

# SYLLABI

**M.Tech**

**IN**

**CIVIL ENGINEERING  
(Environmental Engineering)**



**2016**

**Department of Civil Engineering**

**JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY**

**A-B ROAD, RAGHOGARH, DT. GUNA-473226 MP, INDIA**

## TEACHING SCHEME

### Master of Technology (M.Tech.)

#### Branch – Environmental engineering

Year/Sem: Ist Year/IstSem

SN	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1	14M12CL121	Environmental Chemistry and Microbiology	Core	3	0	0	3
2	14M12CL122	Environment and Development	Core	3	0	0	3
3	14M12CL123	Solid & Hazardous Waste Management	Core	3	0	0	3
4	14M1GXX14x	Elective-I	Elective	3	0	0	3
		<b>Bridge Course</b>					
5	14B11CI 111	<b>for Civil Engineering Students:</b> Material Balance & Reaction Engineering <b>OR for Chemical Engineering Students:</b> Water Supply & Sewage Treatment	Core	3	0	0	3
6	14B17PH171	Environmental Chemistry and Microbiology lab	Core	4	0	0	2
		<b>Total</b>		<b>Sub Total</b>			<b>17</b>

List of Electives for DE-1			Core/ Elective	L	T	P	Credits
1	14M1GCL141	Industrial Waste Treatment	Elective	3	0	0	3
2	14M1GCE141	Environmental Rules and Laws	Elective	3	0	0	3
3	14M1GCE142	Environmental Management	Elective	3	0	0	3
4	14M1GCL142	Physicochemical Processes	Elective	3	0	0	3

Year/Sem: Ist Year/Ind Sem

SN	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1	14M12CL221	Air & Noise Pollution: Monitoring and Control	Core	3	0	0	3
2	14M12CL222	Wastewater Treatment	Core	3	0	0	3
3	14M12CE221	Environmental Impact Assessment and Audit	Core	3	0	0	3
4	14M12CL223	Modeling and Simulation in Environmental Systems	Core	3	0	0	3
5	14M1GXX24x	Elective - II	Elective	3	0	0	3
6	14M18CL281	Pollution Monitoring Lab	Core	4	0	0	2
		<b>Total</b>		<b>Sub Total</b>			<b>17</b>

List of Electives for DE-2			Core/ Elective	L	T	P	Credits
1	14M1GCL241	Membrane Separation Processes	Elective	3	0	0	3
2	14M1GCL242	Absorption and Adsorption Processes	Elective	3	0	0	3
3	14M1GCL243	Green Rating	Elective	3	0	0	3
4	14M1GCE241	Ground water Pollution	Elective	3	0	0	3

**Year/Sem: IInd Year/IIIrd Sem**

SN	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1	14M1GXX34x	Elective-III	Elective	3	0	0	3
2	14M1GXX34x	Elective-IV	Elective	3	0	0	3
3	14M19GE391	Project Seminar-I	Core	0	0	0	2
4	14M19GE392	Dissertation part-I	Core	24	0	0	12
		<b>Total</b>		<b>Sub Total</b>			<b>20</b>

List of Electives for DE-3			Core/ Elective	L	T	P	Credits
1	14M1GCL341	Waste Recycling and Reuse	Elective	3	0	0	3
2	14M1GCE341	Water Quality and Pollution in natural water systems	Elective	3	0	0	3
3	14M1GCL342	Analytical Chemistry and Environmental Instrumentation	Elective	3	0	0	3

List of Electives for DE-4			Core/ Elective	L	T	P	Credits
1	14M1GCE342	Modeling surface water Quality	Elective	3	0	0	3
2	14M1GCE343	Environmental Economics	Elective	3	0	0	3
3	14M1GCL343	Clean Technologies	Elective	3	0	0	3

**Year/Sem: IInd Year/IVth Sem**

SN	Subject Code	Subject	Core/ Elective	L	T	P	Credits
1	14M1GXX44x	Elective-V	Elective	3	0	0	3
2	14M1GXX44x	Elective-VI	Elective	3	0	0	3
3	14M19GE491	Project Seminar-II	Elective	0	0	0	2
4	14M19GE492	Dissertation part-II	Elective	28	0	0	14
		<b>Total</b>		<b>Sub Total</b>			<b>22</b>
List of Electives for DE-5			Core/ Elective	L	T	P	Credits

1	14M1GCE441	Remote Sensing Applications in Environmental Engineering	Elective	3	0	0	3
2	14M1GCE442	Solid Waste management and Land Reclamation	Elective	3	0	0	3
3	14M1GCL441	Transport of Pollutants	Elective	3	0	0	3

<b>List of Electives for DE-6</b>			<b>Core/ Elective</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Credits</b>
1	14M1GCE443	Introduction to Urban and Rural Environmental Engineering	Elective	3	0	0	3
2	14M1GCL442	Energy Resources & Conservation	Elective	3	0	0	3
3	14M1GCL443	Process Analysis	Elective	3	0	0	3

