

**INSTITUTE OF BIOSCIENCES AND BIOTECHNOLOGY**  
**DEPARTMENT OF ENVIRONMENTAL SCIENCES**  
**M.Sc.-Environmental Science Course Content**

| <b>Semester I<sup>st</sup></b>    |                   |                                                                           |                   |
|-----------------------------------|-------------------|---------------------------------------------------------------------------|-------------------|
| <b>S.No.</b>                      | <b>Paper Code</b> | <b>Name of paper</b>                                                      | <b>Max. Marks</b> |
| 1                                 | ENV-101           | Basics of Environment                                                     | 100               |
| 2                                 | ENV-102           | Fundamental of Ecology                                                    | 100               |
| 3                                 | ENV-103           | Natural Resources and their Management                                    | 100               |
| 4                                 | ENV-104           | Conventional and Non-Conventional Energy Resouces                         | 100               |
| 5                                 | ENV-105           | Practical                                                                 | 100               |
| <b>Semester II<sup>nd</sup></b>   |                   |                                                                           |                   |
| 1                                 | ENV-201           | Environmental Chemistry                                                   | 100               |
| 2                                 | ENV-202           | Instrumentation                                                           | 100               |
| 3                                 | ENV-203           | Soil Science                                                              | 100               |
| 4                                 | ENV-204           | Biostatistic and Computer Applications                                    | 100               |
| 5                                 | ENV-205           | Practical                                                                 | 100               |
| <b>Semester III<sup>rd</sup></b>  |                   |                                                                           |                   |
| 1                                 | ENV-301           | Environmental Toxicology                                                  | 100               |
| 2                                 | ENV-302           | Environmental Microbiology and Biotechnology                              | 100               |
| 3                                 | ENV-303           | Environmental law and Sustainable Development                             | 100               |
| 4                                 | ENV-304           | Environmental Pollution and Control                                       | 100               |
| 5                                 | ENV-305           | Practical                                                                 | 100               |
| <b>Semester IV<sup>th</sup></b>   |                   |                                                                           |                   |
| 1                                 | ENV-401           | Environmental Impact Assessment & Auditing                                | 100               |
| 2                                 | ENV-402           | Meteorology and Remote Sensing                                            | 100               |
| <b>ELECT ANY ONE (3.1 to 3.3)</b> |                   |                                                                           |                   |
| 3.1                               | ENV-403           | Pollution monitoring and Bioremediation                                   | 100               |
| 3.2                               | ENV-404           | Environmental Hazards and Disasters                                       | 100               |
| 3.3                               | ENV-405           | Environmental and Occupational Health                                     | 100               |
| 4                                 | ENV-406           | Dissertation/Project/summer training/review of literature and tour report | 150+50=200        |

*Y. K. Reddy*  
23-1-19

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23/10/19

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23/10/2019

## DEPARTMENT OF ENVIRONMENTAL SCIENCES

### MSc. COURSE SYLLABUS

#### Semester I<sup>st</sup>

##### ENV 101: Basics of Environment

Max. Marks: 100

Definition, Principles and Scope of Environmental Sciences; Earth, Man and Environment; Atmosphere: Structure and composition, Hydrosphere, Lithosphere and Biosphere; **Ecosystem: Concept of Ecosystem, Energy flow in Ecosystem**, Food chain, food web, Ecological pyramids. Biogeochemical cycle viz.: Carbon cycle, Nitrogen cycle, Hydrological cycle, Phosphorous cycle and Sulphur cycle. Interaction of Biological System with Physical Environment and among themselves; Common flora and fauna in India; **Rocks: Igneous, Metamorphic and Sedimentary rock, Rock minerals, Rock cycle. Soil: Basic concept of soil, soil profile, soil flora and fauna, absorption and loss of heat, law of thermodynamics, Thermal conductivity through the soil profile**, desertification, **causes, consequences**, soil erosion and **control**.

