

Syllabus for Entrance Test

M.Sc. Environmental Science

Syllabus for M Sc Environmental Science :

The questions will be asked from under graduate level syllabi of Zoology/ Botany / Industrial Microbiology/ Microbiology/Biotechnology/ Industrial Chemistry.

Section 1: Common topics from B Sc Zoology and Botany syllabus

Ecology & Environment: Definition, Scope-Branches of Ecology. Components of the Environment-Atmosphere, Lithosphere, Hydrosphere and Biosphere, Applications of Ecology, Concept of levels of organization and biosphere. Abiotic factors-Nature of response of organisms to Abiotic factors; Laws of limiting factors and Tolerance. Autecology-Definition-Comparison of autecology and synecology, Concept of species, speciation, characteristics of population.

Basic components of an ecosystem

Basic components of an ecosystem-structure and functional aspects of an Ecosystem-Tropic structure-Ecological Niche-Ecological Dominance-Stability, Diversity rule. Homeostasis, aquatic Ecosystem-physico-chemical nature of lentic and lotic ecosystems. Types of aquatic ecosystem-structure and organization with examples of fresh water Ecosystem. Marine water ecosystem, estuarine water Ecosystem-Mangroves. Levels of organization, Laws of limiting factors Study of physical factors, • Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, Exponential and logistic growth,

Types of ecosystem and energy flow

Terrestrial Ecosystem: Tundra forest, Grassland, Desert ecosystem. Energy flow in ecosystems-Laws of Thermodynamics. Productivity-Biomass production, primary productivity and net productivity. Food Chain – Food chain: Detritus and grazing food chains, Food web, Ecological pyramids. Number and energy-inverted ecological pyramids. Types of ecosystems with one example in detail, Food web, Energy flow through the ecosystem • Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle, Anthropogenic Effects- Acid rain, Global Warming, Ozone Depletion. Conventions related to global warming, climate change and ozone depletion

Biogeochemical Cycles –Availability and rate of cycling of nutrients-gaseous and Sedimentary cycle.

Scope and relevance

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Fundamentals, Scope and relevance of Environmental Geology, Interaction of Lithosphere with Atmosphere, Biosphere and Hydrosphere. Earth's Materials: Minerals, rocks and soil. Economic importance of Mineral, Soil forming minerals and rocks. Soil conservation and erosion.

Study of Earth interior – Crust, Mantle and core. Geomorphological studies: Nature and type of land-forms. Natural Hazards-Earthquake, Volcano, Landslides, Floods, Hydrological cycle-Water quality Monitoring methods.

Community Ecology • Community characteristics: species richness, dominance diversity, abundance, Ecological succession with one example. Environmental Hazards • Sources of Environmental hazards • Climate changes • Greenhouse gases and global warming • Acid rain, • Ozone layer destruction, Effects of Climate Change • Effect of climate change on public health

Environmental Chemistry

Scope of Environmental Chemistry-Definition, theory and concept of Environmental Chemistry.

Air pollution – Definition, sources, types, Air Pollutants; Gaseous and particulate matter, smog, green house effect, acid rain and ozone depletion. Air Pollution :Types; Sources; Classification of Air Pollution Monitoring and Control

Water Pollution Causes, Types and Classification; ground water pollution, marine water pollution, minamata episode, itai itai episode, water pollution due to nutrients.Eutrophication; Assessment of Water Quality-Pollutant Monitoring and Control, Concept of DO, BOD, COD their effects on flora and fauna.

Sound pollution:

Sound, intensity, high low and median, Causes of noise pollution. Traffic congestion, subterranean trains, airplanes, and other loud noises, vehicular, transportation and mining sites. Indoor sound, Health issues related to sound, sleeping, stress, diabetes, coronary heart disease, high blood pressure, and arterial hypertension. Control and regulation, The Noise Pollution (Regulation and Control) Rules, 2000.

