M.E. ENVIRONMENTAL ENGINEERING

OBJECTIVES

- To provide the engineering graduates with technical expertise in Environmental Engineering which will enable them to have a career and professional accomplishment in the public or private sector to:
  - Address the complexities of real life environmental engineering problems related to water supply, sewerage, sewage treatment, waste management, environmental impact assessment, industrial pollution prevention and control.
  - Identify, formulate, analyze, and develop processes and technologies to meet desired environmental protection needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.

OUTCOMES

- By the time of their graduation, the students are expected to be able to:
  - identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice
  - design systems, processes, and equipment for control and remediation of water, air, and soil quality environment within realistic constraints of economic affordability and social acceptability
  - assess the potential environmental impacts of development projects and design mitigation measures
  - have basic knowledge about environment protection and operation of pollution control devices
  - design and conduct experiments, as well as interpret data and communicate effectively
  - function in multi-disciplinary teams and understand the ethical and professional responsibility
  - find professional level employment as Environmental Engineers or pursue higher studies
  - have a knowledge of contemporary environmental issues and an ability to engage in life-long learning
# UNIVERSITY DEPARTMENTS
**ANNA UNIVERSITY :: CHENNAI 600 025**

**REGULATIONS - 2013**

**M.E. ENVIRONMENTAL ENGINEERING**

**CURRICULUM AND SYLLABUS I TO IV SEMESTERS (FULL TIME)**

## SEMESTER I

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**ELECTIVES FOR M.E. ENVIRONMENTAL ENGINEERING**

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OBJECTIVE:
- To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

UNIT I INTRODUCTION
Pollutants in water and wastewater – characteristics, Standards for performance - Significance of physico-chemical treatment – Selection criteria-types of reactor- reactor selection-batch-continuous type-kinetics

UNIT II TREATMENT PRINCIPLES

UNIT IV DESIGN OF MUNICIPAL WATER TREATMENT PLANTS

UNIT V DESIGN OF INDUSTRIAL WATER TREATMENT PLANTS

UNIT VI DESIGN OF WASTEWATER TREATMENT PLANTS

TOTAL: 45 PERIODS

OUTCOME:
- Developed conceptual schematics required for the treatment of water and wastewater and an ability to translate pertinent forcing criteria into physical and chemical treatment system.

REFERENCES:

EN8102 CHEMISTRY FOR ENVIRONMENTAL ENGINEERS

OBJECTIVES:
- To educate the students in the area of water, air and soil chemistry
- To impart knowledge on the transformation of chemicals in the environment

UNIT I INTRODUCTION
Stoichiometry and mass balance-Chemical equilibria, acid base, solubility product(Ksp) ,heavy metal precipitation, amphoteric hydroxides,CO₂ solubility in water and species distribution – Chemical kinetics , First order- 12 Principles of green chemistry

UNIT II AQUATIC CHEMISTRY
Water quality parameters- environmental significance and determination; Fate of chemicals in aquatic environment, volatilization, partitioning, hydrolysis, photochemical transformation– Degradation of synthetic chemicals-Metals, complex formation, oxidation and reduction , pE – pH diagrams, redox zones – sorption- Colloids, electrical properties, double layer theory, environmental significance of colloids, coagulation .

UNIT III ATMOSPHERIC CHEMISTRY
Atmospheric structure—chemical and photochemical reactions – photochemical smog. Ozone layer depletion – greenhouse gases and global warming, CO₂ capture and sequestration – Acid rain- origin and composition of particulates. Air quality parameters-effects and determination

UNIT IV SOIL CHEMISTRY
Nature and composition of soil-Clays- cation exchange capacity-acid base and ion-exchange reactions in soil – Agricultural chemicals in soil-Reclamation of contaminated land; salt by leaching-Heavy metals by electrokinetic remediation.

UNIT V ENVIRONMENTAL CHEMICALS
Heavy metals-Chemical speciation –Speciation of Hg &As- Organic chemicals- Pesticides, Dioxins,PCBs,PAHs and endocrine disruptors and their Toxicity- Nano materials, CNT, titania, composites, environmental applications.