## **SYLLABI**

### **Master of Technology (M.Tech.)**

#### **Branch – Environmental engineering**

##### **Year/Sem: Ist Year/IstSem**

##### **14M12CL121 Environmental Chemistry & Microbiology**

Fundamentals of chemistry for environmental engineering Environmental Segments: Atmosphere, Lithosphere, Hydrosphere Basic Concepts: General Chemistry, Physical Equilibrium, Organic Chemistry, Biochemistry, Colloidal Chemistry, Quantitative Chemistry, Chemistry of Water and wastewater Soil Chemistry: Acid-Base and Ion-exchange reactions in soils. Waste and pollutants in soil, Heavy metals and radio nuclides in soil, absorption in soils - forces and isotherms; soil as cation and anion exchanger; degradation of natural substances; remediation of metal contaminated soil. Atmospheric Chemistry: Ozone, Smog, Aerosol, Precipitation Introduction to instrumental techniques in environmental chemical Analysis Introduction to Microbiology Methods: Microscopy, Sterilization, Culture method, Classification and structure of Microorganisms Microbial Metabolism & growth Microbial Associations-Symbiosis, Viral and Bacterial diseases, Control of Microorganisms, Microbiology of water and wastewater, Industrial Microbiology.

##### **14M12CL122 Environment And Development**

Understanding earth, atmosphere and processes governing environmental conditions, Energy budget, Climate and climate change, Chemical and Biological cycles, Study and significance of natural resources. Ecology, Wildlife Conservation, forestry, Global Climate and hazards, Effect of development and population increase on environment, Global environmental issues, Concept of sustainability, strategies to implement sustainable development, measures /indices of sustainable development, sustainability in developing countries. Regulatory provisions: Environmental protection acts and regulations, regulations for storage and handling of hazardous substances and labeling Material Hazards, Process Hazards, Ignition Sources, explosions ,Toxic materials and biological response, Hazard Identification & Hazard analysis, HAZOP and other methods of study, Safety devices, Disaster Management Plan: On site and off site plans.

##### **14M12CL123 Solid And Hazardous Waste Management**

Introduction: Types and sources of solid wastes, Municipal, solid waste, Industrial solid wastes and Hazardous wastes, Present scenarios of municipal and industrial waste management in India. Properties of Solid Wastes: Physical and chemical composition of municipal solid wastes, waste generation rates, factors effecting waste generation rates. Management of Solid Wastes in India : Prevalent SWM practices and deficiencies : Storage of waste at source, segregation of wastes, Primary collection of waste, transportation of waste, disposal of wastes, institutional deficiencies. Engineered Systems of Solid Waste Management: Design specifications of primary waste collection tools, waste storage bins, transportation vehicles, route selection and provision of transfer stations. Disposal of Wastes: Site selection, rapid EIA of proposed sites, disposal technologies such as: Composting: Aerobic composting, Anaerobic composting, mechanical composting, vermin composting; advantages and limitations of composting technologies, Economics of composting. Anaerobic digestion: Traditional digesters such as KVIC model, Deenbandhu model, emerging technologies for waste stabilization. Pyrolysis; Incineration - waste characterization, combustion calculation, unit operations, supply of air, products of combustion, furnace temperature, furnace calculation, storage of refuse, waste reduction and environmental control. Sanitary land-filling : Method of preparing sanitary landfill site, land filling techniques, operation and maintenance of landfill sites including leachate collection and treatment, recovery of methane from landfill sites for power generation.

## **Departmental elective-I**

### **14M1GCL141 Industrial Waste Treatment**

Sources and characteristics of industrial wastewater, effects on environment. Standards related to industrial wastewater. Waste volume reduction, waste strength reduction, neutralization, equalization and proportioning. Advanced wastewater treatment. Industry specific wastewater treatment for chloro-alkali, electroplating, distillery, tannery, pulp and paper, fertilizer, etc. Treatment technology of coal washery and coke oven effluents. Acid mine drainage: occurrence, effects and treatment technologies. Principles of reactor design; flow pattern in reactors, estimation of dispersion number. Kinetics of plug flow and completely mixed flow reactor. Microbiology and bioenergetics of waste degradation, modeling and application of biological process employed in wastewater engineering. Growth kinetics determination for inhibitory substrate. Sludge handling and disposal; Design and operation of sludge thickener. Stabilization of sludge- anaerobic digestion, single stage and two stage; process design. Aerobic sludge digestion – process microbiology and design. Conditioning of sludge. Land application of sludge and design consideration. Sludge storage, land application of domestic sewage and ground water recharge. Wastewater reclamation and reuse. Sustainable sewage treatment.

