

DEPARTMENT OF ENVIRONMENT SCIENCE

PROGRAMME: M. SC.

Semester I

Paper I Environmental Chemistry (1T1)

Student shall be able to:

- Explain the Fundamentals of Chemistry: Concept of Molarity, Normality and Standard Solutions.
- Apply The Laws and Principles of Basic Chemistry and solve the problems.
- Analyze the various constituents present in environment.
- Understand the Green Chemistry and apply the knowledge for Sustainable Future.
- Interpret the process of soil formation and explain the concept of soil chemistry.
- Discern the typical characteristics of Paper and Pulp, Tannery, Textile, Dairy, Sugar, Petrochemical, Pharmaceutical, Oil Refinery and Power Plants-Thermal, Gas Based and Hydroelectric and design the suitable treatment.

Paper II: Atmospheric Science (1T2)

Student shall be able to:

- Explain the Fundamentals of Atmospheric Science: Composition and evolution of Atmosphere and concept of temperature inversion and lapse rate.
- Understand the concept of Climatology, Insolation-Factors, Solar Radiation, Condensation and Hydrologic Cycle.
- Discern the various forms of Condensation: Dew, Frost, Fog, Mist, Smog.
- Interpret the primary and secondary Meteorological Parameters and their Measurement: Temperature, Wind, Humidity and Solar Radiation.
- Collect and analyze of Wind Data and plot Wind Roses and pollution roses.
- Explain the sources and effects of Green House Gases: O₂, O₃, H₂O, NH₃, N₂, NO, NO₂, NO₃, CH₄ and CFCs and the mechanism of Ozone Depletion.

Paper III: Environmental Biology (1T3)

Student shall be able to:

- Explain the concept of Ecology and the ecological relationships and Ecological Status in India
- Understand Population Ecology and its dynamics, Biotic potential, Prey- Predator Relationship, Concept of Carrying Capacity.
- Interpret and explain Community Ecology with composition, functions and characteristics and discern the terms Stratification, Periodicity, Fluctuation, Eco-tone and Edge Effect, Ecological Niche, Eco-types.
- Utilize the knowledge of Dose – Effect and Dose-Response Relationship- Frequency and Cumulative Response, Lethal and Non-Lethal Effects, LD₅₀, in eco-toxicological studies.
- Apply the principles of Bioassay studies and explain chemical toxicology.

Paper IV: Environmental Microbiology and Biotechnology (1T4)

Student shall be able to:

- Understand the scope and importance of Environmental Microbiology and Structure of Microorganisms-Fungi, Bacteria, Virus and their role in Air, Water and Soil for Environmental Management and pollution abatement.
- Apply the Techniques used of Enrichment of Culture, Method of Pure Culture (Pour plate, Streak plate and Spread plate).
- Explain the Basic and scope of Environmental Biotechnology its approach of Environmental Pollution abatement with Bioremediation, Reclamation and Restoration.
- Apply In-situ and Ex-situ Bioremediation, Phytoremediation- Metal Phytoremediation, Organic Phytoremediation, Microbes in Pollution Mitigation.

SEMESTER – I: PRACTICAL – I

Student shall be able to:

ENVIRONMENTAL CHEMISTRY AND ATMOSPHERIC SCIENCE (IP1)

- Prepare standard solutions and discern the weighing capacity and sensitivity of weighing balances.
- Carry-out water sampling and storage techniques.
- Estimate primary productivity.
- Examine the water quality with respect to: pH, conductivity, density, viscosity, turbidity, colour, Acidity, Alkalinity, TDS & DO and iron.
- Inspect texture and particle size distribution (sand, silt and clay) porosity, water holding capacity, electrical conductivity and infiltration rate of soil.
- Determine meteorological parameters wind velocity, direction and relative humidity for air pollution studies.

PRACTICAL – II: ENVIRONMENTAL BIOLOGY, ENVIRONMENTAL MICROBIOLOGY AND BIOTECHNOLOGY (IP2)

Student shall be able to:

- Estimate the primary productivity and interpret the effects of light/pollutants on photosynthetic activity.
- Analyze the lake ecosystem with special reference to its conservation and management.
- Isolate the bacteria from soil water & air and analyze by Standard plate count and Coli form count by MID & MPN technique.
- Identify and enumerate Phytoplankton and zooplankton in surface water.
- Collect affected leaves from road side plantation and compare with reference plants.

