Syllabus

M.Sc. Course in Environmental Science

Directorate of Distance Education
VIDYASAGAR UNIVERSITY

MIDNAPORE-721102

WEST BENGAL

Syllabus of M.Sc. Course in Environmental Sciences

(Distance Mode)

M.Sc. Part I

TYPE	**PAPER**	**TOPIC**	**FULL MARKS**	**Credit**
Theory	I	Fundamentals of Environmental Science	100	8
Theory	II	Current Issues and Problems in Environment	100	8
Theory	III	Environmental Pollution and Control	100	8
Theory	IV	Environmental Impact Assessment, Eco-planning and Sustainable development, Environmental Biotechnology	100	8
Practical	V	Methods and Techniques For Environmental Analysis	100	8
Practical	VI (A+B)	**A.** Methods and Techniques of Environmental Geo-Sciences **B.** Field Work	100 (50+50)	8 (4+4)
Total			**600**	**48**

M.Sc. Part II

TYPE	PAPER	TOPIC	FULL MARKS	Credit
Theory	VII	Environmental Management, Laws and Policies.	100	8
Theory	VIII	Conventional and Non Conventional Energy Resources	100	8
Theory	IX	Environmental Chemistry and Environmental Geosciences	100	8
Theory	X	Environmental Biology; Biodiversity; Conservation Biology; Different Biomes/Ecosystems.	100	8
Practical	XI	Analytical studies on Environmental Parameters.	100	8
Practical	XII (A+B)	A. Dissertation **B.**Field Work	100 (75 +25)	8 (6+2)
		Total	**600**	**48**

Distribution of Marks for Each Theoretical Paper

Sl. No.	Theory	Marks
1	Answer any 10 questions out of 16	2X10 = 20
2.	Answer any 5 questions out of 8	4X 5 = 20
3.	Answer any 5 questions out of 8	8X 5 = 40
4.	Internal Assessment	20
Total		100 Marks

Note for paper setting: In theory papers questions will be set 16 questions carrying 2 marks each (10 to be answered), 8 questions carrying 4 marks each (5 to be answered), and 8 questions carrying 8 marks each (5 to be answered). Twenty percent (20%) marks will be assigned for internal assessment.

Syllabus of M.Sc. Part - I

Paper - I

Fundamentals of Environmental Science

Marks-100

Unit – I: Basic Aspects of Environmental Science.

Meaning, scope and interdisciplinary nature of Environmental Science; Related subjects and their relation with environmental science; Major components of the environment.

Unit – II: Global environment and its segments.

Structure and composition of atmosphere, hydrosphere, lithosphere, biosphere and Ecosphere.

Unit – III: Fundamentals of Ecology.

Meaning and scope; Ecosystems - types, structural and functional aspects; Energy flow in ecosystems, food chain, food web, trophic levels, ecological pyramids; Ecotone; Ecological niche and Ecological Succession.

Unit – IV: Environmental Resources.

Abiotic resources like Air, Water, Soil, Minerals. Forests and Energy resources; Concept of reserve and resources; Problems with the exploitation of resources and sustainable management; Population Growth – Biological Growth Curves and Carrying capacity.

Unit – V: Weather and climate.

Weather Elements and their variations; Heat balance of the earth atmosphere system; Earth as a heat engine; Major climatic zones of the world; Climates of India; Climate and vegetation; Climatic extremes - environmental implications.

Unit – VI: Energy fundamentals.

Heat transfer processes; Mass and energy transfer across the interfaces of various geospheres. Hydrologic cycle: Types and distribution of water—sustainable management of freshwater. Biogeochemical cycles — carbon, nitrogen, and phosphorus cycles.

Unit – VII: Human Ecology and Ecosystem.

Man and Environment relationship; Concepts and aspects of Human Ecology and Human Eco-system; Different terrestrial ecosystem.

Unit – VIII:Human Adaptability in different environments.

Adaptation in Arid Land, High Altitude, Humid Tropic and Arctic environment.

Unit –IX:Environmental Risk and Hazards.

Risk and hazards; Chemical hazards; Physical hazards; Biological hazards; Basics of hazard management and mitigation.

Unit – X: Human Defense system and Environment.

Role of Cell, tissue, organs of the immune system to against environmental perturbations with special reference to: innate, humoral, cell modified immunity, compliments, hyper sensitivity.

