

**Savitribai Phule Pune University**  
**Online Entrance Exam' 2024**  
**Syllabus for MSc in Environmental Sciences**

**Unit 1: Environmental Issues**

**Green House Effect:** Introduction; sources of greenhouse gases (GHG); major GHG; emission of CO<sub>2</sub>; impact of GHG on global climate; consequences of GHG effects; remedial measures of GHG effects; impact of global warming on – human health, agriculture, biodiversity etc. Ozone depletion, global warming and climatic change. Ecological restoration, Energy crisis and conservation, Clean Development Mechanism, Carbon emissions, Carbon Sequestration, Carbon credits. Biodiversity conservation, Hotspots, Life cycle analysis, Bio-resources and their impact on local economy, Sustainable development, Conventions and Protocols, Climate change, Copenhagen outcome, GM plants and it's controversies. Role of NGO's in Environment conservation, WTO and environmental issues, Environmental Movements: Genesis of global environmental movement, Chernobyl disaster. The green revolution, food crisis and population explosion, Pastoralism, Rehabilitating degraded lands, The Gender and environment debate. Environmentalism and political economy, Aspects related to Eco-housing, E- waste management, Eco-journalism, Biological warfare, Eco- terrorism, Issues related to Shipping, Water Crisis. Citizen participation and representation in environmental issues; the national environmental advisory forum; Access to environmental information. Environmental Toxicology, Nano- technology. Ecological conflicts and the environmental movements in India: Narmada Bachao Andolan, Appiko Movement, Chipko movement, Silent Valley Movement, Tehri Dam conflicts, Almatti dam, Bhopal gas tragedy, Soil Erosion, Formation and reclamation of Usar, Alkaline and Saline Soil. Resources depletion and pollution (case studies), environmental problems of urbanization, environmental problems of slums, population, poverty and environment in India, international trade and economic reforms on the environment, industrial growth, environmental and ecology in India, major issues in sustaining growth and development in less developed countries. Use of computer in environmental health modelling, environmental health modelling, Resource management by remote sensing & GIS. Land use policy for India; Urban planning for India; Rural planning

and land use pattern; Concept and strategies of sustainable development; Cost-Benefit analysis. Environmental priorities in India and sustainable development. Ganga Action plan, Interlinking of rivers, Handling of Solid waste management, Tribal community problems and their rehabilitation, Natural disasters and their management. Waste lands and their reclamation; Desertification and its control; Vehicular pollution and urban air quality; Depletion of Nature resources; Biodiversity conservation and Agenda-21, COP. Waste disposal, recycling and power generation; Fly ash utilization; Water Crises-Conservation of water; Environmental Hazards; Eutrophication and restoration of Indian lakes; Rain water harvesting; Wet lands conservation; Epidemiological issues (e.g. Goitre, Fluorosis, Arsenic). Occupational Health & Safety

## **Unit 2: Biology, Biodiversity & Wildlife**

**Basic Biology:** The evolution of life on earth: Origin of life - Microbes, Plants and Animals, fossils and sediments, distribution and pattern of life in past, Paleontological evidences, Mass extinction. Life forms on Earth (all forms of plants and animals), Life in Water, Life on Land, Microbial life in air, water and soils, microbes and diseases, decomposing soil microbes, marine biology. Taxonomic principles: hierarchy and kingdoms, identification and nomenclature. Classification of plants and animals based on form-relationship, species concept, organization of living things, microbial classification, Ecological Classification Systems, Collection and Herbarium, Preservation, flora, fauna, preservation of insects. Ecological adaptation under various environmental conditions, Hydrophytes, Xerophytes, Halophytes, Mesophytes, Epiphytes. Distribution of life on earth and factors responsible for present day distribution; Continental drift