Paper V: Environmental Ecosystem and Biodiversity (2T1)

Student shall be able to:

- Explain the Concept and Structure, Functions and Types of Ecosystem-Abiotic and biotic components.
- Interpret the Importance of Conservation, Reason for extinction of wildlife and conservation measures.
- Understand Biomes and Conservation of Forest with Special Emphasis on Indian Biomes and explain Characteristics Features and Different Types of Ecological Indicator.

- Discern the Level and Types of Biodiversity, Significance, Magnitude & Distribution of Biodiversity, Trends, Biogeographic Classification of India, Values and Impact of Biodiversity.
- Conserve and restore Wilderness and Green Cover and apply Biodiversity Legislation, Diversity Act 2002, Biodiversity Rules 2004.

Paper VI: Natural Resources Management (2T2)

- Understand Natural Resources its Conservation and Management, Broad Classification, Renewable, Non-Renewable and Mineral Resources.
- Discern Importance, Methods, Barriers and Measures to Energy Conservation.
- Explain the Water resources: Surface, Ground and Frozen Water, causes for water stress and Water Conservation Strategies in India.
- Interpret the exploitation and impact of Land & Forest Resources and apply control measures and conservation practices: Afforestation and Joint Forest Management – Social Forestry, Agro-Forestry.

Paper VII: Environmental Sampling and Research Methodology (2T3)

Student shall be able to:

- Discern Air Sampling Location, Sampling Methods (Sedimentation, Filtration, Centrifugal and Impingement Method), Instrumental Techniques used in Estimation of Atmospheric Air Pollutant
- Collect, Handle and Preserve Water Samples and classify, analyze, interpret the water quality parameters with the significance of measurement.
- Explain the Soil and Solid Waste Sampling: objectives, criteria, site selection and significance of Physico-Chemical Parameters.
- Collect and represent the data for Environmental Analysis and interpret the statistical terms: Measure of Central Tendency, Measure of Variation, Correlation and Regression, Testing of Hypothesis, Standard Deviation, Bias, Precision and Accuracy.

Paper VIII: Analytical Techniques for Environmental Monitoring (2T4)

Student shall be able to:

- Understand the Theory and Classification of Chromatographic Separation and explain the chromatographic techniques-instrumentation.
- Apply principle and working of UV-Visible Spectrophotometer, Infrared (IR) Spectrophotometer, Nuclear Magnetic Resonance (NMR), Atomic Absorption Spectrophotometer (AAS), Flame Photometer.
- Explain Electro Chemical Techniques: Principle, Instrumentation and Application of Polarography, Anodic Stripping Voltametry and speciation in Environmental Analysis.
- Interpret the Modern Instrumental Techniques: Atomic mass Spectrometry, Molecular Mass Spectrometry, Mass Spectrometric Applications, Radiochemical Analysis, ICP, ATOMFS in Environmental Analysis.

• SEMESTER II

PRACTICAL – III (2P1)L: Environmental Ecosystem And Management

Student shall be able to:

- Explain the Biotic components of pond and lake ecosystem and different ecological indicators of an ecosystem.
- Interpret forest ecosystem as biome, vegetation type characteristics and features of forest, soil type etc.
- Collect and interpret wild life data with respective common species, endanger species
- Determine the important value index (IVI) of vegetation.
- Implement conservation strategies with respect to project tiger, project elephant, project crocodile in India.

Natural Resources Management

- Perform proximate analysis of Coal.
- Determine calorific value of biomass.
- Estimate Chemical Oxygen Demand and Biochemical Oxygen Demand of waste water sample.
- Determine efficiency of biogas by raw materials and outlet effluents.
- Estimate soil for Organic Carbon, NPK, CEC and SAR.

Practical IV (2P2): Industrial chemistry

Student shall be able to:

- Explain and discern industrial processes of different industries.
- Able to explain and interpret the raw material used in industries and their environmental significances.
- Analyze the Characteristics of different waste from industries.
- Understand and treat the wastewater by Preliminary treatment, Chemical treatment and biological treatment of waste water.
- Discern amongst preliminary treatment of waste water Study of chemical treatment of waste water biological treatment of waste water.

Analytical techniques

- Explain the principle components and working of U.V. visible spectrophotometer
- Analyze the concentration of sulphate by spectrophotometer.
- Analyze the concentration of phosphate by spectrophotometer.
- Analyze the concentration of nitrate by spectrophotometer.
- Determine the concentration of sodium, potassium, calcium and lithium by flame photometer.
- Demonstrate AAS and analyze trace and heavy metals.
- Demonstrate HPLC and analyze GC for pesticide analysis.