Paper - II

Current Issues and Problems in Environment

Marks-100

Unit – I:Environmental education and Awareness.

Text book knowledge v/s Traditional knowledge; Major mandates and principles on environment; Role of NGO's in environmental management; Green movement and its different dimensions;

Unit – II:Sacred groves and its conservation values.

Concept and historical perspectives of sacred grooves. Role of sacred groves in environmental conservation.

Unit – III:Environmental Ethics and Global Imperatives.

Concepts and aspects of Environmental ethics, Anthropocentrism and Eco-centrism; Deep ecology.

Unit – IV: Global environmental problems.

Green houseeffect, global warming and climate change,ozone layer depletion,acid rain,deforestation and loss of biodiversity,unplanned urbanization.

Unit V: National and Regional Environmental Issues

Resource and its conservation; Ecological refugees; Conservation strategies of the environment: Mines, riverine networks; forest, soil and wild life

***Unit – VI:*Current Environmental Movements in India.**

Silent Valley, Chipko, Narmada dam, Appiko, Tehri Garwal Dam, Uttara Kannada and Almatti dam movements.

Unit – VII:Reclamation and management of Ecosystem.

Soil erosion, Formation and reclamation of Usar, Alkaline and Saline Soil. Waste lands and their reclamation; Water shed management; Desertification and its control.

Unit – VIII:Aspects of Bio-fertilizer and Bio-pesticides

Types of bio-fertilizer; Production and application of bio-fertilizer; Merits and Demerits of bio-fertilizer; Compost and vermi-compost.Types of pests and pesticides; Application and controlling mechanism of bio-pesticides.

Unit – IX: Management of freshwater.

Present scenario of water crisis in India; Conservation of Indian wetlands and freshwater rivers; Rain Water harvesting; River linking projects in India.

Unit – X: Epidemiological issues.

Environmental quality deterioration and public/community health; Problems relating to Goitre, Fluorosis, Arsenic, Malaria, Dengue, Swain flue, HIV; Vectors of disease transmission and Vaccination.

Paper - III

Environmental Pollution and Control

Marks-100

Unit – I: Aspects of Air Pollution.

Structure and composition of atmosphere; Reactions in the lower and upper atmosphere; Sources, types and fate of pollutants; Primary and Secondary pollutants; Persistent organic and inorganic air pollutants; Acid rain and photochemical smog; Air quality standards; Ambient air sampling, analysis and measurement; Mitigative measures; indoor air pollution; Vehicular pollution;

Unit – II: Air pollution management.

Methods of monitoring and control of air pollution SO2, NO2, CO2, S.P.M.; Effect of pollutants on plants, animals, materials and on climate.

Unit – III: Aspects of Water Pollution.

Water Pollution and Waste water transport; Sources and types of water pollutants; Ground water and surface water pollution; Water quality standards; Effects on aquatic ecosystem;

Unit – IV: Aspects of Waste water.

Composition and characteristics; Waste water treatment, recycle/reuse.

Unit – V:Soil.

Physico-chemical and bacteriological sampling as analysis of soil quality.Soil pollution control ; Industrial waste and heavy metals.

Unit – VI: Impact of Synthetic Fertilizers on soil.

Different kinds of synthetic fertilizers (NP and K) and their interactions with different components of soil.

Unit – VII:**Aspects of** ***Noise pollution.***

Sources of noise pollution; Measurement of noise and indices; Effect of meteorological parameters on noise propagation; Noise exposure levels and standards; Noise control and abatement measures.

Unit – VIII:Aspects of Marine pollution.

Sources of marine pollution and control; Criteria employed for disposal pollutants in marine system; Oil Pollution;

Unit – IX: Aspects of Coastal Zone Management.

Environmental problems related to Coastal zone; Methods and techniques adopted for coastal zone management; Salient features of Coastal Regulatory Zone notification in India.

Unit – X: Impact of pollutants on human health.

Effect of air and water pollutants; Pesticides, heavy metals, noise, thermal pollution and Ionizing radiation on human health.

Paper - IV

Environmental Impact Assessment (EIA);
Eco-planning and Sustainable Development;
Environmental Bio-Technology;

Marks-100

Unit – I: Basics of EIA.