Soil pollution:

Soil pollution: Definition, sources & types – classification of soil pollutants, effects of pollution on soil, to health and productivity. Soil and Solid Waste Pollution

Characteristics of Wastes, Impacts of Solid Waste on Health, Occupational Hazards and Control. 1.4 Marine pollution : causes, effects and control majors II

Air and water quality analysis

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Global Environmental Problems and Issues 2.1 Green House Effect :Factors Responsible for Green House Effect; Green House Gases. 15 2.2 Global Warming; Ozone Depletion; 2.3 KyotoProtocol; UV Radiation; Acid Rain

Air and water quality standards, national & international criteria for the drinking water. Sampling, preservation, storage & processing of water sample, sewage – Municipal sewage, lake/pond, river water. Principles of potentiometry, Flame photometry, conductometry and colorimetry.

Structure of microbial cells;, Cell constituents; Differences between eukaryotic and prokaryotic cells; Reproduction of bacteria. Biology of microbes, algae, protozoa and fungi; bluegreen Algae; mycobacteria, spirochaetes and autotrophy,

Anaerobic Respiration; Nitrogen fixation. Role of Microorganisms in air, water and soil pollution – Microbes and Health hazards. Biological control – Microbial control of plant pests, pathogens and insects.

Waste management

Sources of waste, types and characteristics Sewage disposal and its management, Solid waste disposal, Biomedical waste handling and disposal, • Nuclear waste handling and disposal, Waste from thermal power plants, • Case histories on Bhopal gas tragedy, Chernobyl disaster, Seveso disaster and Three Mile Island accident and their aftermath.

Biochemical wastes, Municipal solid wastes, plastic wastes. Importance of Microorganisms in industry, forestry and horticulture, secondary metabolic products and their applications.

Bioremediation – Types of bioremediation, basics of bioremediation of surface soil and sludges, bioaccumulation, biomagnifications, biodegradation. Basics of Genetically engineered organisms in control of pollution and agriculture. Principles of staining techniques. Cryopreservation and germplasm storage. Enzyme biotechnology, isolation, purification, immobilization and uses of enzymes, uses of microbes in industry and agriculture.

Noise- Oscillatory motion, wave phenomena, sound as a wave motion, sound Intensity, the human ear,noise insulation. Impact of noise on human beings.

Radioactivity-Sources, Types and Properties of Radiation. Interaction of radiation with matter. Ionisation – direct and indirect ionization. Radiation exposure. Impact of radiation pollution on plants and animals.

Natural waters, distribution of microorganisms in the aquatic environment. Water pollution:

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definition, types sources, water-borne diseases. Determination of sanitary quality of water: SPC, Tests for coliform, MPN.

Water purification in municipal water supply. Sources of waste water-domestic, agricultural and industrial. Physico- chemical and microbiological characteristics of wastewater. Wastewater treatment: municipal wastewater treatment – Primary, Secondary, Tertiary and reclamation of wastewater. Advance treatment of wastewater. Solid waste recycling: Anaerobic digestion process, Biogas and composting.

Resource conservation:

Natural Resources and their Conservation i.e. energy, fossil fuel, nuclear, wave, solar and geothermal energies. Forest resources: Use and over-exploitation, deforestation. Timber extraction, mining, dams and their effects on forest and tribal people. Natural resources & Sustainable utilization: Land Utilization, Soil degradation and management strategies; Restoration of degraded lands. Water, Wetlands; Threats and management strategies, Ramsar sites, Forests: Major and minor forest products; Depletion, Biological Invasion, Energy: Renewable and non-renewable sources of energy, Contemporary practices in resource management.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity.

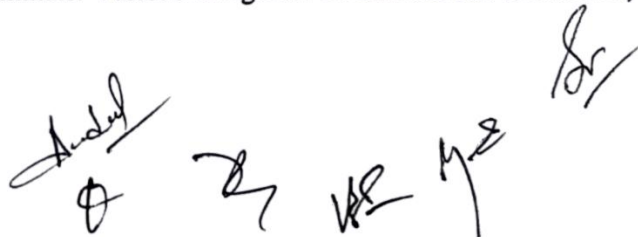
Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources.

Land resources: Land as a resource, land degradation, man induced landslides. Equitable use of resources for sustainable lifestyles.

Conservation of Biodiversity:

Definition -genetic, species and ecosystem diversity. Value of biodiversity: hotspots of Biodiversity threats to biodiversity, Biotic communities and populations, their characteristics and dynamics. Endemic and endangered species of plants in India. Ecological niche, ecotypes, ecological indicators.

