

**M.Sc. I – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES – 101 T: ENVIRONMENTAL CHEMISTRY**

- Unit I : ATMOSPHERE : Definition of atmosphere, Geosphere and Hydrosphere. Atmospheric Composition and Structure. Atmospheric Gases N<sub>2</sub>, O<sub>2</sub>, CO<sub>2</sub>, Ozone layer, Green house effect and its gases, Global warming, Earth's radiation balance and heat islands.
- Unit II : LITHOSPHERE : Soil Characters – Structure, composition formation, weathering processes, types. Soil chemistry, humification, mineralization, inorganic and organic compounds, NPK in soil, Kaolinite, Montmorillonite, Illite clayey soils. Soil erosion.
- Unit III : HYDROSPHERE : Hydrologic cycle, Study of different aquatic environments (Ponds, Lakes, Rivers) Water characteristics, Thermal Phenomena in lakes Types of thermal stratification Biogeochemical cycles - C,N,P cycles. Dissolved gasses: CO<sub>2</sub>, D.O. Oligotrophication and Eutrophication of water bodies
- Unit IV : PHOTOCHEMISTRY: Radioactive pollution, Radioactivity and radiations, damages caused by a biological system by radiations, sources of radiations in the environment, hazards associated with radioactive pollution, disposal of radioactive wastes, bioluminescence, Photosensitized reactions - Photochemical smog. Solar energy conversion and storage.

**BOOKS RECOMMEND**

1. Environmental Chemistry A.K.De, Wiley Eastern Ltd., 1987.
2. Environmental chemistry : R.C. Rasswell, Edward Arnold Press 1980.
3. Fundamentals of Environmental Chem. Stanley E Manahan..
4. Limnology - Wetzel.
5. Photochemistry and spectroscopy, J.P.Simmons : Wiley : 1971.
6. Fundamentals of Photochemistry K.K. Rohatgi – Mukherjee.
7. Environmental Chemistry – B.K. Sharma

**M.Sc. I – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES – 102: T CLIMATOLOGY AND SAFETY MANAGEMENT**

- Unit I – Definition and scope, aims and objectives of climatology, Subdivisions of climatology, Meteorology and climatology, Clouds- classification of clouds, reporting of clouds, clouds as an aid to weather forecasting, distribution of clouds  
Precipitation process –ice crystal theory of Bergeron  
Collision - coalescence theory, forms and types of precipitation.
- Unit II- Objectives of classification of climates, Major climatic regions of the world based on latitude, Distribution of vegetation, Classification of climates- Thornthwait's and Koppen's classifications, Climatogram studies and climatic groups based on Precipitation and temperature and Climate change.
- Unit III- Succession – Development and evolution of ecosystem  
Patterns of succession, Types of succession, concept of climax, Mono and poly climax theory, Endemism, Continental drift and its significance, Ecological significance of macro phytes.  
Adaptations of plants to adverse environmental conditions
- Unit IV- Classification of Hazardous chemicals, Their storage and safe keeping, Industrial fires and explosions and their effect on environment. Industrial safety – National and International safety organizations. Industrial safety and health standards with reference to ventilation lighting, noise air quality and ergonomics.  
OHSAS 18001,

**Books recommended:-**

1. Climatology - D.S.Lal, 2001
2. General climatology - J.Howard and Critchfield – 1999.
3. Principles of Physical Geography - A.Das Gupta and A.N.Kapoor- 2001.
4. Fundamental of Ecology - E.P. Odum -1996.
5. Ecology and Environment - P.D.Sharma

**M.Sc. I – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 103 T: AIR POLLUTION & CONTROL**

- Unit I : Types of pollution - Air, Water, Land, Noise and Radioactive pollution  
**Air Pollution** : Definition, Methods for identification of air pollution, classification of pollution – Natural contaminants, aerosols, particulates, gases, various sources of air pollutants – Primary and secondary pollutants stationary and mobile sources, point, area and line sources, behavior and fate of air pollutants- photochemical smog. Effects of air pollutants – Health of plants, animals, humans and material damage.
- Unit II : Meteorological aspects of air pollution dispersions-Temperature lapse rates and stability-wind velocity and turbulence-plume behavior –various types of plumes wind rose-dispersion of air pollutants-dispersion models – The Gaussian Plume Models  
Air pollution sampling and measurement.  
Ambient air sampling methods for collection and analysis of suspended particulate matter (SPM), Respirable suspended particulate matter (RSPM), Sulfur dioxide (SO<sub>2</sub>) and Oxides of Nitrogen (NO<sub>x</sub>) Oxidants, Carbon monoxides (CO) and Hydro Carbons (HC), Stack sampling and analysis for SPM, RSPM, SO<sub>2</sub>, NO<sub>x</sub>.
- Unit III : Air pollution control methods – Need for control methods. Particulate emission control – Gravitational settling chambers – Cyclone separators – Fabric filters - Electrostatic precipitators – Wet scrubbers – Control of gaseous emissions – Adsorption by solids – Absorption by liquids – Control of SO<sub>2</sub> emissions – Dry methods – Wet scrubbing methods – Control of Nitrogen oxides - Modification of operating conditions – Modification of design conditions
- Unit IV : Air pollution from Automobiles .  
Genesis of vehicular emissions- Air pollution from automobiles - Fuel tank, carburetor, crank case – Exhaust emissions – Indian scenario – Automobile pollution control – control at source.  
Noise Pollution – Definition – Sources of noise – Effects of noise on people, Assessment and measurement of noise – Basic principles of noise control – Noise from construction activities, industries and automobiles and its control.  
Indoor air pollution – Sources, factors, health effects, control methods.