Concept of environmental impact assessment; Nexus between development and environment; Origin and development of EIA; Measurement of impact – physical, social - economical, natural; Concept of significant effect; Short term versus long term effect; Relationship of EIA with Sustainable Development.

Unit – II: Framework of Environmental Assessment.

Description of environmental setting; Environmental impact factors and area consideration; Prediction and assessment of impact on air, water, noise and biological environment; Prediction and assessment of impact on the cultural and socio-economic environment; Methods of impact analysis; Public participation in environmental decision making; Integration and Optimization criteria for Multipurpose Development Projects; Environmental auditing.

Unit – III: Impact Assessment Methodologies.

Evaluation of proposed actions and determination of impact importance; Development of value functions and scoping EIA methodologies; Comparison of alternatives and decision making; Compensatory actions - green belts; Preparation and writing of EIA/EIS; Review of procedures, practices and guidelines for EIA in India; Examples of total impact evaluation; Role of GIS in EIA – Base line study, risk assessment, risk management, mitigation measures, comparison of alternatives.

Unit –IV:Socioeconomic Impact Analysis (SIA):

Types of socioeconomic impact; Basic steps in SIA; Analysis of public services and facilities impacts; Fiscal impact analysis; Analysis of social impacts; Impacts of economic profile of the community.

Unit – V: Environmental Planning and Management.

Environmental Monitoring – Bio-monitoring, Eco-restoration,Eco-rehabilitation, Eco-remediation; Bioremediation – Concept, role of bioremediation in controlling various pollution problems like solid water, sewage water, industrial effluents, heavy metals, radioactive substances, oil spillage; Phyto-remediation – Abatement of different types of pollution using plants, types of phyto-remediation, mechanism involved with case studies.

Unit – VI: Bio-monitoring of Environmental Quality

Aquatic biota and its utility in water quality monitoring; Soil biota and its utility in soil quality monitoring; Plant responses to air quality and its application in bio-monitoring of air; Categories, basic measurement methods, computation of species richness indices – Margalef's index and Menhinick's index; Diversity indices – Shannon diversity index; Aquatic biota and its utility in water quality monitoring; Soil biota and its utility in soil quality monitoring; Plant responses to air quality and its application in bio-monitoring of air.

Unit – VII:Sustainable development.

Sustainable development – Concept, underlying principle, types and growth of the idea, indicators of sustainability, models of sustainable development; Sustainable Development Scenario – global and national.

Unit – VIII: Environmental biotechnology.

Basic concept and broad outlines of various application areas – waste treatment, biodegradation of xenobiotic compounds, hydrocarbon degradation, bioleaching:Integrated pest management: concept, technology involved in agriculture & forestry; Basic techniques in Genetic Engineering.

Unit – IX: GM Crops and Biofuel production.

Recombinant DNA technology and its application in strain improvement; Environmental implications of GM Crops and GMO. Alternate fuels: source and mechanism of various bio-fuel productions;

Unit – X: Environmental Toxicology.

Concepts and aspects of Environmental Toxicology; Air borne microbes and allergic disorders;Ecological Toxicology and Forensic toxicology – Dose response relationships, frequency response and cumulative response; Statistical concepts LD 50's – potencyversus toxicity.

Paper – V (Practical)

Methods and Techniques for Environmental Analysis

Marks-100

1. Determination of physico-chemical properties of water: pH, transparency, conductivity, DO, CO_2, alkalinity and hardness.
2. Determination of the water quality: BOD, COD.
3. Microbial water quality analysis through MPN and Spread plate method.
4. Air sampling device - demonstration of operating principles of high volume air sampler, estimation of dust particles, ambient air quality.
5. Estimation of noise level and intensity of light by sound meter and Lux meter respectively.
6. Antifungal and antibacterial activity of toxic compounds.
7. Estimation of chlorophyll andphenolics.
8. Collection and identification of particulatepollutantsincludingmicrobes.

Paper VI: (Practical)

Marks-100

VIA: Methods and Techniques of Environmental Geo-Sciences

Marks -50

1. Determination of physico-chemical properties of soil: moisture content, colour, texture, pH, temperature, organic carbon content, electrical conductivity, WHC, bulk density, pore density and porosity.
2. Study of soil profile by vertical section.
3. Interpretation of SOI toposheets and satelliteimageries.
4. Basic identification of rocks and minerals.
5. Recording wind direction and wind velocity by Anemometer and preparation of wind rose diagram.