**Biological Diversity** -Biodiversity concept, Definition. Organisms evolution and distribution in space and time; types of biodiversity – ecosystem, species and genetic, Biodiversity at local, national and international level, History and origin of species diversity, Species variation, convergence and divergence in species, number of species of microbes, plants and animals, Centers of diversity, concept of endemism, types and endemic species with examples. Origin and evolution of species diversity, **Agro-ecosystem** – factors responsible for variation, Ecosystem diversity- classification of ecosystem, major ecosystems of India and their

characteristics, floral and faunal elements. **Genetic diversity** – Brief introduction to genetic variation in species, concept of genetic drift, gene pool; measurement of genetic diversity using DNA, chromosomes, molecular markers. Concept of hotspots and the basis of hotspot identification, detailed account of Western Ghats as a hotspot, India as mega-biodiversity nation, Mayr's system and latest estimates. **Value of biodiversity** – direct and indirect value as food, fodder, timber, forage, medicinal and ornamental, other benefits of biodiversity. **Loss of biodiversity**- Factors responsible for degradation of ecosystem, fragmentation, pollution and overexploitation, change in habitat, effects of climate change, genetically modified organisms and their effects on ecosystem, human-wildlife conflict. **Conservation of biodiversity** –need and awareness, In-Situ and Ex-Situ conservation with examples, traditional methods of conservation, International and national efforts for biodiversity conservation

**Wildlife Biology:** Concept of Wildlife Biology, Definition of Wildlife (Refer to Wildlife Protection Act), examples of protected wildlife species. **Diversity of major groups of plants and animals** **Plants**- Algae, Bryophytes, Pteridophytes, Gymnosperms, Angiosperms (Monocots and Dicots) **Animals**: Invertebrates- Arthropods (Insects, Arachnids, Crustaceans, Millipedes, Centipedes). Vertebrates- (Mammals, Birds, Fish, Reptiles, Amphibians), habitats of faunal species. **Wildlife Habitats**- Aquatic (Marine, Freshwater, Brackish) Terrestrial habitats (Vegetation types- forest, grassland, arid zones, hot and cold deserts, agriculture, landscape patterns Examples of food chain in each type of habitat. **Threats to Wildlife**- Habitat destruction, developmental projects, urbanization, agricultural expansions, excessive harvesting and poaching, human wildlife conflict, examples of excessive exploitation of plants and animals. **Wildlife Management Techniques**- Population assessment techniques for flying insects, Birds and Mammals: Transects, Point Counts, net swipes, census from pug marks, camera trapping. Diversity assessment for plants- Determination of sampling area, quadrates, transects, point centre method, Diversity Indices and its applications. **Application of GIS and Remote Sensing** (Radio tagging) in monitoring of Wildlife and wildlife planning and management. **Biodiversity hotspots**, reasons for biodiversity formation, contribution to adaptive evolution, land races of crop plants, conservation of genetic resources, highly productive and unique habitats, examples of wetlands and mangrove ecosystem

### **Unit 3: Environmental Chemistry**

Stoichiometry, Gibb's energy, chemical potential, chemical equilibria, acid-base reactions, solubility product, carbonate system. Chemistry of water, unusual physical properties, changes in water properties by addition of solute, hydrogen bonding, gases present in water, basic reversible and irreversible reactions in water, sources of cations and anions in water, changes in water properties by addition of solute. Chemistry of carcinogenic compounds and their effects on human body. **Surfactants:** Cationic, anionic and non-ionic detergents, modified detergents. **Pesticides:** Classification, degradation, analysis, pollution due to pesticides and DDT problems. **Lead and its compounds:** Physical and chemical Properties, behavior, human exposure, absorption, influence. **Mercury and its compounds:** Physical and chemical Properties, behavior, human exposure, absorption, influence. **Hydrocarbons:** Chemistry of hydrocarbon decay, environmental effects, effects on macro and microorganism. **Destruction of some hazardous substances:** acid halide, anhydrides, cyanides and cyanogens bromides, chromium, aflotoxins, halogenated compounds.

### **Unit 4: Earth Sciences**

**Basic Geology:** Internal structure of earth, Geological evolution, plate tectonic, formation of lithosphere. Continental and oceanic crust formation. Types of rocks, Rock cycle, basic minerals of rock, clay minerals, mineral chemistry.

