

SEMESTER I

EVS - 111 Concepts and Components of Environment

Marks - 75

Unit I – Environment: Concepts, definition and importance; Scope of Environmental Science; Multidisciplinary nature of Environmental Science; Man-Environment Relationship; Need for environmental awareness.

Unit II – Atmosphere: Composition and structure; Heat Budget; Lapse Rate; Inversion of Temperature. Weather and climate: Different types of winds; Major climatic zones of the World; Tropical cyclones; Ocean currents; Western disturbances; El Nino and La Nino.

Unit III – Lithosphere: Earth's crust and its composition; Internal structure of the earth; Different types of rocks; Plate tectonics; Continental drift theory; Earthquakes. Hydrosphere: Sources of water; Distribution of freshwater and marine water on the earth; Zonation of Hydrosphere – lentic, lotic and marine; Hydrological cycle.

Unit IV – Biomes: Concept and definition; Concept of Biomes; Types of Biomes and their distribution. Biogeography: Biogeographical zones; Barriers; Continuous and discontinuous distribution; and Endemism.

EVS - 112 Practical

Marks - 25

1. Identification of rocks.
2. Climatic maps - drawing of Hythograph and Climograph.
3. Study of the soil profile.
4. Estimation of moisture, temperature and conductivity of soil.
5. Determination of transparency, temperature and conductivity of water.
6. Qualitative and quantitative analyses of planktons.

SEMESTER II

EVS - 211 Ecology: Population, Community and Ecosystem

Marks - 75

Unit I – Ecology: Definition of ecology; Ecological Factors - biotic and abiotic (light, temperature, precipitation, fire) factors; Shelford's Law of Tolerance; Liebig's Law of Minimum. Population Ecology: Concept and characteristics of population – natality, mortality, age structure, population pyramids, population density, population dispersion, population growth, life table and survivorship curves; Carrying Capacity of the Earth.

Unit II – Community Ecology: Concept of community – definition, classification; Community structure – horizontal and vertical stratification; Community Characteristics: Analytical Characters of a community - qualitative and quantitative; Methods of study of community. Ecological Succession: Definition; Processes and stages of succession; Types of succession; Examples of Succession; Concept of Climax; Climax Theories - Monoclimax and Polyclimax theories.

Unit III – Ecosystem: Concept of ecosystem; Structure and function of ecosystems - energy flow in ecosystem, trophic levels, food chain, food-web, and ecological pyramids. Productivity and Biogeochemical cycles: Concept of productivity; types - primary and secondary. Biogeochemical cycles – carbon cycle, oxygen cycle, nitrogen cycle and phosphorous cycle.

Unit IV - Major ecosystem types: Structure and functions of grassland ecosystem; forest ecosystem; agro-ecosystem; lake ecosystems; estuarine ecosystem. Population Interactions: competition, predation, parasitism, symbiosis, commensalisms, mutualism, protooperation and ammensalism.

1. Determination of requisite size and number of quadrats to be laid down for studying vegetation.
2. Determination of Density, Abundance and Frequency of component species in a Grassland community.
3. Measurement of primary productivity of a pond ecosystem.
4. Determination of Chlorophyll-*a* content of a given sample.
5. Estimation of population size from population chart by quadrat method.
6. Study of different types of lichens (crustose, frutose and foliose).

SEMESTER III

Unit I - Pollution: Definition; Pollutants – classification; primary and secondary, biodegradable and non-biodegradable, point and non-point sources of pollution; Biological indicators of environmental pollution. **Air Pollution:** Sources of air pollutants - Gaseous pollutant: oxides of nitrogen, sulphur and carbon, hydrocarbons and CFCs; Particulate pollutants – total suspended particulate matter (TSPM), respirable suspended particulate matter (RSPM), aerosols; Consequences of air pollution; Methods of mitigating and controlling air pollution.

Unit II - Water Pollution: Surface water and ground water pollution; Types and sources of water pollutants; Agricultural discharge – pesticides, fertilizers and farm waste; Thermal pollution; Oil spills; Eutrophication; Bioaccumulation and bio-magnification; Consequences of water pollution; Primary and secondary treatment of waste water; Methods of mitigating and controlling water pollution. **Soil Pollution:** Sources of soil pollutants – domestic, urban, industrial, agricultural practices and mining; Chemical and biological agents and their harmful effects on soil; Salinisation of soil; Consequences of soil pollution; Methods of mitigating and controlling soil pollution.