Semester III

Paper IX: Physico-Chemical Treatment of Water & Waste Water (3T1)

Student shall be able to

- Discern Domestic and Industrial Wastes and its sources and the factors affecting Quantity of Sanitary Sewage.
- Explain the objectives, system, principle and design of wastewater collection and understand the Physico-chemical and Biological Characteristic of wastewater.
- Apply the design principle and construction of Screen, Grit Chamber, Oil & Grease Trap, Pre-Sedimentation, Pre-aeration, and Equalization.
- Understand the wastewater treatment methods Unit Operations, Processes and Treatment Systems Used in Wastewater Treatment, Treatment Flow sheet, Plant Layout, Hydraulic

Profile.

- Analyze the Methods of Treatment, Chemical Coagulation, Flocculation, Sedimentation, Filtration, Air Stripping, Ion Exchange Carbon Adsorption, Reverse Osmosis, Clarifiers and Efficiency of Chemical Precipitation.

Paper X: Biological Process in Wastewater Treatment (3T2)

Student shall be able to

- Understand Basic Principles of Anaerobic Treatment and explain Anaerobic Digestion and Sludge Treatment.
- Apply Basic Principles of Aerobic Treatment Technologies and explain Activated Sludge Process.
- Interpret the Operation & Maintenance measures of Wastewater Treatment Plant for various units & equipment such as Screens, Grit Chamber, Skimming Tanks, Primary clarifiers, aeration tanks, secondary clarifiers, Anaerobic digesters.
- Explain Waste water treatment & Reuse: Treatment scheme, flow diagram & hydraulic profile for Sewage reuse plant, generation & utilization of methane from treatment of industrial waste water & sewage.

Paper XI (ELECTIVE – I): Water and Water Treatment (3T3)

Student shall be able to

- Understand Water Treatment Process: Primary, Secondary and Tertiary and explain Objective, Principles, Unit Operation and Unit Processes of Water Treatment.
- Explain the Necessity, Method and Theory of Filtration and Disinfection and discern Plain Chlorination, Prechlorination, Post chlorination, Super Chlorination, Double Chlorination, Break Point Chlorination.
- Analyze Methods of Water Softening, (Lime, Soda Process, Zeolite Process, Demineralization Process, Ion Exchange Resins) and their Chemical.
- Apply Modern Water Treatment Techniques for Removal of Colour, Odour and Taste, Aeration and Treatment With Activated Carbon.

Paper XII (ELECTIVE-II): Water Supply and Resources (3T3)

- Student shall be able to
- Explain Importance and Necessity of Water Supply Scheme, Essential of Water Supply Scheme, Types of Water Sources.
- Interpret Surface & Ground Water Quality: Infiltration, Porosity, Water Bearing Stratum, Groundwater flow, Groundwater Yield, Permeability, Groundwater Velocity, Springs, Infiltration Galleries, Porous Pipe Galleries.
- Discern Quantity and Quality of Water: Types of Demand, Measurement of Water Quantity, Pure and Potable Water, Physical Tests, Chemical Test, Bacteriological Tests.
- Understand Distribution of Water: Method of Distribution System, Requirement of

Distribution of Water and their Merits and Demerits, System of Supplying Water, Types of Service Reservoir.

Paper XIII (Foundation-I): Fundamentals of Environmental Science- I (3T4)

- Student shall be able to
- Define and explain Scope of Environmental Science, Types of Environment, Environmental Organizations and Agencies, Activists in Environmental Movements and their role.
- Interpret the Structure of Atmosphere, Hydrological Cycle, Global Water Balance, Structure and Composition of Lithosphere and Biosphere.
- Understand the Branches of Ecology, Ecological Landmark, Concepts, Structure and Functions of Ecosystem and Biogeochemical Cycles.
- Discern Diversity of Wildlife, Protected Wildlife Species, Categories of Threatened Species and Developmental Projects: Project Tiger, Project Elephant.