**Soil Science** - Definition of soil, classification, types, soil formation. Physical, chemical and biological weathering. Main components of soil profile – Introduction, horizons – A, B, C and D. Soil morphology – texture, structure, and other physical, chemical, and biological properties. Macro and micro plant nutrients in soil; Role of soil nutrients (major, minor and trace) in plant growth, various forms of nutrients in soil, soil moisture. Soil microbes and other organisms, types and their role in soil fertility, nitrate and phosphate solubilizing microbes. Soil organic matter, its decomposition and effects on soil fertility. Soil chemistry – reactions in soil, Acidic and alkaline soils, organic manures and green manures, biofertilizers; effects of fertilizers on soil properties. Soil erosion, types of agents, factors affecting erosion. Soil pollution, types, sources, and effects of soil pollution, bioremediation of soils with

examples. Soil conservation: Methods, engineering practices and land treatment, land drainage. Need and practices for agricultural lands: physical, mechanical and biological practices. Soil classification, Soils of India in general.

**Hydrology:** Definition and Scope, Sources, Occurrence and distribution of surface and groundwater. Origin of water – meteoric, juvenile, magmatic and sea waters, chemical composition of groundwater, river water, sea water. Hydrological process: Surface run off, interception, infiltration, evaporation, evapotranspiration, groundwater flow, primary and secondary aquifers. **Water Harvesting:** Introduction to watershed, Definition, characters of materials for catchment apron. Rainwater harvesting: Techniques for preparation of water harvesting catchments, storage of harvested water, traditional methods of water harvesting, some issues related to rain water harvesting. **Groundwater Chemistry:** Groundwater quality, physical, chemical and biological properties of water, quality criteria for different uses. Groundwater quality in different provinces of India. **Water Pollution:** consequences, groundwater contamination, effects on man and environment problems of Arsenic, nitrate and Fluoride with case studies, saline water intrusion in aquifer and its prevention. **Groundwater problems and Management:** Groundwater problems related to foundation work, mining, canals and tunnels, agriculture. Problems of over exploitation, remediation, groundwater balance and methods of estimation, legislation, sustainability criteria and managing renewable and non-renewable groundwater resources and groundwater development in urban area and artificial recharge methods

**Atmosphere:** Evolution, structure and chemical composition of atmosphere. Chemistry of atmosphere, Chemical reactions involved in atmosphere, chemistry in ozone depletion, chemical reactions of global warming. Temperature measurement and controls, Environmental lapse rate, dry and wet adiabatic lapse rate, inversion of temperature and atmospheric stability. Atmospheric pressure and winds, factors affecting on wind, Forms of condensation, precipitation, hydrological cycle. Global Warming, Ozone Hole, El Nino, La Nina Phenomenon. Chemical and photochemical reactions in the atmosphere, Human Activities and meteorology,

**Ocean:** World oceans, distribution, Coastal ecosystems, Mangroves and Coral reefs, Importance in resources, impacts of climate change and issues related to pollution, conservation and wildlife. Desalination, coastal erosion, reclamation of land. CRZ, Sea Water intrusion. Ballast Water and Marine Pollution.

## **Unit 5: Ecology and Ecosystems**

**Levels of ecology** (Gene to organism – Individual to Biome, Biosphere and Landscape). Autecology, Synecology, population, community, biome, and limiting factors: biotic and abiotic. **Population Ecology** - Basic concepts of population ecology, size and distribution of population. (Random, Aggregate and uniform populations with examples). **Population dynamics** - characteristic features, Natality Mortality, fecundity, density, fluctuation, age distribution, biotic potential, prey-predator relationship, Environmental resistance in relation to absolute maximum and realized minimum carrying capacity. **Characteristics of community**- composition and structure, origin and development, ecotone, edge effect, ecological niche, interspecific and intra specific competition, examples. **Ecological Succession**- Mechanism of succession; trends of succession, climax and sub-climax concept, edaphic and climatic succession, models of succession, hydrosere and xerosere. **Concept of food chain food web**, ten percent law, net community' production, Energy flow, ecosystem concept, abiotic and biotic components. **Energy** input in ecosystem, standing crop, biomass, primary and secondary production, gross and net production, methods of measuring productivity, pattern of primary production and biomass in the major ecosystem of the world, feedback and control. **Concept of Biogeochemical cycles**, gaseous and sedimentary Hydrological cycle, Oxygen, carbon, nitrogen, sulphur, and phosphorus cycle, nutrient budget, human impact on nutrient cycles.

