests, social forestry and agro-forestry, carbon sequestration).

UNIT III- DISASTERS: Meaning and definitions, characteristics of disasters, classification of disasters: natural and man-made hazards, hazard zonation and risk assessment, mitigation strategies; man- made disasters, biological disasters, chemical and radiological disasters; nature and types of natural disasters, general effects of natural disasters; earthquake and seismic hazards, volcanic eruptions, landslides, snow avalanches, floods, cyclones, tsunami, drought, heat and cold waves (meaning, types, general characteristics, causes and impacts, prediction, warning and mitigation measures).

UNIT IV- ENVIRONMENTAL POLLUTION GLOBAL WARMING, GREENHOUSE EFFECT AND ACID RAIN: Definition and sources of pollution, different types of pollution (sources, impacts and management of air pollution, water pollution, noise pollution, soil pollution, thermal pollution, radiation pollution; Natural and man-made radiation, sources of ionizing radiation, types of ionizing radiation, radiation dose and units, direct and indirect effects, dose limits, radiation hazard; impact of radiations on biological molecules (proteins, nucleic acids, lipid and carbohydrates); Global Warming Potential, possible impact of global warming, trends of emission of Carbon dioxide, Nitrous Oxide, methane, CFCs, Sulphur hexafluoride; GHG inventories; Sectoral emissions; time series plots of GHGs and temperature; consequences of global CO₂ changes; strategies for conservation of environmental changes induced by

CO₂Rise; greenhouse effect – policy response, El-NINO Climate Cycle; ozone in the atmosphere, ozone depletion, ozone hole, worldwide, ozone trends, consequence of ozone depletion; nature and development of acid rain, impacts of acid rain on aquatic environment, terrestrial environment, build environment, human health, mitigation of acid rain.

UNIT V- ENVIRONMENTAL CHEMISTRY AND GREEN TECHNOLOGY: Concept and scope of environmental chemistry; Chemistry of various organic and inorganic compounds; Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganisms; Stoichiometry, Gibb's energy, chemical potential; Chemical equilibrium, Acid-base reaction, solubility product, solubility of gases in water; Solubility product, solubility of gases in water the carbonate system unsaturated and saturated hydrocarbons; Pesticides (classification, degradation, analysis, pollution due to pesticides and DDT problems, organochlorides, organophosphates, organo-carbamates, herbicides; synthetic polymers (microbial decomposition, polymer decay, ecological and consideration, photosensitize additives); Thermo-chemical and Photochemical reaction in the atmosphere, Oxygen and Ozone chemistry, Chemistry of Air pollutants; photochemical smog. O₃, N₀x, HC CFCs and PAN; Chemistry of greenhouse gases, emission of CO₂; consequences of greenhouse gases, their control and remedial measures, threats of Global warming; overview of green chemistry, principles of sustainable and green chemistry; introduction to nano-materials and green nanotechnology; application of green technology; Biofuel production (bio-ethanol and biodiesel).

UNIT VI- ECOTOXICOLOGY AND ENVIRONMENTAL HEALTH: Origin and scope of toxicology, relationship with other sciences; classification of toxicants, natural and synthetic toxins, sources of toxicants; toxicants and toxicity, factors affecting toxicity, types of toxins and basic mechanism of action; dose response relationship, LD 50, LC 50, toxicity testing, acute toxicity tests; sub-acute and chronic toxicity tests, heavy metal toxicity tests; environmental toxicants (mode of action of toxicants, factors affecting the metabolism of xenobiotics; transport process mechanism of toxicants); Mode of action and impacts of Arsenic, Cadmium, Lead, Mercury, Carbon-Monoxide, Nitrous Oxide, Sulphur Dioxide, Ozone, Cyanide, mode of action of pesticides; health impacts of toxicants on human and aquatic life, long-term effects- chronic, carcinogenic, mutagenic and teratogenic effects; environmental factors affecting health, environmental health problems and its causes; occupational cancer: cancers caused due to Asbestos, Benzidine, Chromium, Nickel compounds, Arsenic, Cadmium; water-borne diseases; Vector-borne diseases; diseases caused by chemical and physical agents.

UNIT VII- ENVIRONMENT IMPACT ASSESSMENT: Origin and benefits of EIA, rapid and comprehensive EIA perspectives, sources and collection of data for EIA; measurement of Impact (physical, social, economic, natural); EIA Methodology (outline of EIA process, screening, scoping, purpose of scoping, impact implications, baseline studies and superimposition of projected plant emission impacts; reliability of database; intrinsic and external database supports and interpretation; checklist, matrices, overlays and geographical information system, impact analysis and predictions); Public hearing as part of EIA; EIA report; prediction and assessment of impacts on water environment, air environment, noise environment, biological environment, cultural and socio-cultural environment; Social Impact Assessment (SIA), Strategic Environmental Assessment (SEA), types of impacts, Public involvement, Public Hearing compulsion, restoration and rehabilitation methodologies, Mitigation criteria, Project modification, Post project analysis; Environmental Management Systems (EMS).