### **BOOKS RECOMMENDED**

1. Air Pollution : H.C.V. Rao, 1990,
2. Air Pollution : MN Rao, McGraw Hill 1993
3. Air pollution and control : P. Pratapmouli G.N. Venkatasubbayya, Divya  
Jyothi Prakasham , Jodhpur 1989.
4. Meteorology of Air Pollution : R.S. Scores 1990 Ellis Harwood Pub
5. Fundamentals of Air pollution : 2nd Ed Arthur C. Stern Acad. Press 1984.,
6. Pollution control in process : S.P. Mahajan, Tata McGraw Hill Publication  
industries N. Delhi .

**M.Sc. I – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 104 T : ENVIRONMENTAL INSTRUMENTATION AND  
ANALYTICAL METHODS**

- Unit I : Sampling : Preservation, Storage and Processing of air, water and soil samples. Estimation and Significance of – pH, Turbidity, Acidity, Alkalinity, Solids, Hardness, Chlorine and Chlorides, Iron, Manganese, Fluoride, Sulphate, Oil and Grease.
- Unit II : Potentiometry : Determination of concentration from potential measurements – ion selective electrodes –  $\text{NH}_4^+$ , Cl, F,  $\text{H}^+$ ,  $\text{Na}^+$ .  
Chromatography – Classification. Principle and instrumentation of the thin layer chromatography (TLC), Gas Chromatography(GC), Gas Liquid Chromatography(GLC), High Performance Liquid Chromatography (HPLC).
- Unit III : Colorimetry and Spectrophotometry – Types of Spectrophotometers (UV, UV- VIP, AAS, Flame emission, Flame absorption) – Basic principles – Applications in the analysis of air, water and soil samples.  
Nephelometry and Turbidimetry: Determination of turbidity,  
Electrophoresis : Theory and Applications.
- Unit IV : Microscopy – Principles and Application - Compound microscope, Bright field, Dark field microscope, Phasecontrast microscope – Fluorescence, Transmission and Scanning Electron Microscope.

**BOOK RECOMMENDED**

1. Mass spectrometry of pesticides : Safe & Hutzinger 1977 CRC Press and pollutants.
2. Standard methods for the : APHA, AWWA & WPCF 1985  
examination of water&waste water
3. Chemical Analysis : Kenneth A. Rubinson
4. Anal. Chem. : Gary D. Christian.
5. Instrumental Methods of analysis: 6<sup>th</sup> Ed. Willered merit & Dean CBS  
Publications, New Delhi.

**M.Sc. ENVIRONMENTAL SCIENCE**  
( Practical Syllabus)  
**I- SEMESTER**

**PAPER - I : ENVIRONMENTAL CHEMISTRY**

Analysis of the following parameters .

In water environment Acidity, Alkalinity Conductivity, Chlorides, Dissolved Oxygen , Organic matter, Total Hardness, Nitrates, Phosphates, Sulphates, Hydrogen sulphide, Residual Chlorine, Calcium Hardness.

In Soil : Acidity, Alkalinity, Chlorides, Organic matter, Nitrates and Phosphates.

**PAPER- II CLIMATOLOGY AND SAFETY MANAGEMENT**

Study of climatograms

Analyzing the climatic changes of a given area.

Identification of Macrophytes.

Identification of vegetation types.

Identification of Personal Protective Equipment.

Handling of hazardous chemicals.

**PAPER—III: AIR POLLUTION & CONTROL**

Analysis of  $SO_x$ ,  $NO_x$ ,  $NH_3$ , SPM, & RSPM in aerial Environment.

Use of Activated Charcoal in air pollution control.

Sound measurement -- Sound meter

Identification of Cyclone separators, Electrostatic precipitators, High Volume samplers

**PAPER—IV : ENVIRONMENTAL INSTRUMENTATION AND ANALYTICAL METHODS**

Environmental Instruments Gravimetric, PH meter, Conductivity, Potentiometer,

Colorimeter, Flame photometer, Spectrophotometer, Chromatography (TLC, paper, HPLC, GC chromatography), Electrophoresis, Microscopy -- Compound Phase contrast,

Electron Microscope, Microscopic Calibration.