## **Unit 6: Terrestrial Ecosystem and Management**

**The terrestrial environment**, terrestrial biota and biogeographic regions, general structure of terrestrial communities. **The soil subsystem**, the vegetation subsystem, parameters of the terrestrial environment, hotspots in India: Western Ghats and Eastern Himalaya. **Distribution** of major terrestrial communities, patterns, structure and classification, ecotone and edge

effect, keystone species and control of community structure, types of interactions: predation, parasitism, antibiosis, commensalism, cooperation, and mutualism. **The biomes-** introduction, concept, types: Tundra, northern conifer forests, Temperate deciduous and rain forests, temperate grassland, chaparral, desert, tropical rain forest, tropical deciduous forest, tropical scrub forest, tropical grassland and savanna, mountains. **Terrestrial ecosystem services and management-** aesthetic and cultural benefits, tourism and recreation, industry, drugs and medicines, carbon pool and sequestration potential, etc. Bio-geocycles, importance, applications, Bio-geocycles as a source of plant nutrients for ecosystem maintenance **Methods of terrestrial ecosystem management-** remote sensing, geographical information system, Joint Forest Management, Eco-development program, community-based forest management, traditional methods, Forest fire: reasons, effects, control measures and management. **Methods of vegetation sampling and data analysis-** sampling approaches, quadrat methods, line and belt transect, the point frame method, vegetation classification, species association. **Management-** Exploitation and Consequences of terrestrial natural resources, Sustainable management of the same, Role of Local Government and people in conservation, Impact of Tourism, Eco-tourism Managing rain for the Future, Conservation and Sustainable use of India's Forest resources.

## **Unit 7: Aquatic Ecosystem and Management**

Limnology, the aquatic environment, the aquatic biota and water resources, water and plant functioning, structure of aquatic communities, the parameters of the aquatic environment. Distribution of major aquatic ecosystems, patterns, structure and classification, ecotone and edge effect, types of interactions: predation, parasitism, antibiosis, commensalism, cooperation, and mutualism. **Freshwater ecology-** The freshwater environment: types and limiting factors; Ecological classification of freshwater organisms, the freshwater biota (flora and fauna), lentic (lakes and ponds) and lotic (rivers, streams, springs, etc) communities, planktons. **Marine ecology-** the marine environment, the marine biota (flora and fauna), zonation in the sea, study of planktons, communities in the marine environment. **Estuarine ecology-** Definition and types, biota and productivity, food production potential, mangrove vegetation: distribution, ecological importance. **Aquatic ecosystem services and**

**management-** aesthetic and cultural benefits, tourism and recreation, pollution, etc. Methods of aquatic ecosystem management: remote sensing, geographical information system, Eco-development program, traditional methods, Methods of aquatic sampling and data analysis: sampling approaches, species association. **Management** - Exploitation and Consequences of wetlands, Sustainable management of the same, Role of Local Government and people in conservation, Impact of Tourism, Eco-tourism Conservation and Sustainable use of India's aquatic resources