TOTAL: 45 PERIODS

REFERENCES:

OUTCOMES:
- Students will gain competency in solving environmental issues of chemicals based Pollution
- Able to determine chemicals need calculations for treatment purpose Ability to identify contaminating chemicals
OBJECTIVES:
- The course provides a basic understanding on microbiology relevant to environmental engineering for candidates with little prior knowledge of the subject.
- The morphology, behavior and biochemistry of bacteria, fungi, protozoa, viruses, and algae are outlined.
- The microbiology of wastewater, sewage sludge and solid waste treatment processes is also provided. Aspects on nutrient removal and the transmission of disease causing organisms are also covered.
- An exposure to toxicology due to industrial products and byproducts are also covered.

UNIT I  CLASSIFICATION AND CHARACTERISTICS  5
Classification of microorganisms – prokaryotic, eukaryotic, cell structure, characteristics, Preservation of microorganisms, DNA, RNA, replication, Recombinant DNA technology.

UNIT II  MICROBES AND NUTRIENT CYCLES  10

UNIT III  METABOLISM OF MICROORGANISMS  10
Nutrition and metabolism in microorganisms, growth phases, carbohydrate, protein, lipid metabolism – respiration, aerobic and anaerobic-fermentation, glycolysis, Kreb’s cycle, hexose monophosphate pathway, electron transport system, oxidative phosphorylation, environmental factors, enzymes, Bioenergetics.

UNIT IV  PATHOGENS IN WASTEWATER  10

UNIT V  TOXICOLOGY  10

TOTAL: 45 PERIODS

REFERENCES:
1. S.C.Bhatia, "Hand Book of Environmental Microbiology", Part 1 and 2, Atlantic Publisher
2. Gabriel Bitton, Wastewater Microbiology, 2nd Edition ,
7. Frank C. Lu and Sam Kacew, LU's Basic Toxicology, Taylor & Francis, London (4th Ed), 2002
OUTCOMES:
- The candidate at the end of the course will have a basic understanding on the basics of microbiology and their diversity and on the genetic material in the living cell.
- The candidate would be able to understand and describe the type of microorganisms in the environment and the role of microorganisms in the cycling of nutrients in an ecosystem.
- The candidate would have understood the role microbial metabolism in a wastewater treatment plant.
- The candidate would know the role of microorganisms in a contaminated water and the diseases caused.
- The candidate has the ability to conduct and test the toxicity due to various natural and synthetic products in the environment.

EN8104 TRANSPORT OF WATER AND WASTEWATER

OBJECTIVE:
- To educate the students in detailed design concepts related to water transmission mains, water distribution system, sewer networks and storm water drain and computer application on design.

UNIT I GENERAL HYDRAULICS AND FLOW MEASUREMENT 8
Fluid properties; fluid flow – continuity principle, energy principle and momentum principle; frictional head loss in free and pressure flow, minor heads losses, Carrying Capacity–Flow measurement.

UNIT II WATER TRANSMISSION AND DISTRIBUTION 10

UNIT III WASTEWATER COLLECTION AND CONVEYANCE 10
Planning factors – Design of sanitary sewer; partial flow in sewers, economics of sewer design; Wastewater pumps and pumping stations- sewer appurtenances; material, construction, inspection and maintenance of sewers; Design of sewer outfalls-mixing conditions; conveyance of corrosive wastewaters.

UNIT IV STORM WATER DRAINAGE 7
Necessity- combined and separate system; Estimation of storm water run-off Formulation of rainfall intensity duration and frequency relationships- Rational methods

UNIT V CASE STUDIES AND SOFTWARE APPLICATIONS 10
Use of computer software in water transmission, water distribution and sewer design – EPANET 2.0, LOOP version 4.0, SEWER, BRANCH, Canal ++ and GIS based softwares.

TOTAL: 45 PERIODS

REFERENCES:
OUTCOMES:
On Completion of the Course the student will
- be able to select various pipe materials for water supply main, distribution network and sewer
- be able to design water supply main, distribution network and sewer for various field conditions
- Troubleshooting in water and sewage transmission be able to use various computer software for
the design of water and sewage network

MA8161 STATISTICAL METHODS FOR ENGINEERS

OBJECTIVE:
- To study and understand the concepts of Statistical methods and its applications in Engineering.
  To study the effect of estimation theory, testing of hypothesis, correlation and regression,
  randomized design, and multivariate analysis.