**M.Sc. II – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES- 201 T : ENVIRONMENTAL MICROBIOLOGY**

- Unit I : MICRO ORGANISMS AND THE ENVIRONMENT  
Micro organisms and the structure of Ecosystems. Extreme Environments. Surfaces and Biofilms. Microbial mats. The Microbial community in marine and freshwater environments. Plankton. Phytoplankton-classification, Composition, seasonal distribution. Zoo plankton. Water borne diseases.
- Unit II : MICROBIAL CHARACTERISTICS AND THEIR NUTRITION  
General characters of Cyanobacteria, Mycoplasma, Rickettsias and Chlamydia. The common nutrient requirements, , Nutritional types of Micro Organisms, Culture Media, Types of Media(selective, differential, Enriched and Enrichment) , Isolation of Pure cultures, the growth curve, the continues culture of micro organisms – The chemostat and the turbidostat The influence of Environmental factors on growth.
- Unit III : AIR AND SOIL MICRO ORGANISMS  
The environments of soil micro organisms. Soil microbial communities. Soil microorganism association with plants. The Rhizosphere, Actinorhizae and Mycorrhizae. Soil micro organism inter actions with the atmosphere .  
Aeromicroflora – Micro organism in the atmosphere, Fungal and Pollen allergens. Air borne diseases and control measures.
- Unit IV : MICROBIOLOGY OF FOOD  
Micro organisms and Food spoilage. Intrinsic and Extrinsic factors. Food spoilage. Food preservation alternatives. Diseases and foods. Micro organisms as sources of food (SCP).  
Control of micro organisms by physical and chemical agents.

**BOOKS RECOMMENDED**

1. Limnology : R.G. Wetzel; 1983 Saunders College Publications Philadelphia.
2. Microbiology : LM. Prescott, John P Harley, Donald A.Klein 4<sup>th</sup> Ed. WCB/McGraw – Hill.
3. Microbiology of the atmosphere : Gregory, P.H. Wiley & Company.
4. Microbiology - Fundamental and Applications : Ronald m. Atlas and Richard Bartha. 4<sup>th</sup> Ed. Aim Print of Addison Wesley Long Man Inc
5. The Microbial world : Stanier et al, P.H.I, 1990.

**M.Sc. II – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 202 T : ECOLOGY AND ECOSYSTEM DYNAMICIS**

- Unit I : Ecology-Principles, concepts and levels, evolution of Environment, Autecology, Synecology and Applied Ecology.  
ECOSYSTEM : Definition, fundamental concepts Structure biotic and abiotic components and their functions, nutrient pool, Energy flow through Ecosystem : Ecological energetics, food chains, food web, Trophic levels, Ecological pyramids.
- Unit II : Population Ecology :-Characteristic features, Density, Natality, Mortality, Age Distribution, Biotic potential. Positive and negative interactions. Environmental resistance in relation to absolute maximum and realized minimum carrying capacity, size and distribution of population ( Random Aggregate and Uniform populations).
- Unit III : Biological Diversity -Community ecology :Characteristic features, Distribution,(Vertical and Horizontal) Qualitative, Quantitative and Synthetic characters. Raunkiers and Braun - Blanquett Concepts of Phytosociology, Community interactions including prey-predator relation ship- Lotka-Volterra modal – Gaussian model.
- Unit IV : BIOMASS AND PRODUCTIVITY : Definition of biomass, concepts of biomass. Biomass utilization – Biomass as a source of energy  
Definition of productivity, types of productivity, primary and secondary productivity Methods of measurement of biomass and productivity, Ecological efficiencies.

**BOOKS RECOMMENDED**

1. Fundamentals of Ecology E.P. Odum 1971 V.B. Saunders Co. Philadelphia.
2. Concepts of Ecology: E.J. Kormondy, 1976, Concept of Modern Biology Ser., Prentice Hall..
3. Productivity in Freshwater :Ecosystems. Vollenveider



**M.Sc. II – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 203 T : WASTEWATER TREATMENT TECHNOLOGY**

- Unit I : WATER POLLUTION : Sources - Domestic, Municipal sewage, Agricultural, Industrial, Heavy metals, Rivers, Lakes, Oceans as sinks for the waste disposal, Characterization of domestic and industrial wastewaters, Measurement of organic matter, COD, BOD and TOC. Effects of heavy metals on plants, animals, food chain. Oil pollution and thermal pollution, effect on plants and animals. Waste water disposal methods and tolerant limits.
- Unit II : SEWAGE AND INDUSTRIAL WASTE WATER TREATMENT  
The need for wastewater treatment – Treatment of waste water – Primary treatment (sewage) screens , Grit chambers and Oil separation and primary sedimentation, Primary treatment (industrial wastewater)-segregation, equalization, neutralization, sedimentation, flotation and oil separation.
- Unit III : SECONDARY TREATMENT (biological treatment methods) :  
Principle of biological treatment – waste stabilization ponds – Aerated lagoons – Activated sludge process – Trickling filters - Sludge treatment and disposal - Preliminary operations – Sludge thickeners – Sludge digesters. Sludge conditioning – dewatering methods - Sludge drying beds, vacuum filtration – filter process. Centrifugation . Sludge disposal methods
- Unit IV : ADVANCED WASTE WATER TREATMENT – Removal of suspended solids, dissolved solids – nitrogen removal – phosphorus removal – Adsorption – refractory organics and their treatment – Reuse and Recycle of waste water.  
Waste water treatment from specific industries sources, characteristics and methodology for the treatment of industrial waste water – flow diagrams for the treatment methods – Sugar industry, distilleries, tannery, textile and paper and pulp mills.