## **Unit 8: Natural Resources and Nature Conservation**

**Natural resources-** biotic and abiotic resources, Renewable and non-renewable natural resources and their limitations. **Renewable resources:** Forest and wildlife resources, forest wealth of India, animal resources, livestock and fisheries. **Food Resources-** World food problems, agricultural resources, agricultural potential of India, effects of modern agriculture. **Non-renewable resources-** Fossil fuels, coal, oil and natural gas, Consequences of rapid consumption of fossil fuels. **Fresh and marine Water resources-** global distribution of fresh water and its limits, The sources of fresh water for terrestrial life, fresh water resources of India, man's water requirement, floods and droughts. **Soil and Mineral resources-** global status, mineral resources of India, metals and minerals. **Energy resources-** Global energy consumption, energy needs, conventional and non-conventional energy sources, alternative energy sources, energy resources of India. **Mans interactions with natural resources**

**Conservation-** Concept of Nature Conservation; Convention on Biological Diversity (CBD), Protected Area Network (PAN) in India, Details of PAN in Maharashtra state. **Approaches-** Species- Population dynamics and Population Genetics; Landscape/Habitat/Ecosystem approach.

**Priority for Conservation-** Hotspots, Conservation Status (IUCN Categories, Schedules according to Wildlife Protection Act). **Objectives** of Nature Conservation, Challenges (Social, Political, and Economical). **Methods-** In situ-Concept, Principles, Protected area types (global and national level, Heritage sites), Examples, challenges, merits and limitations; Ex situ-Concept, Principles, Types (captive breeding and reintroductions, seed banks, gene banks),



examples, challenges, merits and limitations; Traditional/community conservation-Concept, examples, challenges, merits and limitations. **International efforts for Conservation-** Role of IUCN, WWF and other large organizations, Role of Governments, International Conventions and Protocols, Role of NGOs, Green Peace, International Whaling Mission, BNHS, Reindeers, Tigers, Crocodile farms, Examples of extreme activism, and practical sustainable efforts. **Wildlife Law and Administration:** Wildlife Protection Act, its merits and limitations, State Symbols (Animals and Plants) Administrative Setup: MoEF, Central and State Pollution Control Boards, Interface between administration and NGO's. Personalities, Institutions, Groups & NGO working for environmental conservation

### **Unit 9: Water Quality**

Uses and source of waters, water inventory and available water, quality of natural water, water cycle in nature and in urban area, **Characteristics of water:** physical, chemical and biological, effects of water on rock and minerals, Sewage water: its characteristics and effects.

**Water pollution-** definition, types of water pollution based on source (point and non- point), characteristics (physical, chemical, physiological and biological) Lake water pollution: eutrophication, River water pollution, Groundwater pollution, marine water pollution: with special reference to oil spill and Ballast water. **Detergents-** definition, classification, effects, and control measures. Thermal pollution. **Water quality standards** and criteria for different uses and by different agencies; water analysis methods for physical, chemical and biological parameters; history of water resources development as related to current and future sustainability of water quality and quantity. Role of science and policy in solving water problems. **Control of water pollution-** at source level, by treatment methods – primary, secondary, tertiary, through law; Classification of water pollutants based on characteristics, physical, chemical, and biological with special reference to fertilizers, pesticides, and toxic compounds and heavy metals. **Water borne diseases,** bacterial, and viral, potential and wide spread effects, epidemics, preventive and curative measures. **Characterization of waste water-** quality of various industrial effluents –sources of pathogens – human risks – pollution of fresh water and estuaries. **Fundamentals of waste water treatment technologies-**

measurement of purification – insoluble and soluble material, concept of oxygen demand, tests for biologically degradable organic matter, Water crisis; World water day – 22nd March, background and awareness. Introduction to GIS-application for management of water resources