### **14M12CL124 Material Balance & Reaction Engineering**

Material Balance: Units, their dimensions and conversions, mass and volume relations, Stoichiometric and composition relations, excess reactants, degree of completion, conversion selectivity and yield. Ideal gas law, Dalton's law, Amagat's law, and average molecular weight of gaseous mixtures. Effect of temperature on vapor pressure, vapor pressure plot, vapor pressures of miscible and immiscible liquids and solutions, Raoult's law and Henry's Law. Material balances for systems with and without chemical reactions. Analysis of systems with by-pass, recycle and purge. Reaction Engineering: Rate of reaction, elementary and non-elementary homogeneous reactions, molecularity and order of reaction, Thermodynamic formulation of rates, mechanism of reaction, temperature dependency from thermodynamics, Arrhenius collision and activated complex theories, Integral and differential methods for analyzing kinetic data, Interpretation of constant volume batch reactor data for zero, first, second, and third order reactions, half life period, Design equations for batch reactor, plug flow reactor and Continuous Stirred Tank.

### **14M1GCE141 Environmental Rules and Laws**

Environmental Policies - National and International trends, changes in global perspective, International treaties. Legal provisions for environmental protection; various Acts, Rules and Regulations. Notifications issued under various Acts and Rules. Environmental standards, Criteria for standard setting. Public Liability Insurance Act and Acts relating to hazardous and toxic substances. Introduction to Environmental Law and Regulations, Enforcement and Liability Enforcers of Environmental Law, Clean Air Act, Clean Water Act (CWA), Occupational, Safety, and Health Act (OSHA), Pollution Prevention Act, Safe Drinking Water Act, Environmental Management Systems

### **14M1GCE142 Environmental Management**

Environmental Management, problem and strategies; review of political, ecological and remedial actions, Future strategies; multidisciplinary environmental strategies, planning, decision making and management dimensions Life Cycle Assessment as EM Tool, Environmental Management Systems Standards: e.g. ISO 14000 (EMS), Related Issues in Environmental Management.

### **14M1GCL142 Physicochemical Processes**

Structure and basic properties of water and their significance in environmental engineering, Sources of water impurities, abiotic reactions, biological metabolism, solid-liquid-gas interaction, mass transfer and transport of impurities in water and air, diffusion, dispersion Physical and chemical interactions due to various forces, suspensions and dispersions Chemical thermodynamics, acid-base equilibria, Solubility equilibria, oxidation-reduction equilibria. Reaction rates and catalysis. Surface and colloidal chemistry, Settling of particles in water, Coagulation and flocculation, filtration- mechanisms and interpretations, water stabilization, aeration and gas transfer, desalination.

## **14M12CE121 Water Supply & Sewage Treatment**

Population forecasting and water demand estimation, variation in water demand, Sources of water, Water Intakes, Water resources of India, components of water supply schemes, Transportation of water & wastewater: pipes and pumps, Water Quality: impurities, quality standards. Water treatment: methods and their selection. Distribution systems, Introduction to sewage, sewage systems, estimation of design sewage discharge, peak drainage discharge, Quality and characteristics of sewage: Decomposition of Sewage (N,C & S cycles); physical, chemical & biological characteristics of sewage; Treatment of sewage: Basics of primary, secondary and tertiary treatment, Thickening, digestion, dewatering and disposal of sludge Introduction to treatment of industrial wastewater, Guidelines and Laws Governing water supply and sewage treatment.

## **14M18CL181 Environmental Chemistry And Microbiology Lab**

### **LIST OF EXPERIMENTS:**

**Experiment No.1:** Determination of pH, acidity-alkalinity of water sample

**Experiment No.2:** Total suspended solids, total dissolved solids (TDS) of water sample

**Experiment No.3:** Total hardness (TSS) and Ca & Mg hardness of water sample

**Experiment No.4:** Chloride, sulphate, nitrate in water sample

**Experiment No.5:** Chlorine demand, break-point chlorination and free residual chlorine in water sample

**Experiment No.6:** Coagulation dose for water sample

**Experiment No.7:** Soil sampling, determination of soil ph conductivity and salinity soil

**Experiment No.8:** Sterilization and Disinfection; Media preparation: semi-synthetic, synthetic media and semisolid; culture media –Nutrient agar; Enrichment media preparation; Gram staining.