**BOOKS RECOMMENDED**

- |                                  |   |
|----------------------------------|---|
| 1 Waste Water Treatment          | : Donalk N. Sundstrom and Herbet E. klei<br>prentice Hall Inc. Englwood Cliffs. |
| 2. Waste Water Treatment         | : 2 nd Ed.M. Narayana Rao & Amal K. Datta<br>Oxford & IBM Pub. Com Ltd. 1985.   |
| 3. Water Treatment Specification | : Frank rose, McGrowl Hill 1985.  |
| 4. Waste water treatment         | : Met calf .  |

**M.Sc. II – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 204 T : GEO-ENVIRONMENT**

- Unit - I :** GEOLOGIC FRAME WORK  
Introduction to Geo-Environment, Environmental Dilemmas, Fundamental concepts of Environmental Geology, Earth Systems - The system Concept, Cycles in Earth Systems – The energy cycle (Energy inputs, solar radiations, geothermal energy, tidal energy), The Rock Cycles (heat transfer in the earth, plate tectonics and earth's external structure), the three rock families, earth inside and outside.
- Unit - II:** HAZARDOUS GEOLOGIC PROCESS  
Assessing Geologic Hazards and Risks, Types of Hazards, Earthquakes – Magnitude, Intensity & frequency, Earth quakes caused by human use of land, Earth quakes hazards reduction earth quake prediction, control and adjustments of earth quake activity.  
Volcanic activity- effects and prediction of volcanic activity.  
River flooding, nature and extent of flood hazard, preventive and adjustment measures,  
Landslides – causes, Human use and landslides, identification, prevention and correction of land slides, snow avalanche , Subsidence,
- Unit - III :** HUMAN IMPACTS ON THE ENVIRONMENT  
The geology of waste management – Solid waste disposal. On-site disposal, landfill, Hazardous chemical waste management, uncontrolled sites, secure landfill, land application, surface impoundment, deep-well disposal incineration of hazardous chemical waste, radioactive waste management- scope of disposal problem, disposal in geologic environment , Pollution of ground water.
- Unit-IV :** ENVIRONMENTAL CASE STUDIES  
Silent valley, Narmada Project, Tehridam, Bhopal gas tragedy, impact of Mathura refineries on Tajmahal. Large Damas and Environmental problems. Coastal hazards – Tropical cyclones, Tsunamis, coastal erosion, Perception of and adjustment to costal hazards, Environmental impacts of mining, mining for ground water, Sea water intrusion..

**BOOKS RECOMMENDED**

1. Barbara, W.M., Brian, J.S., Stephen, C.P.- Environmental Geology. John Wiley & Sons Inc.
2. Keller – Environmental Geology.
3. Lundgran, Lawrence – Environmental Geology – Prentice Hall.
4. David K Todd – Groundwater Hydrology, McGraw Hill.
5. Howard, A.D. and Remson, I-Geology in Environmental Planning McGraw Hill, New York, 1978.
6. Dix, H.M. - Environmental Pollution, John wiley, New York 1981.

**M.Sc. ENVIRONMENTAL SCIENCE**  
( Practical Syllabus)  
**II - SEMESTER**

**PAPER - I : ENVIRONMENTAL MICROBIOLOGY**

Qualitative and quantitative estimation of Phytoplankton & Zooplankton,  
Phytoplankton (Fresh water) : Chlorophyceae, Cyanophyceae, Bacillariophyceae,  
Euglenophyceae.

Zooplankton Daphnia, Cyclops

Types of culture media, Isolation of cultures.

Slides : Air Microflora (Fungal), Soil Microflora, Water Microflora.

Identification and ecological significance of cyanobacteria

Food borne diseases.

**PAPER — II : ECOLOGY AND ECOSYSTEM DYNAMICS**

Biomass estimation in different ecosystems.

Measurement of Productivity in different ecosystems.

Study of Phytosociological parameters, Abundance, Frequency, Relative frequency,

Density, Relative density, Cover, Relative cover,

Dominance, Raunkier's Biological spectrum

Diversity index.

**PAPER- III : WASTE WATER TREATMENT TECHNOLOGY**

Analysis of different types of Pollutants

Sewage wastes : NH<sub>3</sub>, Organic matter, COD , BOD.

Agricultural wastes : Pesticides, Fungicides Herbicides, Fertilizers.

Industrial wastes : COD, BOD, Heavy metals like Cu, Zn, Pb, Cd, Hg, Fe, Mn.

Identification of Activated sludge, Trickling filters, Aerated lagoons.