VIB: Field Work

Marks -50

Field visit for at least two days to study the different aspects of Environment.

Syllabus of M.Sc. Part - II

Paper – VII

Environmental Management, Laws and Policies

Marks-100

Unit – I: Environmental Management.

Concept and scope of Environmental Management; Systems and approaches; Standards – international and national; Ecomark; Environmental accounts and auditing; Green funding and taxes; Trade and environmental management.

Unit – II: Ecosystem Management.

Ecosystem analysis, modeling, monitoring and planning; Ecotourism and heritage management; Eco-restoration; Environmental management of water, forest and biological resource.

Unit – III: Environmental management of industrial pollution.

Management of pollution due to chemical, mining and manufacturing industries (petroleum, coal, cement, paper, fertilizer).

Unit – IV: Management of Solid Wastes.

Different types of solid wastes; Methods of disposal and management of Municipal and Thermal power plant generated solid wastes; Bio-medical wastes and Hazardous wastes; Recycling of wastes, Power generation and waste minimization techniques.

Unit – V: Basic elements and tools of statistical analysis.

Probability sampling measurement and distribution of attributes: Distribution of normal and x^2; Poisson and Binomial—Arithmetic, geometric and harmonic means: Tests of hypothesis and significance.

Unit – VI: Introduction to environmental system analysis.

Approaches to development of models.Validation and forecasting. Models of population growth and interactions – Lotka- Volterra model. Leslie's matrix model, point source stream pollution model, box model, Gaussian plume model.

Unit – VII: International Environmental Laws.

Evolution and development of International Environmental laws with reference to Stockholm Conference, Nairobi Declaration, Rio Conference, and other international meets/summits on environmental issues.

Unit – VIII: Global environmental issues and International laws.

To control Global warming, Ozone depletion, Acid rains, hazardous waste; Role of UN authorities in protection of Global Environment, Women and environment.

Unit – IX: Environmental laws in India.

Legal, administrative and constitutional provisions for environmental protection in India; Statutory protection of the Human Environment – Factories Act, Motor Vehicle Act, Hazardous Waste legislation for pollution abatement; Biodiversity Act, 2002 and Biodiversity Rules, 2004;Anti Pollution Act; The water (Prevention and control of pollution) Act, 1974; Forest Conservation Act, 1980; Air (Prevention and control of pollution) Act 1988; The Environmental (Protection) Act, 1986; Public Liability Insurance Act, 1991; Wildlife Protection Act, 1972.

Unit – X: Sanction and enforcement bodies of environmental laws in India.

Role of Supreme Court and Green Bench of High Court; Public awareness and Government measures; Role of Pressure Groups and NGOs; Concepts and Aspects of Public Interest Litigation (PIL); Public Interest Litigation in India on different Environmental Issues.

Paper VIII:

Conventional and Non-Conventional Energy Resources

Marks-100

Unit – I: Sources of energy and their classification.

Energy forms and transformation; Sun as source of energy – Source of sun's energy, Solar spectrum, solar radiation – absorption, reflection, scattering and diffusion in the atmosphere, Albedo, Global energy balance.

Unit –II:Energy use pattern.

Human energy requirement; Energy use pattern in different parts of the world and its impact on the environment; Energy use pattern in India;

Unit – III:Fossil Fuels.

Classification, composition, physiochemical characteristics of Fossil fuels; Energy content of coal, petroleum and natural gas; Formation, reserves, exploration/ mining and uses of Coal, Oil and Natural gas; Environmental problems associated with exploration/mining, processing, transportation and uses.

Unit – IV:Bio-energy.

Biomass composition and types of Bio-energy; Conversion processes – pyrolysis, charcoal production, compression, gasification and liquefaction; Energy plantation; Biogas – production and uses, anaerobic digestion; Environmental constrains; Energy from solid Wastes – Sources, types, energy production.

Unit – V: Nuclear energy.

Fission and fusion of Nuclear Energy; Nuclear fuels; Mining and processing of Uranium – concentration, refining, enrichment, fuel fabrication and fuel cycle; Nuclear reactors and radioactive waste; Environmental implications.