##### Recent initiations

##### ENV102: Fundamental of Ecology

Max. Marks: 100

History and scope of Ecology, Autecology, Synecology, Population characteristics and dynamics, Community, Biome, Environmental factors (Abiotic medium, substratum, soil humidity, climate, water, light, temperature, current and pressure, atmospheric gases, pH and nutrients their importance and role). Limiting factors (Liebig's law of minimum, Shelford's law of tolerance), combined concept of limiting factors. Biotic factors: **mutualism, commensalism, parasitism, competition**. Distinguishing characters of forest grasslands, wetlands and arid lands, community organization, concept of habitat, functional role and niche, dominant species, keystone species, ecotone, edge effect; **tolerance range and carrying capacity**; Ecological succession, primary & secondary processes of successions, models of successions, climax community and type of climax.

##### Recent initiations

  
Head  
Department of Environmental Sciences  
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**ENV103: Natural Resources and their Management**

Max. Marks: 100

Definition and classification of natural resources; Water resources: Fresh and marine water, **causes of scarcity**, management and conservation, water budget. The land: **classification**, land used **pattern, policy** and management. Land degradation: causes and their management, Classification, **causes** and their management, integrated land planning. **Waste land and their reclamation**; Mineral resources: **metallic and nonmetallic minerals, geographical distribution**, exhaustibility, development and preservation. Forest: classification, importance, causes of depletion and degradation, **consequences**, conservation and management, National forest programme (NFP), A-forestation, social and agro-forestry. Wild life: definition, ecological balance, importance, **ethical value, wild life reserves, geographical distribution of wild life**, causes of depletion and extinction of wild life, wild life management, **protected areas**, Biological diversity: definition, types, **hot spots, Biogeographic Zones in India**, natural and anthropogenic causes of depletion, red data book, rare, endangered, threatened and near extinct species, biodiversity conservation.

**Recent initiations****ENV-104: Conventional and Non-Conventional Energy Resources**

Max. Marks: 100

**Energy resources: Classification, Importance, Non-Conventional energy resources:** Sun as source of energy, solar radiation, solar collectors, storage of energy, photovoltaic, solar ponds **and application**, Wind energy: **Application, Site selection, wind machine and application**, Ocean energy: **OTEC**, Tides, Wave; thermal energy conversion. Geothermal energy, Bioenergy: Energy from biomass, **conversion technology**, biogas, **biogas plants**, anaerobic digestion. **Conventional energy resources:** Fossil fuels classification, composition, physicochemical characteristics and energy content of coal, petroleum and natural gas. Principles of generation of hydroelectric power. Nuclear energy: Fission and fusion, magneto hydrodynamic power, **Environment aspect of energy**. Energy used pattern in different parts of the world.

**Recent initiations****ENV-105: Practical(based on ENV-101,102,103 & 104)**

Max. Marks: 100

  
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## Semester II<sup>nd</sup>

### ENV-201: Environmental Chemistry

Max. Marks: 100

Fundamental of Environmental chemistry: Stoichiometry, Gibb's energy, chemical potential, chemical equilibrium, acid base reaction, solubility product, solubility of glass in water, the carbonate system, unsaturated and saturated hydrocarbon system, radionuclide. Chemical composition of air: chemical specification, practical's, ions, radicals in the atmosphere, formation of inorganic and organic particulate matter, thermochemical and photochemical reactions in the atmosphere. Oxygen and ozone chemistry, chemistry of air pollutants, photochemical smog. Water chemistry: **Properties of marine water, surface water, ground water;** Chemical composition, concept of pH, Acidity, Hardness, alkalinity. Nitrate, Nitrite, DO, BOD, COD, **Eutrophication**, sedimentation, coagulation, filtration, and Redox potential. Lithosphere: **Paleozoic, Mesozoic and Cenozoic Lithosphere, mineral chemistry**, Characteristics of earth, Chemical composition of earth, minerals, fossils, fuel and soil.