**PAPER- IV : GEO- ENVIRONMENT**

Identification of following

Different types of Minerals

Different types of Rocks

**M.Sc. III – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 301 T: BIODIVERSITY AND CONSERVATION**

**Unit I - Introduction, definition of biodiversity**

Global magnitude and distribution of biodiversity  
Categories and Levels of biodiversity, International  
Organisations in biodiversity and its Conventions -CBD,  
CITES, IUCN, Bio-geographical classification of India,  
Value of biodiversity- Direct use value – Consumptive value,  
Food value, Medicinal value Productive value, Timber value,  
Indirect value – aesthetic value and ethical value,

**Unit II – Endemism sand Biodiversity**

Key stones species, Umbrella species, Flag ship species,  
Loss of biodiversity,  
Ecological Extinction, The IUCN Red List categories – Red Data Book  
Threatened plant and animal species of India

**Unit III- India as a mega biodiversity nation –**

diversity of micro organism (Algae and Fungi)  
Bio-wealth of India – Forests, deserts, wetlands,  
Mangroves, coral reefs, rivers and lakes  
Hot spots, Hot spots of India

**Unit IV - Conservation of biodiversity- Principles of conservation**

In- situ conservation – Protected areas, National parks,  
Wild life sanctuaries, Biosphere reserves, sacred groves,  
Ex- situ conservation – Botanical gardens, Zoo parks,  
the role of NBPGR, NBAGR in the conservation of bio diversity  
Problems and policies of biodiversity conservation in India.

**Book Recommended :-**

- |  |   |
|--|---|
| Global Biodiversity Assessment             | - V.H.Heywood and RT Watson,<br>Cam.univ.pre -1995. |
| Biodiversity principles and conservation - | Kumar and Asija<br>Agrobios India – 2000            |
| Essential Environmental studies            | - S.P.Misra and S.N.Pandey<br>Ane Books India -2008 |

**M.Sc. III – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES. 302 T : WATER TREATMENT AND  
SOLID WASTE MANAGEMENT**

- Unit - I : **WATER HEALTH**  
Health , Role of environment on Water , Sanitation , Hygiene ,  
Water borne diseases , Need for public water supply schemes-  
Urban water supply scheme and Rural water supply schemes  
Water sources-Hydrologic cycle, sources of water  
Protected water supply - Surface sources – Sub surface sources ,  
Selection of water for PWS
- Unit - II : **WATER DEMAND AND QUALITY**  
Design period , per capita demand , population forecast fire fighting ,  
industrial and other needs . Raw water quality for PWS ,  
Drinking water quality , standards CPHEEO, BIS, WHO guidelines ,  
need for water treatment .  
Urban local bodies – service level Bench marks ( performance indicators)  
for water supply waste water management and solid waste management
- Unit - III: **WATER TREATMENT METHODS**  
Need for water treatment, Conventional water Treatment methods – Slow sand  
filters , Rapid sand filters – Flow sheets consists of aeration, Coagulation,  
Flocculation, Sedimentation, Filtration, Disinfection, Criteria for good  
disinfection – Chlorination, Ozonisation, UV rays and other methods, pressure  
filters.  
Specific water treatment methods – water softening deflouridation, Iron and  
Manganese removal, Removal of colour, , Control of taste and odours
- Unit - IV : **SOLID WASTES**  
Types, source, deposition of xenobiotics in soil, plastics, nylon etc. Dumping  
of garbage from houses, hotels and hospitals and their effects on soil  
substratum and public health. Pollution due to human waste, solid wastes  
disposal : Septic tanks, garbage disposal - incinerators, sanitary land filling, pit  
dumping, composting, recycling of garbage, Bio-medical waste management.

**BOOKS RECOMMENDED**

1. Text books of Water Supply & Sanitary Engineering : S.K. Garg, Oxford IBH Publ.
2. Water Supply and Sanitary Engineering : H.S. Birdi New Delhi.
3. Environmental Engineer's Hand Book. Vol 1,2,3 (Ed.) Bela G. Liptak, Chilton Book  
Company, Radnor, Pennsylv Vania, 1975.
4. Standard methods for the Examination of water and waste water - 19<sup>th</sup> Ed. 1995.  
Andrew and Eaton - APHA.

**M.Sc. III – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 303 T : REMOTE SENSING AND GIS**

- Unit - I : Fundamentals of Remote sensing Principles of remote sensing (Optical/Microwave)- Physical principles, Aerial photography, Image systems, Satellites, Sensors, data generation and products data indexing
- Unit - II : Image Interpretation, Principles of image interpretation, Visual image interpretation – image elements, visual interpretation aids. Digital processing- Image enhancement, image classification and image processing systems. Advantages and limitations of visual and digital interpretation for environmental studies..
- Unit - III : application of remote sensing to – Urban landscape mapping, industrial land use, remote sensing of vegetation – spectral characters of vegetation, landscape ecology, remote sensing of vegetation change, remote sensing surface water , biophysical characteristics, remote sensing of soil properties – soil texture and moisture content, soil organic matter, remote sensing for flood mapping, flood damage assessment, drought assessment and water shed management.
- Unit - IV : GIS and GPS System : GIS concepts, spatial and attribute data, data structures-vector and raster data map features, Data inputting, Data storage, Data manipulation, Data analysis, output generation, Hardware and software requirement, Application of GIS for environmental studies – a case study. GIS as decision support system. GPS: Concepts, available constellations, accuracy and types of errors, types of GPS machines, applications for environmental studies interface of GPS data with GIS