Unit III - Radioactive Pollution: Radioactivity; Units of measurement of radiation; Half-life period; Kinds and sources of radiation; Effects of ionizing and non-ionizing radiation; Prevention and remedial measures. **Noise Pollution:** Sources of noise pollution; Measurement of noise pollution; Effects of noise pollution of human health – auditory and non-auditory; Shock waves; Silence zone; Abatement of noise pollution.

Unit IV - Environmental Issues: Greenhouse effect and Global warming; Acid rain; Ozone layer depletion; Smog – photochemical and non-photochemical. Bhopal Gas Tragedy; Chernobyl Disaster; Minamata Disease.

1. Determination of SPM in atmosphere (roadside and classroom).
2. Determination of total suspended solids (TSS) and total dissolved solids (TDS) in water samples.
3. Determination of alkalinity, chloride, calcium and magnesium content of water samples.
4. Estimation of soil organic carbon content in grassland and forest.
5. Determination of pH of grassland and forest soil.
6. Monitoring of noise level in public area (campus and roadside).

SEMESTER IV

EVS – 411 Tools and Techniques in Environmental Science

Marks –75

Unit I – Statistics: Methods of collection of environmental data; Classification and tabulation of data; Frequency distribution; Measures of central tendency; Measures of dispersion; Correlation and Regression.

Unit II – Computer Applications: Word processing; Spreadsheet and presentation using MS Office; Internet. **Geo-informatics:** Basics of Remote Sensing and GIS; Use of remote sensing and GIS in resource survey and land use mapping.

Unit III – Air Quality Monitoring: Ambient air quality monitoring; Meteorological measurements; Measurement of SPM; CO; NO_x; SO_x.

Unit IV – Water quality monitoring: Water sampling techniques; Principles and procedures for measurement of pH, conductivity, Total Solids, hardness, chloride, Dissolved Oxygen, phosphorous, nitrogen, heavy metals (Atomic Absorption Spectrophotometry method) and total coliform count.

EVS – 412 Practical

Marks – 25

1. Computation of Mean, Median, Mode and Variance of the given environmental data set.
2. Working on Word Processing software.
3. Preparation of Power point presentation for seminar.
4. Demonstration on the use of GPS.
5. Study of meteorological parameters: light intensity, ambient temperature and relative humidity.
6. Estimation of nitrate and phosphate content in natural waters.
7. Determination of Coliform count in natural waters.

SEMESTER V

EVS –511 Natural Resources

Marks –75

Unit I – Natural Resources: Concept and classification of natural resources; Renewable and Non-Renewable Resources. **Water Resources:** Water as a resource; Ground water resources – importance, depletion and recharge; Watershed Management; Rainwater harvesting; Conservation of water resources.

Unit II – Soil Resources: Soil formation and types; Soil as a resource; Soil erosion and conservation. **Mineral Resources:** Distribution of important major minerals in India; Environmental problems relating to extraction of coal and limestone; Measures for conservation of mineral resources.

Unit III – Energy Resources: Types of energy resources – Fossil fuels, Hydro-electric power, Nuclear energy, Solar energy, Wind energy, Tidal energy, Geothermal energy, Biogas and Bio-diesel.

Unit IV – Forest Resources: Major forest types and their distribution; Causes and consequences of deforestation; Timber and non-timber forest products; Management and Conservation of forests – afforestation, agro-forestry, community forestry, joint forest management, social forestry, sustainable forest management; Impact of shifting cultivation on forest resources of N.E. India

1. Identification of important minerals.
2. Inventorization of important local NTFPs.
3. Study of important ethno-medicinal plants with the help of herbarium.
4. Measurement of girth, height and volume of tree bole.
5. Determination of similarity and dissimilarity by Morista Index and Bray Curtis methods.
6. Determination of Simpson Diversity Index (λ) in a forest community.
7. Determination of texture of given soil sample.

Unit I – Biodiversity: Concept and definition; Levels of biodiversity; Mega-diversity countries; Global biodiversity hot spots; Values of biodiversity; Factors causing biodiversity loss. Ethnobiology: Concept and definition of Ethnobiology; Plants and animals of ethnomedicinal value.

Unit II – Biodiversity Conservation: *Ex-Situ* and *In-Situ* conservation measures: Protected area network (wildlife sanctuaries, national parks, biosphere reserves), botanical gardens, germ-plasm bank; IUCN Red List; Keystone species, Indicator species, Umbrella species, Endemic species. Concept and importance of traditional practices pertaining to bioresource conservation; Concept and importance of sacred groves; Traditional uses of plants and animals.