#### Recent initiations

### ENV-202: Instrumentation

Max. Marks: 100

Microscopy: Compound, phase contrast, fluorescent, electron microscope, Spectrocolorimeter, spectrophotometry, atomic absorption spectrophotometer, **ICP**, flame photometer, ion analyzer, oxygen and carbon dioxide electrode, biosensors. Radioactive techniques and scintillation counter, pH meter, refractometer, bomb calorimeter, nephelometer, paper chromatography, gas and high pressure liquid chromatography (HPLC), smoke meter. Samplers: types, methods of sampling, preservation. NMR, ESR spectroscopy, Electrophoresis: **PAGE and SDS-PAGE and their application, Centrifugation, ELISA.**

#### Recent initiations

  
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**ENV-203: Soil Science**

Max. Marks: 100

Soil genesis: Weathering processes and soil formation (**soil forming factors, soil forming processes**), **soil horizon**, soil profile development processes, chemical and mineralogical composition of soil, soil classification: **US soil classification (taxonomy), Canadian soil classification, Indian soil classification**). **Soil: Definition, component, soil types, soil physics (soil colour, structure, texture, particle density, bulk density, porosity, moisture, infiltration, soil aeration)**. **Soil chemistry:** soil colloids, ion exchange (cation and anion exchange phenomena), **CEC**, pH, **SAR, ESP** and buffering capacity. **Soil biology: Nitrification, de-nitrification, mineralization, role of microbes in soil fertility; Soil enzymes;** Soil organic matter: Sources, composition, microbial decomposition of organic matter, humus formation, nature and properties of humus, clay-humus complex, significance of C:N ratio. Soil acidity, alkalinity, salinity nature, formation and control; **problem soils and their managements;** Soil nutrients and trace elements; Soil water: Different forms of water viz. hygroscopic, capillary and gravitational; Movement of soil water under saturated and unsaturated conditions, **irrigation, cropping pattern, soil water plant relationship;** Soil air: composition and gaseous exchange between atmosphere and soil air.

**Recent initiations****ENV-204: Biostatistics and Computer Applications**

Max. Marks: 100

Application of biostatistics in environmental study, **data collection, sampling methods, data classification, tabulation, graphical and diagrammatic presentation**, basic idea of probability, measures of central tendency (mean, median, mode) and standard error deviation. Distribution pattern: normal, binomial, poisson, sampling methods and sampling errors. **Test of significance– testing hypothesis, t-test, F-test**, Chi-square test, analysis of variance, correlation and regression. Computer: introduction and history, basics, data representation, input and output units, computer memory, processor, machine language programme, operating system, eco-modeling and forecasting of environmental problems with the help of computer.

**Recent initiations****ENV-205: Practical(based on ENV-201,202,203 & 204)**

Max. Marks: 100

  
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## Semester III<sup>rd</sup>

### ENV-301: Environmental Toxicology

Max. Marks: 100

**Toxicology: Importance of toxicology, classification of Environmental toxicants**, Principles of toxicology, **translocation of xenobiotics, toxic effect of xenobiotics**, Animal toxicity test, statistical concept of LD<sub>50</sub>, **route of exposure**, frequency and cumulative response, dose effect and dose response relationship; biological and chemical factors and influence toxicity, bio-absorption of heavy metals, bioaccumulation, bio-magnification; **Mutagenic and carcinogenic compounds**; influence of ecological factors on the effect of toxicity, pollution of ecosphere by industries, global dispersion of toxic substances; dispersion and circulating mechanisms of pollutants; **degradable and non-degradable** toxic substances, food chains; ecosystem influence on the fate and transport of xenobiotics; **Biotransformation: site, enzymes and reaction; Nano-toxicology; Immuno-toxicology**, aquatic toxicity test (**acute, sub-acute, chronic and sub chronic test**), statistical test of LC<sub>50</sub> ; Response of plankton to toxicants, EC<sub>50</sub>, photosynthetic bacteria; Information management system in ecotoxicology, Animal management in toxicological evaluation.