**BOOKS RECOMMENDED**

1. Remote sensing and Image interpretation. Thomas M. Lillesand and Ralph W. Keifer, John Wiley & Sons Inc . New York.
2. Introduction to Remote Sensing, James B. Campbell, Tylor & Franeis Ltd, London.
3. Fundamentals of GIS --- Micheal N. Demers.
4. Remote sensing applications in applied geosciences by Sumitra Mukherjee, Milton Book Company.
5. Environmental Geography, H.M. Saxena, Milton Book Company

## M.Sc. III – SEMESTER ENVIRONMENTAL SCIENCE

### SYLLABUS

#### ENV 304T-Paper IV : Resource Management

##### Unit I

Environmental Priorities and Resource – Types of Priorities – Population Stabilization, Land use planning, and Re-vegetation (Croplands, Grassland)  
Energy Resource – Source of Energy –Renewable and Non renewable -Solar energy, Wind energy, Tidal energy, Hydroelectric, Nuclear energy,  
Bio-energy – Biomass and Biogas, Eco-technology – Sustainable development

##### Unit II

Mineral resources – Types, Mineral exploration, Methods of minerals extraction, Impact of over exploitation of minerals, Environmental effects of extraction.  
Fossil Fuels – Classification, Composition, Characters of energy content of Coal, Petroleum and Natural gas .

##### Unit III

Water resource – Global water balance, Ice sheets and Fluctuation of sea levels, Types of water, over utilization of Surface and Ground water, Conservation of water, Rain water harvesting, Eutrophication and Restoration of Indian lakes, Wetland conservation, Watershed management,

##### Unit IV

Land and Forest resources –  
Land as resource land degradation and its causes (man induced Land slides, Soil erosion, Prevention of Soil erosion)  
Forest Distribution, Deforestation - causes of deforestation, conservation of forest (Production forestry – A forestation , Social forestry , Agro forestry ) (Protection Forestry Reforestation Sacred forest and Reserve forest )  
Social movements – Chipko movement and Apikko movement

##### Reference

P.D Sharma. 1996 Ecology and environment  
S.P. Misra .S.N. 2010 Pandey Essential Environmental studies

**M.Sc. ENVIRONMENTAL SCIENCE**  
( Practical Syllabus)  
**III- SEMESTER**

**PAPER — I : BIODIVERSITY AND CONSERVATION**

Important value index (IVI)  
Similarity and Dissimilarity index  
Diversity index  
Identification of Endemic plant species  
Identification of Medicinal plants  
Identification of Exotic plants  
Economic value species  
Vegetation and Biodiversity

**PAPER — II : WATER TREATMENT AND SOLID WASTE MANAGEMENT**

Criteria of water quality  
Most probable Number (MPN)  
Solid waste - Identification , classification.  
Designing of Effluent treatment plant (ETP)  
Water treatment - Filtration, Sedimentation, Coagulation, Disinfection.  
Identification, characterization and utilization of coal, fly ash and metal (Fe),  
Vermicompost, Sugar cane baggace and cow dung

**PAPER- III : REMOTE SENSING & GIS**

Flood mapping  
Land use mapping (NRSA role)  
Study of aerial photographs  
Case studies

**PAPER- IV : RESOURCE MANAGEMENT**

Rain water harvesting  
Wetlands  
Watershed management  
Disasters  
Minerals – Coal, petroleum  
Forest resources  
Identification of energy and timber yielding plants  
Biomass and Biogas



**M.Sc. IV – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 401 T : ENVIRONMENTAL BIOTECHNOLOGY**

- Unit - I : **BIO DEGRADATION**  
Degradation of biopolymers – Cellulose, Hemicelluloses, Pectin, Chitin, Lignin, Degradation of aliphatic and aromatic Hydrocarbons, Metabolisms and Degradation of pesticides.
- Unit - II : **BIOREMEDIATION**  
Bioremediation in-situ and ex-situ, Bioremediation of contaminated soils, Bioremediation of Marine oil pollutants  
Phytoremediation– Rhizofiltration , Phytoextraction Phytotransformation , Phytostimulation, Phytostabilisation , Root zone technology, Rhizodeposition and their role in Rhizodegradation. Bioindicators- Algae and macrophytes
- Unit - III : **BIOFERTILIZERS AND BIOPESTICIDES**  
Mass cultivation and application of Rhizobium  
Blue green algae – reclamation of alkaline and saline soils, symbiotic cyanobacteria, algalization , BGA and nitrogen fixation, cultivation methods of BGA and Azolla and Anabena, VAM fungi, Bacillus thuringensis, Nuclear polyhedrosis virus, Vermicomposting
- Unit - IV : **INDUSTRIAL MICROBIOLOGY**  
Fermentation technology – biofermentors Major products of microbes – Alcohols, Antibiotics, Aminoacids and Organic acids.  
Immobilization technology -Methods of Immobilization and applications Hydrogen Evolving bacteria, Methanogenesis