**Experiment No.9:** Bacteriology of drinking water MPN techniques for total coli form; fecal coli form (thermo-tolerant coli form) MPN test; Membrane filtration techniques for fecal coli form and total coli form

**Experiment No.10:** Microbiology of Air: by exposure plate method;

**Experiment No.11:** Microbiology of soil- Hetero-tropic bacterial counts by colony counter (Nutrient agar medium)

### **Year/Sem: Ist Year/IIInd Sem**

## **14M12CL221 Air And Noise Pollution: Monitoring and Control**

Sources of air pollution- stationary and mobile, fugitive emissions, secondary pollutants; Effects of air pollution in regional and global scale, air pollution episodes; Emission factors inventory and predictive equations. Atmospheric meteorology, wind profiles, turbulent diffusion, topographic effects, separated flows, temperature profiles in atmosphere, stability, inversions, plume behavior. Air quality monitoring - objectives, time and space variability in air quality; air sampling design, analysis and interpretation of air pollution data, guidelines of network design in urban and rural areas. Stack monitoring. Air pollution standards and indices. Dispersion of air pollutants and modeling- Basic concepts, inversion layer and mixing height, atmospheric stability classes, theory and application of acoustic sounding (SODAR) technique. Box model, The Gaussian dispersion model -- point, area and line sources. Prediction of effective stack height - physics of plume rise, Holland's equation, Briggs equation, etc. modifications of Gaussian dispersion models; indoor air quality models. Review of general principles of air pollution control. Design and operation of gravity settling chambers, Design and operation of cyclones. Design and operation of wet dust scrubbers – column scrubbers, jet scrubbers, vortex scrubbers, rotating disc scrubbers, and venturi scrubbers, Design and operation of fabric filters. Design and operation of electrostatic precipitators design and operation of mist separators- baffled mist separators, pressure separators. Control devices for gaseous pollutants with special emphasis on adsorption, absorption, mass transfer, condensation, and combustion, Control of motor vehicle emissions, Indoor air pollution control. Noise Pollution: Noise: elementary sound theory, sound perception, noise in buildings, special types of noise, measurement of noise and calculation methods for traffic noise Basics of acoustics and specification of sound; sound power, sound intensity and sound pressure levels; plane, point and line sources, multiple sources; outdoor and indoor noise propagation; psycho-acoustics and noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound and sonic boom; noise

standards and limit values; noise instrumentation and monitoring procedure. Noise indices, Methods of abatement of noise pollution. Guidelines and laws Governing air and noise pollution

#### **14M12CL222 Wastewater Treatment**

Source and character of wastes; design and operation of wastewater treatment facilities; ultimate disposal of wastewater residues and considerations of discharge criteria, Biological processes for wastewater treatment Hydraulics of treatment plant, flow measurement and hydraulic control points, hydraulic analysis of unit operations. Theory and design of wastewater disposal systems; disposal to inland water bodies, sea/ocean disposal, land/underground disposal Sewage characteristics, Quantity & Quality, flow rate, treatment flow -sheets. Sewage treatment process, reactor type, hydraulic characteristics. Preliminary treatment-design and operation of screening and grit chamber. Sedimentation, design and operation PST; Chemical precipitation. Principle of biological treatment-derivation of bacterial growth kinetics used in designing of wastewater treatment plant. Process design and operation of Activated sludge process and its modification. Bulking and rising sludge. Design of secondary settling tank. Wastewater treatment for small communities -- Oxidation ditch, extended aeration system, SBR; Process design and operation of mechanically aerated lagoon and Waste stabilization pond system. Sanitation-- rural sanitation, short term and long term control of insects, rodents, vectors and nuisance; municipal sanitary standards and regulation. Sewage disposal in isolated un-sewered areas-- septic tank Aerobic attached growth process -Process design and operation of trickling filter, RBC, Bio-filter. Anaerobic treatment: process microbiology and biochemistry; application for treatment of sewage, advantage and disadvantages. Concept of common effluent treatment plant (CETP). Sludge characteristics and disposal methods -design and operation of sludge drying bed. Guidelines and laws governing wastewater treatment.

#### **14M12CE221 Environmental Impact Assessment And Audit**

Framework for environmental impact assessment. Screening, Scoping and baseline studies, Techniques for assessment of impacts on physical resources, ecological resources, human use values and quality of life values. Impact assessment methodologies -various methods, their applicability. Strategic Environmental Assessment. Cumulative impact assessment. Risk and uncertainty in EIA. Environmental Management Planning. Disaster management planning. Concepts of environmental audit, objectives of audit. Types of Audits; Features of Effective auditing; Programme Planning; Organisation of Auditing Programme, pre-visit data collection. Audit Protocol; Onsite Audit; Data Sampling - Inspections - Evaluation and presentation; Exit Interview; Audit Report - Action Plan - Management of Audits; Waste Management Contractor Audits. Life Cycle Approach. Introduction; Principles & elements of successful environmental management; ISO principles; EMS; Creating an environmental management system in line with ISO: 14000; Benefits of an environmental management system; Principles & elements of successful environmental management: leadership, environmental management planning, implementing an environmental management system, measurement & evaluations required for an environmental management system, environmental management reviews & improvements; Legal and regulatory concerns; Integrating ISO 9000 & ISO 14000.