Ex-situ and in-situ conservation, introduction to Red data book, botanical gardens, National park, Sanctuaries and Biosphere reserves. Role of Seed Bank and Gene Bank, Valuing plant , resources, ecotourism, Role of BSI, Conservation of minerals, Forests and wildlife, In situ and ex-situ conservation of wild animals. Various categories of animals i.e. threatened, vulnerable,



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endangered, rare and extinct, National parks, sanctuary, reserves, ecotourism, project tiger, Hangul, Rhino, Golden langur, Environmental laws for protection of wild animals and environment.

Environmental audit & Sustainability

Introductory concepts of environmental audit; Guidelines of environmental audit; Concept of energy and green audit, Concept of Sustainable Agriculture; India's environment action programme: issues, approaches and initiatives towards Sustainability; Sustainable development in practice.

Pollution, Waste management & Circular Economy

Environmental pollution, Environmental protection laws, Bioremediation, Activated Sludge Process (ASP) – Trickling Filters – oxidation ponds, fluidized bed reactors, membrane bioreactor, digesters, fixed film reactors, bioscrubbers, biotrickling filters; case study: Ganga Action Plan; implementation of CNG; Waste- Types, collection and disposal, Recycling of solid wastes (hazardous & non-hazardous) - classification, collection and segregation, Incineration, Pyrolysis and gasification, Sanitary landfilling ; composting, Biogas production.

Environmental ethics, Carbon Credits & Role of GIS

Introduction to Carbon credit: concept, exchange of carbon credits. Carbon sequestration, importance, meaning and ways. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Applications and case studies of remote sensing and GIS in land use planning, forest resources & agriculture studies.

Parasitology:

Parasitology, Structure, life cycle, pathogenicity, including diseases, causes symptoms and control of the following parasites of domestic animals and humans: Trypanosoma, Giardia and Wuchereria VI Vectors and pests • Life cycle and their control of following pests: Gundhi bug, Sugarcane leafhopper, Rodents. Termites and Mosquitoes and their control.

Economic Zoology- Beneficial and harmful insects, Animal breeding and culture: Aquaculture, Pisciculture, Poultry VIII Economic Zoology- 2 • Sericulture, Apiculture, Lac-culture, Vermiculture.

Wild Life • Values of wild life - positive and negative; • Conservation ethics; • Importance of conservation; • Causes of depletion; • World conservation strategies.
Protected areas • National parks & sanctuaries, • Community reserve; • Important features of protected areas in India; • Tiger conservation - Tiger reserves in India; • Management challenges in Tiger reserve.

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Phytogeography: Introductory concepts of -Biogeographic regions of India & world, Agroecological & Floristic zones of India. Natural vegetation of India, static and dynamic plant geography, basic principles governing geographical distribution of plants, Vegetation types in Uttar Pradesh.

Economic Botany

Economic importance of food grain crops, cereals, pulses, edible oils, essential oils, perfumes, vegetables fruits, fibres, tubers and ornamental plants, Plants natural products as alternative medicines. Micro-propagation techniques.

Section 3: Topics from B. Sc. Microbiology

Microbial diversity

Fundamentals of Microbiology: Introduction to Microbiology, Microscopy, Control of microorganisms, Prokaryotic structure and function, Biology of microorganisms, Stains and staining techniques, Fundamental principles of bacteriology. Microbial diversity, Classification of microbial diversity, Reproduction and significance of fungi, Nutritional requirements and growth of microorganisms, Isolation, culturing, and maintenance of pure culture, Growth curve and diauxic growth curve, Determination of cell count by hemocytometry

Environmental Microbiology

Concepts of Microbiology, Microbial biochemistry, Microbial physiology and adaptations, Environmental Microbiology in sustainable development, Advancement in bioremediation, Cell biology and immunology

Indicator Microorganisms A. Total Coliforms. B. Fecal Coliforms and *Escherichia coli*. C. Fecal Enterococci. D. *Clostridium perfringens*. E. *Bacteroides* and *Bifidobacterium*. F. Heterotrophic Plate Count. G. Bacteriophages

Microbial Diversity and Interactions in Natural Ecosystems A. Microbial Diversity in Natural Systems. B. Microbial Interactions. C. Microbial Diversity and Natural Products.