**BOOKS RECOMMENDED**

1. Microbial ecology fundamentals and applications - Ronald M. Atlas and RichardBartha 4thd Ed. Aimprint of Addison Wesley Longman Inc. - 1998
2. Environmental biotechnology principal and applications – Bruce. E. Rittmann and Perry L. Mc Carty McGraw Hill Int- 2001
3. Environmental biotechnology – SK Agarwal APH Pub. 1998.

**M.Sc. IV – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 402 T : ENVIRONMENTAL TOXICOLOGY**

- Unit - I : Scope and concepts of eco-toxicology  
Toxicology- Acute, Chronic, Paracelsus's view of poison ;  
Xenobiotics concentration and Dose, Calibration of Dose response curve, Lethal,  
LC<sub>50</sub> and threshold concentration,  
Bio-concentration and Bio-magnification,  
Tests for assessing Carcinogenicity and Mutagenicity of compounds  
1. Ames techniques, 2. Micronucleus test 3. Karyotyping,  
TLC techniques for determination of toxicants in water and vegetable samples.
- Unit - II : Chemical classification and Mode of action of pesticides. (Herbicide, fungicide,)  
Chemical basis of toxicity of pesticides,  
Persistence of pesticides in the environment  
Towards safer pesticides  
Insecticides, Botanical Insecticides - Pyrethroids, Azadirachtin., Nicotine
- Unit - III : Factors effecting metabolism of Xenobiotics, host factors age, sex, species,  
nutrition, hormonal status, disease  
Factor relating to toxicant solubility route of entry, molecular size and structure.  
Biotransformation Of Xenobiotics - Phase I reactions, Phase II reactions  
Genetic Toxicology
- Unit-IV: Metal toxicity – Lead , Arsenic ,Cadmium and Mercury their sources and effects  
on the human health  
Role of toxic substances released by Micro-organisms –  
Bacterial toxins , Mycotoxins, Phycotoxins , Plant toxins .

**BOOKS RECOMMENDED**

1. Text book of Modern Toxicology Ernest Hodgson & Patricia E.Levi Appleton & Lange Stamford, ct., U.S.A (1996).
2. Introduction to Biochemical Toxicology, Ernest Hodgson; Patricia E.Levi Appleton & Lange et. U.S.A. (1995).
3. D.K Asthana Environmental : Problems and Solutions (2005)
4. Basic Toxicology, Frank .C. Lu, Hemisphere Publishing Corporation, New York, Washington (1993)
5. Environmental Toxicology – David A. Wright and Pamela Welbourn, Cambridge University Press –2002.

**M.Sc. IV – SEMESTER ENVIRONMENTAL SCIENCE  
SYLLABUS**

**ES 403 T : ENVIRONMENTAL IMPACT ASSESSMENT.**

- Unit - I : Definition of EIA – Concept, scope and objectives , Sustainable development and EIA – Need for environmental Impact assessment – Agriculture, Industrialization and Urbanization Environmental Screening and scoping – Role – Significance .  
EIA notification of 1994 – Environmental Assessment guidelines various categories of EIA – Rapid EIA, Compressive EIA, Regional EIA, Carrying capacity basal developmental studies, Strategic EIA various components in EIA
- Unit - II : Baseline data - Air environment, Water environment, Biological environment, Socio economic environment and Aesthetic environment  
Identification of Impacts – Primary and Secondary impacts.  
Net work methods, Cause- Condition effect.  
Prediction of impacts – Use of mathematical models in predication.  
Evaluation of Impacts – Matrix method, Battelle environmental evaluation system (BEES).  
Environmental management plan (EMP) and Environmental monitoring public participation.  
Role of Remote Sensing and GIS in EIA Studies
- Unit - III : Environmental Audit  
Introduction - Designing and implementation of Audit programmes  
Management commitments – Audit objectives – Key Audit Tools – Pre audit activities, on-site activities, Post audit activities, Environmental statement – Benefits of Environmental Audit – EA Scenario in India – Submission of Environmental Audit report in MOEF format – Form V.
- Unit - IV : Environmental Laws  
Environmental Protection Act – 1986  
Wild Life Protection Act – 1972 and 1991  
Forest Conservation Act – 1980  
Air (Prevention and Control of Pollution) Act – 1981 and 1987  
Water (Prevention and Control of Pollution) Act – 1974 and 1988

**BOOKS RECOMMENDED**

1. Environmental Impact Assessment by A. Eillpin.
2. Environmental Impact Assessment and Management by H. Kumar (1998)
3. Environmental Impact Assessment of Tehri dam by V. Govardhan.
4. Practical guide to Env. Impact Assessment, Belly Bowers and Marriott 1977.
5. Environment Impact Assessment - AK Shrivastava, APH Pul.-2003.