#### **14M12CL223 Modeling And Simulation in Environmental Systems**

Systems approach - concept and analysis. Problems formulation, model construction and deriving solution from models. Modeling of wastewater management systems- model formation and solution. Modeling of pesticide management problems; optimization model for planning municipal wastewater treatment. linear programming models, solution and sensitivity analysis; Pollution. Separable and integer programming- application to multi-objective planning. Application of integer programming to municipal solid waste management. Transportation models. Dynamic programming models- application to land use planning and air pollutant emission control.

### **Departmental elective-II**

#### **14M1GCL241 Membrane Separation Processes**

Introduction: Separation processes, introduction to membrane processes, history, definition of a membrane, membrane processes. Materials and Material Properties: Introduction, polymers, stereoisomerism, chain flexibility, molecular weight, chain interactions, state of the polymer, effect of polymeric structure on  $T_g$ , glass transition temperature depression, Preparation of Synthetic Membranes: Introduction, preparation of synthetic. Membranes, phase inversion membranes, preparation technique for immersion precipitation, preparation technique for composite



membranes, Characterization of Membranes: Introduction, membrane characterization, characterization of porous membranes, characterization of ionic membranes, characterization of non porous membranes. Transport in Membranes: Introduction, driving forces, non equilibrium thermodynamics, transport through porous, non porous, and ion exchange membranes. Membrane Processes: Introduction, osmosis, Pressure driven membrane processes, concentration driven membrane electrically driven processes, membrane reactors. Polarization phenomenon and fouling: introduction, concentration polarization, turbulence promoters, pressure drop, gel layer model, osmotic pressure model, boundary layer resistance model, concentration polarization in diffusive membrane separations and electro dialysis, membrane fouling, methods to reduce fouling, compaction. Module and process design: Introduction, plate and frame model, spiral wound module, tubular module, capillary module, hollow fiber model, comparison of module configurations.

#### **14M1GCL242 Absorption and Adsorption Processes**

Adsorption: Description of adsorption processes and their application, types of adsorption, nature of adsorbents, adsorption equilibria and adsorption hysteresis, Langmuir and Freundlich Isotherm, stage-wise and continuous contact adsorption operations, Fixed Bed Adsorption, Equipments for adsorption, Applications of Adsorption in wastewater treatment, Regeneration of Adsorbent. Absorption and Stripping: Equipments, gas-liquid equilibria, Henry's law, selection of solvent, absorption in tray column, graphical and analytical methods. Absorption in packed columns, HTU, NTU & HETP concepts, design equations for packed column, absorption with chemical reaction and mass transfer. Applications of absorption in removal of gaseous pollutants

#### **14M1GCL243 Green Rating**

Introduction: Society, Development, Environmental Concerns and Environmental Standards. Industrial Activity in India: Growth and GDP, Resource Consumption, Sustainability Issues, Stakeholders' Views, Corporate Responsibility for Environmental Protection (CREP). Life Cycle Analysis: Impact Assessment, Natural Resource Depletion, Greenhouse Gases Effect, Atmospheric Acidification, Ozone Depletion, Eutrophication, Toxicity, Odor. Credible Information System: Mandatory Information Dissemination, Environmental Management Systems, Transparency and Trust in Information, Primary and Secondary Data, Verification of Data, Impact Assessment. Valuation Methods: Environmental Load Index, Eco-points, Eco-indicators, Eco-labeling, Carbon Credits. Green Rating: Concept, Methodology for Scientific Rating For Industrial Systems, Data Collection And Verification, Rating Criteria Corporate Environmental Policy and Management: Corporate Policy, Environmental Systems and Management, Approaches In Industry. Lifecycle Analysis: Environmental Impact in Sourcing Phase (Supply Chain Management), In Production Phase, In Product Use Phase and In Disposal Phase. Examples, Rating, Weightages. Case Studies in Green Rating from India: Pulp & Paper Sector, Caustic and Chlorine Sector, Automobile Sector, Cement Sector

#### **14M1GCE241 Ground Water Pollution**

Overview and Introduction to Groundwater Pollution and Hydrology Principals and fundamental Concepts of Groundwater Flow, Contamination, fate and transport and natural attenuation Fundamental Principles and technical details of Groundwater Monitoring Remediation Strategies for RCRA, Superfund and Brownfield Sites. Illustrative Case Histories of Groundwater Contamination, Cleanup and Management Costs and Aquifer Restoration Alternatives, including Monitored Natural Attenuation, Bioremediation and Permeable Reactive Barriers . Monitoring and Remediation in Sedimentary Deposits and Fractured Hard Rock. Theory and Practice of Mathematical Modeling in Groundwater Pollution and Hydrology. Determine Aquifer Parameters from Pumping & Slug Test Methods. Fundamental Concepts and Theory of Water and Chemical Movement in the Unsaturated Zone; Field Collection Techniques.