UNIT VIII- RESEARCH METHODOLOGY AND STATISTICS: Characteristics and types of scientific research; organizing scientific research (experimental design, research methodology, sampling designs); importance and scope of Statistics; Primary and secondary data; Sampling of data; Diagrammatic (Line, bar, pie diagram) and Graphic (Histogram, frequency polygon, frequency curve, cumulative frequency curve) representation of data, Measures of central tendency – Mean (AM, GM and HM), Mode and Median; Measures of dispersion, skewness and kurtosis; Probability Distribution (Binomial distribution, Poisson distribution and Normal distribution); Statistical Tests: Chi square tests, Co-relation and regression, Analysis of variance (one way and two way analysis of variance); computer application and environment system analysis.

UNIT IX- TECHNIQUES IN ENVIRONMENTAL MONITORING: Sampling Methods (Sampling methodologies for Air, Water, Soil, Noise and Radioactivity); Sampling protocols, preservation, storage and handling of samples; Analytical Instruments: Principles, working and applications of High volume sampler, Respirable Sampler, Impactors, Cyclones, Particle Size Analyser, Gas Analysers, Spectrophotometer (UV-Visible), Flame Photometer, Atomic Absorption spectrophotometer (AAS). Head space analysis, leaching tests, and immunoassay; Advanced Microscopy and Chromatographs (principles, working and applications of Phase contrast, fluorescent, polarization Microscopes, SEM, Gas Chromatograph, GC-MS, HPLC, Ion chromatograph, X-ray diffraction; Radiation Detectors and Monitors (principles and working of radiation detectors and semiconductor; principles and working of Alpha Counter, Beta Counter, Gamma-ray Spectrometer, Liquid scintillation Counter, Beta-Gamma survey meters, Alpha, Beta and Gamma contamination Monitors); Remote Sensing and GIS, scope and systems of remote sensing; Electromagnetic Spectrum and Radiation principles; remote sensing systems, sources of remote sensing information; advantages of remote sensing; Microwave Sensing and Radar equation; aerial photographs and satellite imageries (characteristics of aerial photographs, visual interpretation of aerial photographs and satellite imageries and instruments used in interpretation); Digital Image Processing; application of remote sensing in natural resource management, hazard and disaster mapping and management; GIS (principle, terminology, space and time in GIS, maps and its characteristics, map scale, spatial relationship); data structure and spatial analysis in GIS; software used in GIS.

UNIT X- ENVIRONMENTAL LAW, GOVERNANCE, POLICY ENVIRONMENTAL TREATIES AND CONVENTIONS: Environmental Policy in India, Indian Constitution and Environmental Protection; Environment (Protection) Act, 1986; Powers of Central Government under EPA; Prevention, Control and abatement of environmental pollution under EPA; Hazardous wastes (Management, Handling and Transportation) Rules, 2008; Public Liability Insurance Act, 1991; Water (Prevention and Control of Pollution) Act, 1974; Air (Prevention and Control of Pollution) Act, 1981; Noise pollution (Regulation and Control) Rules, 2000; Wildlife (Protection) Act, 1972; Protected Areas and Trade and Commerce under WPA; National Forest Policy; Forest Conservation Act, 1986; Biological Diversity Act, 2002; Judicial Response towards Environmental Protection; Public Nuisance under IPC (Sections 268, 277, 278, 284, 290, 291); Sections 133-143 of Criminal Procedure Code, 1973; Role of UN authorities in protection of Global Environment; Evolution of International Environmental Law, International Environmental Law; Green Economy (Green economy and green economy initiatives, Role of UNEP, Brundtland Commission, Economic Growth and Environment, Environmental Kuznets' curve); Stockholm Convention (1972); Basel Convention (1989, 1992); Earth Summit at Johannesburg (2002); Earth Summit Rio De Janeiro (1992, 2012); Kyoto Protocol, 1997; Montreal Protocol, 1987; Ramsar Convention on Wetland, 1971; Paris Agreement (2015); Rotterdam Convention; Agenda 21, Sustainable Development Goals; National Environmental Policy, Environmental regulatory framework in India; Role of International Environmental Agencies (UNEP, GEF, UNFCCC and IPCC); Carbon Trading; Carbon Credits; Carbon Sequestration; carbon footprint.