



Syllabus: Syllabus for Paper II
PhD Entrance Examination
TERI School of Advanced Studies

The core theme of the Department of Energy and Environment PhD entrance examination will be in the from a multi-disciplinary perspective.

Applicants can select one of the following tracks, Environment and Climate Studies, Renewable Energy and Urban Development. Prospective students appearing for the written examination can opt for only one of the specific tracks as per their research interest.

The syllabi for these three tracks are as follows:

Track 1:

Environment and Climate Studies Ecology and Environment:

Ecosystems: Fundamental concepts and principles; Structure and function, Ecosystem services. Food chain, Trophic levels and Food Web, Biodiversity, threats to biodiversity, Conservation of biodiversity. Environmental Health: Dose response relationships, frequency response and cumulative response; statistical concepts Lethal Concentration / Lethal Dose (LC/LD) 50

Atmospheric and Earth Processes:

Structure and composition of the atmosphere – weather elements. Potential temperature, dry and moist adiabatic lapse rates. Stability in the atmosphere, mixing heights and Meteorology Fundamentals. Geological processes and ocean margins, land-ocean interaction; biogeochemical cycling of elements. Hydrology, floods, structure and geological components of earth, geological timescale, rocks and rock cycle, rock forming minerals, mineral resources, geosphere, lithosphere, weathering, paleotectonic, geomorphology.

Environmental Management:

Human activities and impacts: local, regional and global; short-term and long-term impacts on Environment. Concepts of carrying capacity and global commons. Environmental impact of energy use; energy intensities, environmental damage potential. Greenhouse forcing contribution (GFC) and greenhouse warming potential (GWP), evaluation of greenhouse index. Disaster Management and Risk analysis, floods, droughts, earthquakes, landslides.

Pollution Studies (Air, Water and Soil) and Solid Waste Management:

Causes, effects and control measures, Pollution case studies, Air pollution, (particulates and gaseous pollutants), heavy metals in air. Sources and diffusion of SO₂, CO, NO_x smoke, Greenhouse gases.

Water pollution – freshwater and marine, ecological and human health aspects of water pollution, water chemistry. Type, sources of water pollution. Groundwater depletion and contamination.

Soil Pollution and contamination, toxicity from the application of pesticides, insecticides, and synthetic fertilizers. Heavy metals in soil. Environmental problems related to soils: desertification, salinization, erosion. Bioremediation of contaminated soils.

Urban solid waste management, Hazardous waste management. Definition, Classification, Identification, Sources and Characteristics.

Climate Science, Sustainability, Current Environmental and Climate Issues:

Climate change, global warming, acid rain, ozone layer depletion. Climate change: vulnerability and adaptation.

Sustainability, Sustainable Development and Sustainable Development Goals, Kyoto Protocol, COP21 Paris Agreement, Climate change adaptation and mitigation.

Environmental Law and policy:

Environment Protection, International and national efforts for Environment Protection, Provision of Constitution of India regarding Environment (Article 48A and 58A). Environmental Policy Resolution, Legislation, Public Policy, Pollution control, strategies.

Wildlife Protection Act, 1972 amended 1991, Forest Conservation Act, 1980, Indian Forests Act (Revised) 1982, Air (Prevention and Control of Pollution) Act, 1981 as amended by Amendment Act, 1987 and Rule 1982, Motor Vehicle Act, 1988, The Water (Prevention and Control of Pollution) Act, 1974 as amended up to 1988 and Rules 1975, The Environment (Protection) Act, 1986 and Rules 1986. Biodiversity conservation and Agenda – 21, National Action Plan on Climate Change, INDCs.

Track 2:

Renewable Energy Basics of Electrical Systems: DC circuits – Loop and mesh analysis, Network theorems, star-delta transformation; AC circuits – Behavior of series and/or parallel combination of RLC, Resonance, Complex Power, Line and Phase Voltages; Magnetic Circuit; Transformers; Electricity Infrastructure – generation, transmission & distribution, HVDC systems, Load Flow, Switch Gear and Protection; Power electronics – rectifier, inverter, AC-AC and DC-DC converters

Basics of Thermal Engineering: Laws of thermodynamics, Power and Refrigeration cycles, Heat transfer – conduction, convection and radiation; Heat exchangers; Boiling and condensation; Entropy; Enthalpy; Fundamentals of fluid mechanics; IC engines

Basic of Chemical Engineering: Dimension Analysis, Mass balance in chemical reaction, Energy balance in chemical reaction, Heat transfer in chemical processes, Absorption, and adsorption, ideal and non-ideal isothermal reactors, Biochemical reactions – catalytic and non-catalytic; Laws of viscosity; Shell energy balance; Shell mass balance Energy Systems

Renewable Energy Systems: Solar Energy: solar radiation, solar photovoltaic and thermal systems, Wind: current status, types, measuring instruments, potential assessment, Biomass: gasification, anaerobic and aerobic decomposition, fermentation and incineration and Energy from waste.

Energy Storage: Different modes of energy storage, Technology Types– Mechanical energy storage: flywheels, compressed air, and pumped hydro; Electrical and Magnetic Energy storage: Batteries, Capacitors, electromagnets, Chemical energy storage

Building and Energy: Role of building design and building services to evaluate the energy performance in buildings. Study of Climate and its influence in building design for energy requirement, Principles of energy conscious design of buildings, Building Envelope, Orientation, Building Configuration, Passive Cooling, Basic Principles of Day-lighting

Energy Policy and Regulation: Assessment of International Energy Policy & Regulatory Aspects; Indian Power Sector – Generation, Transmission and Distribution, Energy Markets & Power Exchange; Indian Electricity Regulations and Acts, Electricity Act 2003, Rural Electrification Policies; CERC – Regulations, Orders, Tariff Guidelines.

Track 3:

Urban Development: Ecosystem: Natural and man-made ecosystem; Ecological principles; Concepts of Environmental Impact Analysis; Environmental considerations in planning and design; Thermal comfort, ventilation and air movement.

Green Building: Concepts and Rating; Building Performance Simulation and Evaluation; Environmental pollution- types, causes, controls and abatement strategies.

Urban design and planning: Concepts and theories of urban design; Public Perception; Townscape; Public Realm; Urban design interventions for sustainable development and transportation; Historical and modern examples of urban design; Public spaces, character, spatial qualities and Sense of Place; Urban renewal and conservation; Site planning; Landscape design; Development controls – FAR, densities and building byelaws.

Urban planning and policy: Planning process; Types of plans - Master Plan, City Development Plan, Structure Plan, Zonal Plan, Action Area Plan, Town Planning Scheme, Regional Plan; Salient concepts, theories and principles of urban planning; Sustainable urban development; Emerging concepts of cities - Eco-City, Smart City, Transit Oriented Development (TOD), SEZ, SRZ etc. Housing; Concepts, principles and examples of

neighborhood; Housing typologies; Slums; Affordable Housing; Residential densities; National Housing Policies, Programs and Schemes.

Urban Infrastructure: Transportation, Water Supply, Sewerage, Drainage, Solid Waste Management, Electricity and Communications. Process and Principles of Transportation Planning and Traffic Engineering; Road capacity; Land-use – transportation - urban form inter-relationships; Traffic and transport management and control in urban areas; Mass transportation planning; Paratransit and other modes of transportation, Pedestrian and slow-moving traffic planning. Principles of water supply and sanitation systems; water treatment; Water supply and distribution system; Water harvesting systems; Principles; Sewage disposal methods; Methods of solid waste management - collection, transportation and disposal; Recycling and Reuse of solid waste