#### **14M18CL281 Pollution Monitoring Lab**

##### **LIST OF EXPERIMENTS:**

**Experiment No.1:** Demonstration of air pollution monitoring instruments

**Experiment No.2:** Calibration of HVS by orifice method;

**Experiment No.3:** Determination of SPM; PM10

**Experiment No.4:** Determination of SO<sub>2</sub> in ambient air

**Experiment No.5:** Determination of NO<sub>x</sub> and CO in ambient air;

**Experiment No.6:** Respirable dust monitoring by GDS,

**Experiment No.7:** Demonstration of stack monitoring kits; Wind rose diagram.

**Experiment No.8:** Sampling and analysis of inorganic and organic particulates, SO<sub>x</sub>, NO<sub>x</sub>, NH<sub>3</sub> etc.

**Experiment No.9:** Demonstration of noise pollution monitoring equipment; namely modular precision sound level meter,

**Experiment No.10:** noise dose meter, human vibration monitoring instrument, audiometer, etc.

**Experiment No.11:** Noise survey in a multiple noise sources situation in order to develop noise contour diagram for the entire locality

**Experiment No.12:** Noise monitoring at residential localities. Frequency spectrum analysis of machine noise.

**Experiment No.13:** Audiometry survey in order to assess present status of hearing acuity of the subject

**Experiment No.14:** Traffic noise situation monitoring.

### **Year/Sem: IInd Year/IIIrd Sem**

#### **Departmental elective-III**

##### **14M1GCL341 Waste Recycling and Reuse**

Waste As A Resource: Resource Economics, Disposable Materials, Recycling, Collection, Processing, Governmental Role in Waste Management, Potential for Reuse. Waste Analysis: Sampling, Composition, Categorization, Determination of Waste Properties, Ash and Fines Analysis, Energy Content. System Design: Design of Recycling Systems, Collection System, Process Train Design and Complexity, Product Design of Recycling, Conveyance, Transport Safety, Efficiency of Operation Systems. Water Reuse: Direct and Indirect Reuse, Intentional Reuse, Groundwater Recharge, Case studies of Water Reuse, Close Cycle and Open Cycle Reuse, Recreational Reuse. Energy Recovery: Combustion, Energy Losses, Energy Recovery Analysis, Emission Control, Residue Control, In-plant Operations, Refuse Derived Fuel-cogeneration and tri generation concepts. Metals Recovery: Ferrous Metals, Properties, Principles of Magnetic Field-ferrous Material Interactions, Magnetic Separation Equipment, Non-ferrous Metal Separation, Eddy-Current Separation – Theory and Types, Extraction of Material from a Bed. Reuse Of Industrial Effluent: Urban Effluent Reuse for Agriculture in Arid and Semiarid Zones, Uses of in Pisciculture, Groundwater Recharge using treated Domestic wastewater. Health Aspects Of Water Reuse: Guidelines for Evaluating Recreational Water Reuse, Resource, Conservation and Recovery Act.

##### **14M1GCE341 Water Quality and Pollution in Natural Water System**

Dissolved Oxygen, Pollution, Beneficial Uses and Assimilative Capacity, Waste Loads—Flow-Concentration Correlations and Averaging,, Chemical, physical, and biological characteristics of aquatic system ,Various water quality constituents - point, non point, diffused, surface-subsurface interaction, Hydro-geometry, Nitrification in Rivers, Photosynthesis, Eutrophication, Steady, Uniform Flow Calculations with QUAL2E,Estuaries and Dispersion, Ecological principles impacting water quality ,Lake stratification and de-stratification: influences on water quality ,waste loadings, steady state and time variable solutions, mixed-flow, diffusion, dispersion, Rivers, lakes, estuaries, Streeter-Phelps, BOD, DO, Nitrogen, Algal growth, heat budgets, light effects, Characterization of water quality ,Spills of conservative pollutants ,Toxicity models Disinfection ,Sediment contamination of streams Surface water pollution, surface water pollutants

##### **14M1GCL342 Analytical Chemistry and Environmental Instrumentation**

Treatment of data in quantitative analysis: Accuracy, precision, standard deviation, and types of errors, minimization of error, significant figures, criteria for rejection of data. Principles of instrumentation; advantages, applications, and limitations of the following analytical techniques: Spectro-chemical methods: spectro-photometry, FTIR, NMR,

atomic absorption and emission spectro-photometry, flame photometry, fluorimetry, nephelometry, Inductively coupled plasma spectrometry and MS. Electrochemical methods: Polarography, pulse polarography, Ion selective electrodes oscilloscopic polarography, cyclic voltametry, anodic stripping voltametry. Chromatography: Classification, general ideas about adsorption, partition, and column Chromatography, paper and thin layer chromatography. Gas chromatography, High performance liquid chromatography (HPLC), Ion chromatography, Physical & biological methods of monitoring.