Paper XIV: Core (Subject Centric) I: Advanced Water & Waste Water Treatment (3T4)

Student shall be able to

- Interpret the advanced treatment in water and waste water: Zero Liquid Discharge, Concept of CETP.
- Understand Advancement in Water Treatment: Membrane technology, Modern Desalination plants, Dual Media Filtration.
- Apply advanced Waste Water Treatments: Dissolved Air Floatation Unit, High Rate Solid Contact Clarifier, Membrane Bio Reactor, Moving Bed Biofilm Reactor.
- Explain Cost Economics of Modern Technologies and Nano Filtration, Multi Effect evaporators, Biogas generation and it's reuse.

Practical –V: Physico- Chemical Treatment of water & Waste Water and Biological Process in Waste Water Treatment (3P1)

Student shall be able to

- Perform Relative density test for a sample of waste water.
- Determine of Sludge Volume Index (SVI) of sludge samples and Sludge Density Index (SDI) of sludge samples.
- Estimate Nitrogen by Kjeldahl's methods and Phosphate and Sulphate in sludge for fertilities values.
- Estimate of Chemical Oxygen Demands (COD) of waste water and Biochemical Oxygen Demands (BOD) of waste water.
- Determine percent organic matter of a sludge.
- Study the sludge for its composition (solids, suspended volatile fixed and total)
- Estimate the suspended, dissolves, total, volatiles solids in sewages.
- Study the sewage treatment plant with respect to :
- Flow measurement

- Design of screen, grit chamber, aeration tank, anaerobic digesters, settling units.

Practical (ELECTIVE I) (3P2): Water & Water Treatment

Student shall be able to

- Determine the impurities of water viz. color, temperature, odour and taste of water.
- Determine the total solids in water (suspended & dissolved).
- Determine the iron and manganese by spectrophotometer.
- Determine the hardness in raw and treated water.
- Determine the chloride in water samples by argentometric method.
- Conduct the chlorine demand test of a sample of water and to draw chlorine demand curve to determine break point chlorination.
- Determination of optimum coagulant dose by jar test apparatus.

Practical (ELECTIVE) II (3P2): Water Supply and Resources

Student shall be able to

- Determine the turbidity of the sample by turbidity meter.
- Determine the optimum coagulant dose by jar test apparatus.
- Determine the fluoride concentration by SPADNS methods / Ions selective Electrodes.
- Determine the langelier calcium carbonate saturation Index.
- Conduct the chlorine demand test of a sample of water and draw chlorine demand curve.
- Determine break point chlorination.
- Determine the alum dosage for defluoridation of water by application of Nalgonda techniques.
- Prepare different models for rain water harvesting.

SEMESTER IV

Paper XV: Air and Noise Pollution Control Technology (4T1)

Student shall be able to

- Explain the Origin and Composition, Structure, Atmospheric Photochemical Reactions, Acid Rain, Photochemical Smog and Air Pollution Index.
- Interpret the Air Sampling & Monitoring: Criteria, Selection of Sampling Locations, Analytical and Instrumental Techniques Used in Estimation of Atmospheric Pollutants, Methodology of Measurement of SO₂, NO and Dust.
- Understand Industrial Air Emission Control: Characterizing the Air Stream, Equipment Selection, Principle & Design - Condensation, Absorption, Adsorption, Filtration, Impingement Separator.
- Discern Noise Pollution: Basic Properties of Sound, Sound Pressure and Intensity Levels Equivalent Sound Pressure Levels (leq), Noise Pollution Levels (npl), Sound Exposure Levels (sel).

Paper XVI: Solid and Hazardous Waste Management (4T2)

Student shall be able to

- Understand the Nature of Solid Waste: Classification and Origin, Characteristic and Methods of Solid Waste Treatment and Disposal Pyrolysis, Recycling and Reuse of Solid Waste and Management.
- Apply the knowledge of Solid Waste Management: Vermiculture, Composting, Biogas from MSW, Land Fill (Site Selection, Site Investigation and Site Characterization) Landfill Planning and Designing, Construction and Operational Practices.
- Interpret the Hazardous Waste: Classification, Identification, Sources and Characteristics of Hazardous Waste and Integrated Approach for Minimization of Air, Water and Solid Pollutants, Collection, Storage, Transportation, Hazardous Waste.
- Explain the Hazardous Waste Treatment & Management: Physico-Chemical, Biological and Thermal Destruction of Hazardous Wastes, Incineration, Pyrolysis, Wet Air Oxidation, Containment Technologies, Secured Landfill, Land Farming, Bioremediation.