Unit – VI: Solar Energy.

Harnessing of solar energy; Solar collectors and concentrators; Solar thermal energy; Solar electricity generation; Solar heaters; Dryers and Cookers; Photovoltaics.

Unit – VII: Wind energy.

Wind power; Harnessing of wind energy; Power generation – wind mills, concentrators, wind characteristics and siting; Environmental Considerations; Wind energy potential in India with special reference to Northeast India.

Unit –VIII: Hydroelectricity.

Principles of generation of hydroelectric power; hazard related to hydropower generation and distribution; Environmental impact.

Unit – IX: Geothermal energy.

Sources – crust, high temperature aquifers, low temperature aquifers, reserves; Harnessing of geothermal energy – problems and prospect; Geothermal energy prospect in India;

Unit – X: Hydrothermal energy.

Different aspects of Tidal and wave energy. Problems and prospects associated with utilization of hydrothermal energy.

Paper IX:

Environmental Chemistry and Environmental Geosciences

Marks-100

Unit –I: Chemical Thermodynamics.

Laws of Thermodynamics; Reversible and irreversible processes; Carnot cycle; Thermodynamic functions; Chemical Kinetics: Order and molecularity of a reaction; Basic kinetic laws – first, second and third order reactions; Determination of rate constant; The Arrhenius equation, Steady state concept, Enzyme Kinetics.

Unit –II: Photochemistry.

Laws of photochemistry; Fluorescence and Phosphorescence phenomena; Chemical, photochemical and photosensitized reactions in the atmosphere; Fluorescence Molecular Sensors.

Unit –III: Analytical Methods in Environmental Quality Assessment.

Principlesof titrimetry; Gravimetry; Colorimetry; Spectrophotometry; Spectrofluorimetry; Flame photometry, AAS; Chromatographic techniques; Gel electrophoresis and X-ray diffraction techniques.

Unit –IV: Bioinorganic chemistry.

Classification of elements (specially heavy metals); Coordination; Organometallic and Organo metalloidal compounds; Structure-toxicity relationships; Chemical speciation ;Concept of chelates; Chelatetherapy and drug design; Bio-essential metals and their role in life processes; DNA – binding and biological activity of metal ligand complexes.

Unit –V: Geological time scale.

An overview; palaecology (Quaternary and phanerozonic palaeontology); Reconstruction of palaeogeography; Common rocks and minerals – Major categories and their mode of origin; Physical and chemical weathering of rocks.

Unit –VI: Geomorphological process and Forms

Process and forms (Fluvial, eolian, glacial, coastal and Karst); Fundamentals of structural geology and tectonics; Coastal systems – Definitions, Energy and classification with an emphasis on broad scale geological and tectonic controls; The impact of human activity in tidal coastal systems; Mountain environment – landslides and mass wasting; Glacial processing; Periglacial process; Fluvial environment – Drainage system, Establishment of drainage system, drainage patterns, process of erosion and transportation by rivers; Erosional and depositional landforms; River basin concept and its application in regional management; Fluvial cycle of erosion; interruption of cycle of erosion.

Unit –VII: Hydrological cycles and groundwater issues.

Aquifers, Aquitards, Darcy's law and hydraulic conductivity; Groundwater quality and contamination with reference to arsenic fluoride and nitrate;

Unit – VIII: Natural hazards and its management.

Problems and prospects related to the management of Drought, Flood, Earth quake and Landslideetc;Human consequences of flood and bank erosion; Application of GIS in Environmental management.

Unit – IX: Environmental issues related to mining and construction.

Problems and prospects of Coal, mineral and metal Mining. Geological consideration of engineering constructions– Dam, Road & Rail link, Landslide area.

Unit –X: Biogeochemical cycle:

An overview of Biogeochemical Cycle; Importance of chemical and biological processes in carbon; Nitrogen and phosphorus cycle; Climate of India –Seasons in Indiaand Indian monsoon; El-nino and La-nino; Tropical cyclones and Western disturbances; Principles of remote sensing and its application in environmental science.

Paper X:

Environmental Biology, Biodiversity and Conservational Biology, Study of Different Ecosystems/ Biomes

Marks-100

Unit –I: Diversities of life forms.

Origin of life and its symbiosis with environment; Environment of Early Men; Origin and Evolution of Man.