Soil as a Microbial Environment. D. Microorganisms in Surface Soils. E. Distribution of Microorganisms in Soil. F. Microorganisms in Subsurface Environments.

Microorganisms and Organic Pollutants A. The Overall Process of Biodegradation. B. Contaminant Structure, Toxicity, and Biodegradability. C. Environmental Factors Affecting Biodegradation. D. Biodegradation of Organic Pollutants. E. Bioremediation



Microorganisms and Metal Pollutants A. Metals in the Environment. B. Metal Solubility, Bioavailability, and Speciation. C. Metal Effects on the Microbial Cell. 5 D. Mechanisms of Microbial Metal Resistance and Detoxification. E. Microbial Metal Transformations. F. Microbial Approaches in the Remediation of Metal-Contaminated Environments.

Municipal Wastewater Treatment, Drinking Water Treatment A. The Nature of Wastewater. B. Conventional Wastewater Treatment. C. Oxidation Pools. D. Septic Tanks. E. Wetlands Systems. Sludge Processing

Section 4 : Topics from B. Sc Industrial Microbiology

Scope of industrial Microbiology, Strain improvement methods, Types of industrial fermentation processes, Immobilisation of enzymes and cells, Methods for studying microorganisms, pure culture techniques, methods of sterilization – physical and chemical, media – types, preservation techniques. Microbial growth, phases of growth, conditions of growth, measurement of growth, bacterial sporulation and germination, binary fission. Microbial genetics is the study of mechanisms of genetic information in microorganisms such as bacteria, archaea, viruses, some protozoa and fungi. Molecular genetics molecular structure of DNA, its cellular activities, and the effects of DNA in determining the overall composition of an organism.

Exploitation of microorganisms and their products, screening, strain development strategies, immobilization methods, fermentation media, raw material used in media production, antifoaming agents, buffers, downstream processing. Fermentation equipment and its uses, fermentor design, Types of fermentors and fermentations- single, batch, continuous, multiple, surface, submerged and solid state. Industrial products from microorganisms- antibiotics: production of penicillin, streptomycin. Interferons, vaccines, hormones, vitamins. Unit 4. Enzymes from microbes: amylase, protease. Organic acids: citric acid, acetic acid, amino acids: glutamic acid, lysine. Production of alcoholic beverages: beer and wine, biofuels: ethanol, methane, biogas. Production of single cell proteins, bio-fuels and antibiotics.

Microbes and Infectious Diseases Host Parasite Relationship: Normal Flora; Factors Affecting the Course of Infection and Disease; Mechanisms of Infection and Virulence Factors. Infection: Patterns of Infection; Types of Infections; Signs and Symptoms; Epidemiology and Epidemiological Markers. Diseases: Origin of Pathogens, Reservoir of infection; Acquisition of Infection; Koch's Postulates.

Study of a few pathogens with respect to Morphological, cultural, biochemical characteristics, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention S. aureus, S. pyogenes, M. tuberculosis S. pneumoniae, E.coli Proteus, Medical Microbiology - Causative Organisms- II Study of a few pathogens with respect to Morphological, cultural, biochemical

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characteristics, pathogenesis & clinical features, laboratory diagnosis, treatment and prevention, Salmonella sp. Shigella sp. HIV, P. aeruginosa Candida albicans

Section 4: Topics from B. Sc. from Biotechnology

Applications of Biotechnology in pollution management, Immunoassays, DNA-based methods, use of biosensors. Biotechnological methods in abatement of CO₂ emission, Biotechnology and Biodegradation: Degradation of xenobiotic compounds-Simple, aromatic, chlorinated, poly aromatic, petroleum products, pesticides and surfactants. Bioleaching, biosorption, oil degradation, creation of superbug. Treatment of Industrial wastes: Dairy, pulp, dye, leather and pharmaceutical industries. Genetically engineered microbes for waste treatment. Environmental Microbiology in sustainable development, Advancement in bioremediation

Concept of Bioremediation. Microorganisms in Bioremediation, Mycoremediation and Phytoremediation. Bioremediation Technologies. Measuring Bioremediation in the Field. Bioaugmentation and Biostimulation. Monitoring the Efficacy of Bioremediation

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