#### Recent initiations

### ENV-302: Environmental Microbiology and Biotechnology

Max. Marks: 100

**Microbes: Definition, characters, types and importance**; Fermentation technology, Vermiculture technology and Bio-fertilizer technology; **significance of bio-fertilizers in agriculture, role of microbes in degradation of xenobiotic**, bioaccumulation, **bio-magnification**; micro-flora of atmosphere; air, **water and soil** sampling techniques, identification of aeroallergens, air borne diseases and allergies, **soil borne diseases**, GEMs; effect of environmental factors on microorganisms, control of air pollution by plants, responses of plants and animals to change in physiochemical characteristics and distribution of plants in relation to pollution (microphytes, phytoplanktons, periphytons and macrophytes), biodegradation of leather, fiber and wood; **Biotechnology: concept, techniques, transgenic plants and animals, vaccines, production of vaccines, culturing of microbes, animals cells and plant cells.**

#### Recent initiations

  
Head  
Department of Environmental Science  
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**ENV-303: Environmental law and Sustainable Development**

Max. Marks: 100

National environmental policy statement on abatement of pollution legislation; Forest conservation Act-1980, **Indian Forest Act-1927**; Water (Prevention and control of pollution) Act-1974; Environmental **protection Act 1986**; **Air (Prevention and control of pollution) Act-1981**; **Noise pollution (Regulation and Control) rules-2000**; Hazardous waste (Management and handling) rules-1989; **Biomedical waste (Management and handling) rules-1998**; **E-waste (Management and handling) rules -2011**; Wild life protection Act-1972; **Biodiversity Act-2002**; **The Prevention of Cruelty to Animals Act, 1960**, **National green tribunal Act-2010**; **Case study to be taken up M.C. Mehta vs Union of India Ganga river pollution, 1998**; Manufacture, use, import, export and storage of hazardous microorganisms; Scheme for labeling of environmental friendly products (Eco-mark scheme); Public liability Insurance Act-1991; National and International organizations dealing with environmental issues; Famous environmental conventions.

**Recent initiations****ENV-304: Environmental Pollution and Control**

Max. Marks: 100

Pollution of air: sources (natural and anthropogenic), **consequences**, primary and secondary pollutants, particulate matters, transport and diffusion of pollutants. Methods of monitoring and control of air pollution (SO<sub>x</sub>, NO<sub>x</sub>, CO<sub>x</sub>, SPM) **of vehicles, thermal power, refineries, industries and bricks**. Pollution of water: types, sources and consequences, **impacts on aquaculture**, water sampling **processes**, physical, chemical and microbiological analysis of water. Sewage and industrial wastewater treatment and recycling, water quality standards, **radioactive pollution- source and control**. Soil pollution: **sources (natural and anthropogenic), consequences**, soil sampling methods, physical, chemical and bacteriological analysis of soil and control. Industry based effluents and heavy metals their interaction with soil components, soil microorganisms and their functions, degradation of different biocides in soil. Noise pollution: sources, consequences, measurement of noise and indices and **control**, effect of meteorological parameters of noise propagations, impact of noise on human health.

**Recent initiation****ENV-305: Practical(based on ENV-301,302,303 & 304)**

Max. Marks 100

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## Semester IV<sup>th</sup>

### ENV-401: Environmental Impact Assessments and Auditing

Max. Marks: 100

Environmental impact assessment: introduction, concept and aims, impact statements **process, EIA Methodologies – Adhoc Method – Checklist Methods – Matrix Methods – Network Methods, mitigation processes**, predictions and assessment of impact on air, water and noise pollution. Public participation in environment decision making. Environmental education and awareness, environmental economics, economics of pollution control, cost benefit analysis. Prediction and assessment of impacts on the biological, cultural and socioeconomic environment, introduction and concepts. Environmental impact assessment of major and minor developmental project: industries, mining, thermal power plants, atomic power station, transport and tourism, water resources and disaster management **and bricks**. Environmental audit: introduction, concepts, steps, methodology. **Cost benefit analysis**, EIA of different xenobiotic (chemicals, fertilizers, heavy metals), **ISO-9001, ISO-14001, OHSAS18001, International environmental agreements**.