## **Unit 10: Air and Soil Quality**

**Air pollution-** Meaning and definition, Sources and Types of air pollutants, major air pollutants; types of air pollution – indoor air pollution, vehicular pollution, industrial pollution; Status of Air pollution in India, Effects of air pollution on plants; animals; human; and materials, Smog and Acid rains, Control of air pollution; Emission Standards. **Analytical Methods for Monitoring Air Pollutants-**Sampling, Monitoring, Carbon Monoxide, Nitrogen Oxides, Sulphur Dioxide, Hydrogen Sulphide, Hydrocarbons, Particulate Matter. **Air Pollution Accidents-** Bhopal Disaster, Chernobyl Disaster, Los Angeles & London Smog. **Toxicology of gaseous pollutants-** Carbon monoxide, Oxides of Nitrogen, Sulphur dioxides, Petroleum and Solvents. **Soil-** Introduction to soil and its role within a natural ecosystem and an agroecosystem, Composition of Soil, Soil types and their formation, Soil horizons, texture, soil structure, soil erosion, soil conservation. **Soil Reactions-** Acid Base Reaction, Ion Exchange, Micro and Macro Nutrients, Nitrogen Pathways and NPK in soil. **Soil Analysis-** pH, Lime, Silica and Phosphorous, Total Nitrogen, Total Manganese, Total Sulphur, Soluble Salts, Pesticides, Environmental Friendly Technologies. **Factors influencing soil-** Factors influencing soil structures and plant growth, Effect of soil aeration on plant growth, Effect of soil temperature on soil properties and on plant growth. Soil fertility- concept and evaluation. **Soil toxicology-** Organic and inorganic chemicals in the soil environment Soil, sickness due to biological agents and toxins etc. **Soil Management-** Soil as sink for waste disposal; Remediation of contaminated soil; GIS-application for management of soil resources.

## **Unit 11: Environmental Biotechnology & Ecorestoration**

**Environmental Biotechnology-** Meaning, necessity and scope, history of environmental biotechnology, objectives of environmental biotechnology. **Biopesticides and Neem pesticides** - Classification of Biological pest control agent, Manufacturing process,

Stabilization of biopesticide, formulation, mode of action, selectivity of bacteria, **Plant products**- insecticide, Neem pesticide, Simple Neem products for pest management, major states in production of Neem products, Unique multifaceted action of Neem bitters, **Effects** on Virus and organisms and Sustainable Agriculture. **Composting, Vermicomposting and Biofuels** - Composting technology, Design aspect, composting process, temp. Trend I and influencing factors, Vermicomposting, Earthworm life cycle, chemical characteristic of vermicompost, Operating vermicompost, Biofuels—Alternative to non-fossil energy resources, biological energy resources, Combustion of biomass, Biogas, Biodiesel, Ethanol and hydrogen. **GMOs in the environment** - Risk of GMO's, Risk assessment, Directive principles for GMO's. Measures, Deliberate release, and release criteria. Biosafety—Cartagena Protocol, Biosafety regulation. Natural Resource recovery- Oil recovery, recovery of metals, Agricultural biotechnology- Detection and diagnosis, micropropagation. **Biofertilizers**- types, and their role, Agro based solid waste and its uses. **Microbes in Environment**- Collection and Enumeration of aerial microbes, Dust droplet and droplet nuclei, Air pollution, control of air borne infection, effectiveness of the method. Ecological Relation of microbes—Enrichment, Isolation and counting method, Measurement of microbial activity in nature, aquatic habitat, Terrestrial environment, Deep-sea microbes, Hydrothermal in vent. **Microbes in Abiotic environment**- Soil as an environment, Syntrophism in soil, microbiological examination of soil, Cycles of element, Rhizosphere, Plant diseases, microbiology and petroleum. **Bioremediation**-Principles, factors responsible, microbial population for bioremediation, Environmental variation in field, Enzymatic – biodegradative pathway, Genetic Engineering Approach, Bioremediation strategies; Phytoremediation—Metal and Organic Phytoremediation, need for Research and development.

**Biotechnology for Pollution abatement**- Abatement of air and water pollution, biological treatment, Energy reaction, Anaerobic biological process and anaerobic biological treatment.