**Department of Botany**  
**Semester-IV**

Paper Code: ID/Botany/Sem-IV/Pool-1    **Bio-fertilizers and Organic Farming**

Credits: 4    Marks: 20+80

**Unit-I**

Introduction to Plant Nutrition, Role of Microbes in N<sub>2</sub> fixation Types of Microbes; Nitrogen fixers and phosphate solubilizing microorganisms and VAM. Plant Growth promoting rhizobacteria (PGPR) and Fungi, Modes of N<sub>2</sub> fixation; Symbiosis and free living forms.

Biofertilizer Technology: Mass cultivation, ; Techniques, Biofertilizers and soil reclamation; organic farming Organic manure, composting

**Unit-II**

**Bacterial Biofertilizers**

Isolation and Mass cultivation of *Rhizobium*, *Azotobacter*, *Azospirillum*, *Frankia* and PGPR Formulations and applications.

**Unit-III**

**Cyanobacterial Biofertilizers**

Utilization of BGA in Agriculture

Reclamation of saline and alkaline soils

Symbiotic cyanobacteria and ammonia

Bluegreen algae and nitrogen fixation

Algalization Factors which influence the growth of BGA in rice fields

BGA and rice yield

Free living and symbiotic forms

Cultivation of BGA, Methods of cultivation – Trough Method, Pit Method, Field Method Azolla and its role in rice fields

**Unit-IV:**

**Fungal Biofertilizers:**

Mycorrhizae: AM Fungi – *Glomus*

Ectomycorrhizae – *Pisolithus tinctorius*

Production of root based inoculum

Plant Growth promoting Fungi and Biocontrol agents.

Production of inoculum.

**Reference**

1. Biology of Rice fields – BGA- SC. Santra – 1993 Daya Publishing House
2. Biofertilizers and Organic farming H. Panda & D. Hota – 2007
3. A Text Book of Biotechnology – 2007 – R. C. Dubey
4. A Text Book of Biotechnology by Subba Rao

M.SC IV SEMESTER BOTANY/ ENVIRONMENTAL SCIENCE

404 T / ID :ENVIRONMENTAL POLLUTION AND PROTECTION

Unit I -

Kinds of pollution, Air pollution – Sources of air pollution,  
Major air pollutants, effects of air pollution on plants and human beings, control  
of air pollution.  
Noise pollution – Sources, effects and control measures of noise.  
Acid rain – causes and effects on terrestrial and aquatic systems

Unit II –

Water pollution – Sources, effects and control of water pollution. Eutrophication.  
Thermal pollution – Sources and effects on aquatic life and control measures of  
thermal pollution  
Marine pollution – Sources, effects and control of marine pollution.

Unit III –

Soil pollution – Sources, effects and control of soil pollution.  
Radiation pollution – Sources, Biological effects of radiation and protection  
measures.  
Solid waste – Sources, Disposal methods.

Unit IV-

Role of an individual in the protection of pollution – Direct role  
and indirect role of an individual,  
Environmental protection acts  
Water (Prevention and Control of Pollution) Act 1974., Air Act 1981.  
The Environmental ( Protection) Act 1986.  
Functions and Power of CPCB and SPCB

**Reference Books**

1. S.P. Misra and S.N. Pandey – Essential Environmental studies – Ane Book India 2008
2. Y. Anjaneyulu – Introduction to Environmental Science B.C. publ. 2004
3. Chris Park The Environment – Routledge 1997
4. D.K. Asthana and Meera Asthana – Environment – Problems and Solutions – S.  
Chand Company Ltd. 1998.

**M.Sc. ENVIRONMENTAL SCIENCE**  
( Practical Syllabus)  
**IV - SEMESTER**

**PAPER — I : ENVIRONMENTAL BIOTECHNOLOGY**

Fermentation technology : Use of microbes in fermentation technology  
(Alcohols, Antibiotics)  
Degradation of Cellulose and lignin  
Isolation of pure cultures in fermentation processes.  
Phytoremediation  
Bio-indicators : Use of Biological organisms.  
Role of Biofertilizers in the Environment.

**PAPER—II : ENVIRONMENTAL TOXICOLOGY**

Estimation of lethal, sub lethal and threshold values of pollutants on plankton and fishes.  
Micronucleus test  
Estimation of toxic substances — Herbicides, Pesticides, Fungicides.  
Estimation of pollutants on higher plants  
Toxicity of heavy metals.  
Bio assay studies by using algae  
Bio assay studies by using higher plants.  
Study of Phycotoxins and Mycotoxins  
Study of botanical insecticides

**PAPER—III : ENVIRONMENTAL IMPACT ASSESSMENT**

Preparation of environmental impact statements  
Preparation of Environmental Audit report  
EIA format  
Air act, Water act, Wildlife Act  
Environmental Protection act

**PROJECT REPORT**

The candidates shall submit the Project Report at the time of Practical Examination for evaluation.