#### **Departmental elective-IV**

##### **14M1GCE342 Modeling Surface Water Quality**

Fundamentals of transport mechanisms. Hydrologic and hydraulic principles relating to water quality modeling River Transport—Control Volume Mass Balance, Averaging, Advection and Dispersion. Steady State Solution for Point Loads with First Order Decay, Steady State for Point Loads with Dispersion, Determination of Initial Condition and Dispersion Coefficient. Stream Ecology: BOD, DO Sag and Indicator Species. Oxygen Balance, Re-aeration Rate—Choice of  $K_a$  Formula and Temperature Corrections. Point Source BOD/DO Models, Distributed Source BOD/DO Models. Distributed Load Model for Estuaries, Nitrification Model—Hydrolysis and Oxidation Steps; Effect of pH, DO and temperature, QUAL2E BOD/DO Simulation, Equilibrium Temperature and Simplified Model, QUAL2E Temperature Simulation Water/Sediment Particle Balance and Partition Coefficients, Suspended Solids Transport Model, Toxics Transport Model. Application of fluid mechanics to problems of pollutant transport and mixing in the water environment. Mathematical and numerical models of advection, diffusion, and dispersion. Application of theory to problems of transport and mixing in rivers, estuaries, and lakes and reservoirs.

##### **14M1GCE343 Environmental Economics**

Economy and Environment -the historical development of environmental economics; the circular economy, the sustainable economy. Broad aspects of environmental economics; society and environment, sustainable development, Environmental legislation ; role of U.N. and its associate bodies, role of world bank, administering global environmental funds, environmental program and policies in developed and developing countries, environmental program and policies of the government of India. Economics of Pollution;-The optimal level of pollution, The market achievement of optimal pollution, Taxation and optimal pollution, Environmental standards, Taxes and subsidies, Marketable pollution permits, Measuring environmental damage -Total economic volume and valuation methodology, pollution control policy in mixed economics. Environmental Values Ethics; discounting the future, alternative to adjusting discounting rates. Economics of Natural Resources- Renewable resources, Extinction of species, optimal use of exhaustible resources measuring and mitigating natural resource scarcity. Development and Environment - Development, Preservation and conservation, Irreversibility and sustainability, Environment and the developing countries. Carrying capacity based development planning. Cost Benefit Analysis of Environmental Change; Appraisal of Sustainable development Projects; Principles of Cost Allocation, Preventive, Punitive and social costs. Socio-economic Planning: Importance of Socio-economic development planning. Social indicators and their importance; Social impacts of industrial and developmental activities. Quality of life concept- and its use in development planning. Social surveys and socio-economic data generation. Social cost of environmental pollution. Rehabilitation and resettlement of project affected people. Laws related to social development.

##### **14M1GCL343 Clean Technologies**

Tools for clean processes, reuse, recycle, recovery, source reduction, raw material substitution, toxic use reduction and process modifications. Unit operations in separation technology; Separation technologies as tools for waste minimization, Process optimization for cleaner industrial processes, Flow sheet analysis. Energy and resource (material and water) audits for efficient usage and conservation; Waste audits, emission inventories and waste management hierarchy for process industries; Thermodynamic constraints to waste minimization; Holistic and critical technology assessment; Environmental performance indicators; Concept of industrial ecology and symbiosis of eco-parks. Case studies on industrial applications of cleaner technologies in chemical, metallurgical, pulp and paper, textile, electroplating, leather, dairy, cement and other industries. Cleaner Production (Cp): Principles, Purpose And Potential, What Is Cp, Cp Techniques – Source, Reduction, Recycle, Product Modification, Impetus For Cp. Cleaner Production Indicators: Benchmarking Cp Indicators, Influence of Process Technology, Specific Consumption, Pollution Load, Process Efficiency. Cleaner Production Opportunities: How To Do A Cp Assessment

– A Six Step Methodology: Barriers To Cp : Attitudinal, Systemic, Organizational And Governmental Barriers – Methods To Overcome Them. Examples of Cleaner Production.

#### **14M19GE391 Project Seminar-I**

Student will be given projects in the area of subjects taught upto that semester. The student will do a project based on literature review, small experiments wherever possible and prepare a report. There will be one mid-term evaluation, a presentation at the end followed by a viva-voce examination.

#### **14M19GE392 Dissertation Part-I**

Students will complete project work in the area of environmental engineering under the supervision of guide. The students will do project based on literature review; experiments if possible and write a thesis report. Total credits assigned for project work are 26. Twelve credits will be evaluated in the third semester and will be carried over to fourth semester for final evaluation of project work.