(ELECTIVE-I): Paper XVII: Environmental Impact Assessment and Legislation (4T3)

Student shall be able to

- Explain Environmental Impact Assessment: Basic Concepts and Principles of EIA, Need, Elements, Environmental Attributes, Overview of Impacts.
- Understand EIA Procedure: Screening and Scoping in EIA, Methodologies of EIA, Checklist, Matrices, Overlays, Cost Benefit Analysis, Computer Aided EIA, Battelle Environmental Evaluation System-Impact Identification Networks
- Interpret Environmental Audit and EMS: Concept, Types, Benefits, Scope and Objectives of EA, Pre-Audit, On-Site Audit and Post Audit Activities
- Apply Environmental Legislation: Constitutional and Statutory Laws in India, Fundamental Duties and Fundamental Rights, Legal Control of Environmental Pollution.

Paper XVIII (ELECTIVE-II): Environmental Management (4T3)

Student shall be able to

- Explain the Ecosystem Management, Exploitation (Overuse and Misuse) and its Consequences Wildlife Management and Water and Soil Management.
- Apply the knowledge of Computer Programming: Generation and Classifications, Structure, Function, Capabilities and Limitations of Computers, Operating System and Remote Sensing and GIS and its application in Agriculture, Environmental Management and Land Use, Land Cover.
- Interpret Environmental Geoscience: Conservation of Matter in Various Segments Atmosphere, Hydrosphere, Lithosphere and Biosphere and Earth Process and Hazards: Catastrophic Geological Hazards.
- Analyze Current Issues and Environmental Problems: Environmental Education and Awareness, Narmada Dam, Tehri Dam, Almatti Dam, Waste lands and their Reclamation and Restoration of Indian Lakes.

Paper XIX (Foundation-II): Fundamentals of Environmental Science- II (4T4)

Student shall be able to

- Understand the Air Pollution, Classification of Air Pollutants and their Sources, Effects, Control Measures, Chemical Reaction, Climate Change and Global Warming.
- Explain the Noise Pollution, Properties of Sound, Sound Pressure and Intensity Levels, Equivalent Sound Pressure Levels (leq), Noise Pollution Levels (npl), Sound Exposure Levels z(sel)
- Interpret Water Pollution, Classification, and their Adverse Effects, Sources and Bioaccumulation, Bio-Magnification and Eutrophication, Water Sampling.
- Utilize the knowledge of Soil Pollution, Soil Pollutants, Causes and Effects of Soil Pollution, Sources and Methods of Solid Waste Treatment and Disposal.

Paper XX: Core (Subject Centric) –II: Disaster Management (4T4)

Student shall be able to

- Interpret the Disaster: Disaster management cycle, general effects and concerns.
- Understand the nuclear disasters, forest fires, desertification and transportation accidents: Causes, general effects and management.
- Discern the natural disasters: Earthquake, Volcanic eruptions, Snow avalanches, landslides, cyclone, Floods, drought, Heat and cold waves and tsunami and its characteristics, causes, impacts and mitigation.
- Analyze the disaster response, risk and vulnerability assessment, disaster preparedness, disaster mitigation and Recovery.

Practical - VII (4P1)

Student shall be able to

- **Air and Noise Pollution Control Technologies**
- Determine the Suspended Particulate Matter (SPM) and RSPM in ambient air by using High Volume Sampler.
- Carry out the Comparative analysis of air sampling from residential, commercial, and industrial zone using key parameters like SO_x and NO_x.
- Measure the noise pollution by noise meter in silent, residential, commercial, and industrial zone and comparison with standards.
- Determine the carbon monoxide in ambient air.
- Prepare and interpret the wind roses.
- Estimate the poly-aromatic hydrocarbons in air.
- **Solid and Hazardous Waste Management**
- Determine the volatile matter from solid waste sample.
- Estimate the non-volatile matter form solid waste sample.
- Study the calorific value of solid waste sample.
- Study the moisture content of solid waste sample.
- Study the bio-medical waste generation and disposal practices in urban area.

- **Environmental Impact Assessment and Legislation & Environmental Management**
- Study the natural environment of the area with respect to soil, air, water, noise and socio-economics.
- Study the environmental impact of the industries on water, air, soil and noise quality.
- Study and undertake the preliminary survey to identify impact on environmental parameters.
- Carry-out the Base line Study of investigation of water, air, soil and noise quality of the area.
- Study the EIA legislation for environmental protection.
- Study the environmental management practices in industries.