**Biodegradation process**- Bioleaching-- History, Advantages and disadvantages, microbes used; Biochemical extraction from mixture, types of bioleaching, methods of bioleaching and metal precipitation. Biosorption of metals. **Biomethanation**-Anaerobic treatment for gas generation, microbiology and biochemistry, factors affecting, Problems in biomethanation,

Design of digester, biomethanation in industries, Potential of biomethanation from MSW, merits of biomethanation from MSW and Biomass gasification. **Role of biotechnology in environment protection**, Microbial fundamentals involved in the treatment of industrial wastes, Biochemistry of waste water treatment - impact of pollutants on organisms. **Aerobic Biological treatments** - activated sludge, biofilm reactors and biological filters, Anaerobic biological treatments - UASB, **Removal of specific pollutants** - nitrate, phosphates, heavy metals, etc. **Biosorption techniques for removal of pollutants**. Microbial metabolism of pesticides and other xenobiotic components Wastewater treatment using aquatic plants; Biotechnology for air pollution and odour control, Biotechnology of solid waste disposal; Use of immobilized enzymes and microbes for pollution abatement; Improvement of microbial strains by conventional and molecular biological techniques; Computer implementation for control and monitoring of waste water. **Energy production from biomass** - biogas, ethanol, hydrogen Biotechnology application of hazardous waste management; Mining with microbes

## **Unit 12: Environmental Law & Policy, Safety & EIA and Environmental Economics**

**Elements of environmental governance**; Stockholm conference, The Earth Summit 1992 – The Rio declaration on environment and development, the Earth Summit agreements. Environmental governance in India since 1972; Environmental protection and Fundamental Rights; India's International Obligations, Public interest litigation, Public participation. The Water (Prevention and Control of Pollution) Act – 1974; The Air (Prevention and Control of Pollution) Act – 1981; The public liability Insurance Act, 1991; The National Environmental Tribunal Act, 1995; Environmental Policy Resolution.; Legislation, public Policy Strategies in Pollution Control; Motor Vehicle Act, 1988; Public Liability Insurance Act, 1991 and Rules 1991. The Indian Wildlife (Protection) Act – 1972 amended 1991; The Biological Diversity Act, 2002

Forest Conservation Act, 1980; Indian Forests Act (Revised) 1982; National Forest Policy; The Environment (Protection) Act, 1986 and Rules 1986; Scheme of labelling of environmentally friendly products (Ecomark). National Environmental Policy – 2006. Environment protection-issues and problems. International and National efforts for Environment Protection. Provision of Constitution of India regarding Environment (Article 48A and 58A).

Environmental governance and Regulation in India: Legislative efforts, Constitutional Directives, Role of the Judiciary, Working of Environmental Regulation, Enforcement, Monitoring, Role of NGOs.

**Environmental Ethics, Standards, Health & Safety:** Introduction, concept; Development of environmental ethics, ethical theories applied to the environment; the ethical dilemma, environmental ethics and population, pollution Value options, environment and technology. Introduction, Generic, Management system, benefits, ISO and the environment, Environmental management and sustainability, ISO/TC 207, Scope of ISO/TC 207's work. Overview of the ISO 14000 family of standards, ISO 14000 essentials, An ISO 14001:2004-based EMS, EMS standards, The ISO 14000 family and the Plan-Do-Check-Act (PDCA) cycle. Environmental and economic benefits; Specific applications: Automotive, Energy, Education, Food safety, Health care, Ship recycling and risks. **Environmental standards:** Ambient air quality standards, BIS standards for drinking water, WHO water quality standards. Environmental audits, Compliance and governance mechanism, Environment Status Report, Various instrumental techniques, EIA in detail with case studies, Environmental Economics, CETP. Sustainability and Sustainable Development. ESG.

### **References:**

IPCC and UNFCCC Reports

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Handbook of Environmental Law, Acts, Guidelines, Compliances, and Standards: Vol. I and II; by R.K. Trivedy; BS publ (2004).

International Environmental Law, Fairness, Effectiveness and World Order; by Elli Louka, Cambridge, (2006)

Global Environmental Governance: A Reform Agenda; by Adil Najam, Mihaela Papa, and Nadaa Taiyab (2006), International Institute for Sustainable Development (IISD), Canada

Environmental Governance and Regulation in India: by *Atiyah Curmally*; (Environment and Rehabilitation) India Infrastructure Report 2002