### **Year/Sem: IInd Year/IVth Sem**

#### **Departmental elective-V**

##### **14M1GCE441 Remote Sensing Applications in Environmental Engineering**

Principles of remote sensing, physical basis of remote sensing. The nature and generation of Electromagnetic radiation (EMR), interaction of EMR with the atmosphere and earth's surface features. Spectral quantities Spectral signatures and characteristics spectral reflectance curves for rocks, soil, vegetation and water features within near and near Infrared. Digital Image Processing: Introduction to digital Image structure and data recording format. Sets, Image Restoration, Enhancement and Classifications. Geographic Information System: Introduction, Definition and Terminology, Map Projection and Co ordinate system. Integration of Remote sensing and GIS techniques and its applications in Environmental Impact Assessment and Management including some case studies.

##### **14M1GCE442 Solid Waste Management and Land Reclamation**

Municipal solid waste management: Engineering principles; Sources, nature and characteristics; quantitative and qualitative; Solid waste problems: Industrial, mining, Agricultural and domestic (urban) wastes. Hydrologic aspects of solid waste, regulatory aspects of solid waste management. Solid waste disposal: Sanitary landfill planning, site selection, design and operation, equipment, costs, Aerobic landfill stabilization. Biological oxidation. Composting, optimum conditions for composting. Land Reclamation: Reclamation planning -pre-project land use planning, post project land use monitoring; physical reclamation-re-grading and re-contouring, terracing, slope preparation, segregation and burial of toxic substances, reclamation alternatives, reclamation equipment, scheduling and costs. Factors affecting plant establishment. Soil characteristics: physical, chemical and biological; soil amendments; selection of species, ecological succession theory, top soil conservation, mine spoil evaluation, nitrogen fixation, mycorrhiza, financial aspects of reclamation. Current bioremediation practice and application; factors influencing bioremediation, bioremediation system and process, in situ bioremediation, remediation of contaminated sites.

##### **14M1GCL441 Transport of Pollutants**

Introduction, modeling of volatilization, sorption/desorption, chemical transformations, photochemical transformations, biological transformations, Concept of scale in natural system, brief review of mass, momentum and energy balance, advection, molecular diffusion, dispersion, finite difference and linear algebraic methods to solve the system equations, some special models, Transport of chemical constituents in surface and groundwater, including advection, dispersion, sorption, inter-phase mass transfer, and transformation; water quality requirements for various beneficial uses. Emphasis is on the behavior of hazardous waste contaminants.

#### **Departmental elective-VI**

##### **14M1GCE443 Introduction to Urban and Rural Environmental Engineering**

Urban Environmental Quality, land Use and Environmental Planning, indoor and ambient air pollution, urban planning, Environmental issues in transportation, Geographic Information Systems for urban planning,

Environmental Policy, Population size and rate of growth, Environmental Impact of Cities. Environmental Policy and Natural Hazards, urban Environmental Problems and Issues: water pollution and water sources, urban waste management, Globalization and urban environmental issues and challenges. Rural Environment, Sanitation and water resources, rural environmental problems and remedies.

#### **14M1GCL442 Energy Resources & Conservation**

Energy Crisis: Historical events, energy requirement of society in past and present situation, availability and need of conventional energy resources, major environmental problems related to the conventional energy resources, future possibilities of energy need and availability. Non-conventional energy sources: Hydel power plant, tidal energy, biomass energy, wind energy, Hydrogen as a source of energy, energy conversion technologies, their principles, equipment and suitability in context of India. Environmental impacts of these technologies. Solar Energy option: Sun as source of energy, direct methods of solar energy collection, process of photovoltaic energy conversion, solar energy conversion technologies and devices, their principles, working and application, environmental impacts of solar energy. Biomass option: Concept of biomass energy utilization, types of biomass energy, conversion processes, biogas production, biomass gasification process and technologies, environmental impacts of biomass energy. Energy Storage: Types of energy storage, devices for sensible and latent heat storage, energy storage in dry batteries, nickel-cadmium batteries, secondary heat storage, chemical storage, environmental consequences of energy storage systems. Heat Energy recovery systems: Approaches to waste Energy Utilization, Equipment, Utilization System, objective, principles of heat transfer, Gas to Gas heat transfer, Gas to Liquid heat transfer, Recovery of waste heat in coil coating, Non-conventional liquid fuels, Heat recovery by Cogeneration.

#### **14M1GCL443 Process Analysis**

Engineering calculations, process and process variables, steady state material balances in non-reacting and reacting systems, steady-state energy balances in non-reacting and reacting systems, transient systems, flow-sheet analysis and process simulation, safety and environmental aspects of material & balances applied to chemical processes.

#### **14M19GE491 Project Seminar-II**

Student will be given projects in the area of subjects taught upto that semester. The student will do a project based on literature review, small experiments wherever possible and prepare a report. There will be one mid-term evaluation, a presentation at the end followed by a viva-voce examination.

#### **14M19GE492 Dissertation Part-II**

Twelve credits will be evaluated in the third semester and will be carried over in this semester for final evaluation of project work.