Unit III – Policies and Laws pertaining to Biodiversity conservation: Salient features of – National Forest Policy 1988; Wildlife Protection Act 1972; Biodiversity Act 2002; Convention on Biological Diversity (CBD).

Unit IV – Environmental Biotechnology: Concept and scope of environmental biotechnology; Biopesticides – types, uses and its relevance to the environment; Biofertilizers – use of Rhizobium, Azolla, Mycorrhiza; Vermiculture; Genetically Modified Crops; Bioremediation: Concept and definition; Phytoremediation; Microbial remediation; Concept of super bug. Degradation of lingo-cellulosic waste; Process of Methanogenesis; Biogas production.

1. Identification of plants of a grassland and forest community.
2. Study of plants of ethnobotanical importance.
3. Preparation of vermicompost.
4. Study of Mycorrhizal association.
5. Study of root nodules of a nitrogen fixing plant.
6. Visit to a place/area promoting biodiversity conservation and preparation of field report.

SEMESTER VI

Unit I – Concept and scope of environmental chemistry; Classification and distribution of elements in the earth; Inorganic and organic components of soil. Principles of chemical reactions: Dissociation in solution; Concept of pH; Acids and bases; Buffer solutions.

Unit II – Atmospheric Chemistry: Particles, ions and radicals in the atmosphere; Chemical and photochemical reactions in the atmosphere; Oxygen and ozone chemistry; Chemistry of oxides of sulphur and nitrogen and organic compounds in the atmosphere. Chemistry and impacts of Photochemical smog; Chemistry of Acid Rain.

Unit III – Toxic chemicals: Toxic chemicals in air, soil, water and waste water. Chemistry and impacts of Acid mine Drainage. Toxic Metals – Biochemical effects of heavy metals (arsenic, lead and mercury). Chemical Speciation – Concept and importance; Chemical speciation of lead and mercury.

Unit IV – Organic pollutants – Pesticides – concept and classification; organo-chlorine insecticides, cyclodine insecticides, organophosphates and carbamates; Fertilizers. Role of microorganisms as catalyst in chemical reactions. Chemistry of aerobic and anaerobic treatment of wastewater.

EVS – 612 Practical

Marks – 25

1. Determination of pH of water and soil samples.
2. Determination of acidity and alkalinity of water samples.
3. Determination of dissolved oxygen (DO) of water samples.
4. Determination of heavy metal toxicity by germination and seedling growth tests.
5. Determination of toxic effect of pesticides on soil organisms.
6. Determination of LC_{50}/LD_{50} value of a toxicant.
7. Determination of phosphate, nitrate and sulphate, of water samples.

EVS – 613 EIA, Environmental Economics and Environmental Laws

Marks – 75

Unit I – Environmental Impact Assessment: Concept and definition; Principles of EIA; Necessity of EIA; EIA as a decision making tool; EIA notification of 1994 and 2006; Procedure of environmental clearance. Steps of EIA – screening, scoping, project description, baseline data, impact prediction and analysis and mitigation measures. EMP (Environment Management Plan) – definition, components, and importance of EMP.

Unit II – Environmental Economics: Concept of Environmental Economics; Natural Resource Accounting; Cost Benefit Analysis – cost effectiveness; market-based incentives and disincentives. Environmental Audit: Concept of Environmental Audit; Process and implementation of Environmental Audit; Life Cycle Assessment and Environmental Management System; Ecomark and ISO certification.

Unit III – Environmental Policies and Laws: Salient features of – Convention on Combating Desertification; Convention on Climatic Change; Kyoto Protocol; The Air (Prevention and Control of Pollution) Act 1981; The Water (Prevention and Control of Pollution) Act 1974; Environmental Protection Act 1986; National Environment Policy 2006.

Unit IV – Environmental Movements: Origin of environmental movements; Environmental Movements in India – Silent Valley, Narmada Bachao Andolan, Chipko Movement, Appiko Movement, Bishnoi Movement. Environmental Organizations: National and International – Greenpeace, WWF, IUCN, Friends of the Earth, Earthwatch.

EVS - 614	Project Work and Field Work/ Study Tour/ Industrial Exposure	Marks - 25
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Project work will be assigned in the Semester V and will be evaluated in the semester VI.
Each student will be required to submit a Project Report based on the Field Survey to be conducted under the guidance of a faculty member.
The report shall be evaluated by the examiners during the practical examination.