#### Recent initiations

### ENV-402: Meteorology and Remote Sensing

Max. Marks: 100

Meteorology fundamentals: pressure, temperature, wind, **evaporation, condensation, fog and clouds, monsoon, weather and climate**, atmospheric stability, adiabatic processes, turbulence, and diffusion, scales of meteorology; Application of meteorological principles to transport and diffusion of pollutants; scavenging processes; Effects of meteorological parameters on pollutants and vice-versa; wind rose, topographic effects, seasons of India, **Atmospheric disturbances: cyclone and anticyclone, Avalanches, El-nino, Climate change: Theory of climate change, climate and natural vegetation, climate and urban planning, global warming, ozone depletion, acid rain, earth summit, Kyoto protocol**; principles of remote sensing, **remote sensing satellites, GPS**, and its application in **flood managements, ground water mapping, coastal flood prevent, natural disasters, soil mapping; forest cover and crop cover mapping**; Fundamental concept of GIS with its application in environmental management.

#### Recent initiations

  
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(Elect any one)

**ENV-403: Pollution monitoring and Bioremediation**

Max. Marks: 100

Concept: pollutants vs resources; cycling of minerals, tolerance range ; carrying capacity, bioaccumulation, Air pollution: **Air pollution monitoring, Particulate matter pollution – PM<sub>10</sub> , PM<sub>2.5</sub>, and PM<sub>50</sub>** , monitoring air pollution by plants (for example lichens), control of air pollution by plants, responses of plants and animals; **Ozone depletion – Montreal protocol; Global warming – Kyoto protocol; Gaseous pollution control measures; photo chemical smog; Automobile pollution in India**; Water pollution: **Water pollution monitoring**, Responses of plants and animals to changes in physiochemical characteristics, distribution of plants in relation to pollution (microphytes, phytoplankton, periphyton and macrophytes); biological monitoring of pollution in water, biological control; Soil pollution: **Soil pollution monitoring**, Responses of plants to soil pollution, change in soil characteristics, by waste disposal, sanitary land fill, mining wastes and human activity, plants and animals in degraded soil; Bioremediation, factor affecting bioremediation, biodegradation of pesticides, hydrocarbons

**Recent initiations**

**ENV-404: Environmental Hazards and Disaster**

Max. Marks: 100

River flooding: causes, nature and frequency of flooding, nature and extent of flood hazards; urbanization and flooding; environmental effects of flooding flood mitigation methods. **Hurricanes: causes and predictions, Avalanches: types, preventions and controls.** Landslides: **Types, causes of mass movements, role of human activity, intensity scale**, prevention and control. Coastal hazards: Tropical cyclone, tsunamis, coastal erosion, sea level changes and its impact of coastal areas. Earthquakes: nature of earthquake, causes, **intensity scale**, intensity and magnitude of earthquakes, geographic distribution of earthquakes zone, seismic waves, travel time and location of epicenter, nature of destruction, ground subsidence, protection from earthquakes hazards; Volcanism: nature extent and causes of volcanism, volcanic materials geographic distribution of volcanoes; volcanism and climate.

**Recent initiations**

  
Head  
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**ENV-405: Environmental and Occupational Health**

Max. Marks: 100

Basic principles of environmental health, Physiological responses of man to relevant stresses in the environment. Industrial Toxicology: Study of environmental does effects relationships. Evaluation of toxicity and threshold limits. Principles and methods of occupational health; The relationship of occupation of hygiene, safety and disease. Health maintenance: Survey analysis and recommendations regarding health, and safety problems in the working/living environment. Bio-statistics, epidemiology; Applications of statistical methods of medical records in the study of health problems of human pollution in a given environment. Treatment of variation with demographic, vital statistics and epidemiological data; Hazard evaluation in polluted environment with specific emphasis on radiological health. Industrial hygiene technology-laboratory remains illustrating the principals, methods of recognizing evaluating and controlling environmental hazards like air pollution, etc.

**Recent initiations****ENV-406: Dissertation /Project/Summer Training**

Max. Marks: 200

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