Unit –II: Microbial Diversity.

Fundamental concept of microbial diversity – bacteria, fungi, actinomycetes; Microbial diversity in man-made ecosystems and natural ecosystems; Importance of microbes in nutrient cycling.

Unit –III: Plant diversity.

Plant nomenclature and ICBN; Major classes of plant phytogeographical regions of India; Rare and threatened plants; role of Botanical Survey of India in exploration of floral wealth.

Unit –IV:Animal Diversity.

Animal nomenclature and ICZN;Major categories of animals; Rare and threatened species of mammals; Aves; Reptiles and Pisces in India with special reference to N.E. India; Role of Zoological Survey of India/Zoo Authority of India in exploration and conservation of faunal wealth.

Unit –V: Biodiversity and wildlife.

Categories of Biodiversity and Wildlife; Basic measurement methods—Computation of species richness indices by Margalef's index and Menhinick's index; Diversity indices by Shannon diversity index; Causes and consequences of loss of biodiversity, Biodiversity

Conservation – Need of biodiversity conservation; Biodiversity conservation methods : *In-situ* Conservation – sanctuaries, biosphere reserves, national parks, nature reserves, preservation plots;*Ex-situ* Conservation– botanical gardens, zoos, aquaria, homestead garden, herbarium; *In-vitro* Conservation –germplasm and gene bank, tissue culture, pollen and spore bank, DNA bank; Biodiversity Management – International/National;Concept of SLOSS and Biosphere reserve.

Unit –VI: Global Biodiversity conservation strategies.

Role of MAB, IUCN; Intellectual property rights – TRIPS, role of Indigenous Knowledge System (IKS), Biopiracy, rights of farmers, breeders and indigenous people.

Unit –VII: Forest Ecology.

Definition of forest and forestry; Classification of forest and their distribution with special reference to mangrove forest; Composition of forest – fundamentals of forest population, community, succession, climax; components of a forest ecosystem; Interrelationship among different components in forest ecosystem; Ecological values of forest; Forest types of the world and India.

Unit –VIII: Conservation of forest

Definition, National and international conservation strategies; Importance of indigenous knowledge and people's participation in forest conservation; Concepts and aspects of World Forestry day, World Environment Day, International Day for Biological Diversity, Vanamahotsav, Aranya Saptaha; Forest Biotechnology – Forest resources & bioprocess.

Unit –IX:Aquatic Ecology.

Aquatic flora, fauna and microbes; Diversities of aquatic ecosystem;Food chain and function in aquatic eco-system; Degradation of aquatic ecosystem; Eutrophication and their conservation; Wetland – status and conservation priorities in India.

Unit –X:Study of different ecosystems/ biomes.

Forest; Marine; Mangrove; Desert; Coral.

Paper XI:PRACTICAL

Analytical studies on Environmental Parameters

Marks-100

1. Isolation of microbial population of air, water and soil
2. Observation of curd microorganisms.
3. Gram staining of bacteria.
4. Study of bio-indicators- air pollution and water pollution.
5. Demonstration of instruments like Spectrophotometer, Electrophoretic apparatus, HPLC, Incubators etc.
6. Study of NPK status of soil.
7. Study of biotic-community: Relative Abundance, Density, frequency, Species Dominance Index and Species diversity index. Deduction of α, β, γ diversity.
8. Estimation of primary productivity.
9. Collection, preservation and ecological comments onmacrophytes, phytoplanktons, zooplanktons and benthos.
10. Collection, preservation and ecological comments on soil and litter fauna.
11. Demonstration of alcohol from low cost substrate and alcohol content determination.
12. Demonstration of Bio-fertilizer: *Azotobactor, Rhizobium*.
13. Demonstration of vermicomposting and vermiculture.
14. General survey of a specific area through GPS.
15. Geo environmental mapping using SOI Toposheet.
16. Problems of testing of hypothesis and significance; mean, median, mode, correlation and regression based on socio economic data.

Paper XII:

Dissertation and Field Work

Marks-100

XII-A: Dissertation (Emperical/ Experimental/ Research based): Marks-75

XII-B: Field Work: Marks-25

At least two days of Field tour for appraisal of common landforms/ rocks/mines/mining process/water resource management/human adaptability in a particular environment.