UNIT I ESTIMATION THEORY  9+3
Estimators: Unbiasedness, Consistency, Efficiency and Sufficiency – Maximum Likelihood Estimation
– Method of moments.

UNIT II TESTING OF HYPOTHESIS  9+3
Tests based on Normal, t, $X^2$ and F distributions for testing of means, variance and proportions –
Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION  9+3
Multiple and Partial Correlation – Method of Least Squares – Plane of Regression – Properties
of Residuals – Coefficient of multiple correlation – Coefficient of partial correlation – Multiple correlation
with total and partial correlations – Regression and Partial correlations in terms of lower order co-
efficient.

UNIT IV DESIGN OF EXPERIMENTS  9+3
Analysis of variance – One-way and two-way classifications – Completely randomized design –
Randomized block design – Latin square design.

UNIT V MULTIVARIATE ANALYSIS  9+3
Random vectors and Matrices – Mean vectors and Covariance matrices – Multivariate Normal density
and its properties – Principal components: Population principal components – Principal components
from standardized variables.

L: 45 + T : 15 TOTAL : 60 PERIODS

OUTCOME:
- On completion of this course the students will be able to solve various problems in the field of
engineering employing probability and statistical methods.

REFERENCES:
   and Duxbury, Singapore, 2002
   McGraw-Hill, 2000
EN8151  SOLID AND HAZARDOUS WASTE MANAGEMENT  L T P C  3 0 0 3

OBJECTIVE:
- To impart knowledge and skills in the collection, storage, transport, treatment, disposal and recycling options for solid wastes including the related engineering principles, design criteria, methods and equipments.

UNIT I  SOURCES, CLASSIFICATION AND REGULATORY FRAMEWORK  9
Types and Sources of solid and hazardous wastes - Need for solid and hazardous waste management — Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, nuclear wastes - lead acid batteries, electronic wastes , plastics and fly ash – Elements of integrated waste management and roles of stakeholders - Financing and Public Private Participation for waste management.

UNIT II  WASTE CHARACTERIZATION AND SOURCE REDUCTION  8
Waste generation rates and variation - Composition, physical, chemical and biological properties of solid wastes – Hazardous Characteristics – TCLP tests – waste sampling and characterization plan - Source reduction of wastes –Waste exchange - Extended producer responsibility - Recycling and reuse

UNIT III  STORAGE, COLLECTION AND TRANSPORT OF WASTES  9
Handling and segregation of wastes at source – storage and collection of municipal solid wastes – Analysis of Collection systems - Need for transfer and transport – Transfer stations Optimizing waste allocation– compatibility, storage, labeling and handling of hazardous wastes – hazardous waste manifests and transport

UNIT IV  WASTE PROCESSING TECHNOLOGIES  10
Objectives of waste processing – material separation and processing technologies – biological and chemical conversion technologies – methods and controls of Composting - thermal conversion technologies and energy recovery – incineration – solidification and stabilization of hazardous wastes - treatment of biomedical wastes - Health considerations in the context of operation of facilities, handling of materials and impact of outputs on the environment-

UNIT V  WASTE DISPOSAL  9

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the student is expected to be able to
- Understand the characteristics of different types of solid and hazardous wastes and the factors affecting variation
Define and explain important concepts in the field of solid waste management and suggest suitable technical solutions for treatment of municipal and industrial waste.
Understand the role legislation and policy drivers play in stakeholders’ response to the waste and apply the basic scientific principles for solving practical waste management challenges.

REFERENCES:

EN8111  ENVIRONMENTAL CHEMISTRY LABORATORY

OBJECTIVES:
- To train in the analysis of physico-chemical parameters with hands on experience
  1. Good Laboratory Practices, Quality control, calibration of Glassware
  2. Sampling and Analysis of water (pH, alkalinity, hardness chloride, Sulphate, turbidity EC, TDS, nitrate, fluoride)
  3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).
  4. Sampling and analysis of air pollutants Ambient & Stack (RSPM, SO₂ and NOx)
  5. Sampling and characterization of soil (CEC & SAR, pH and K).

OUTCOME:
- Able to assess quality of environment

REFERENCES:

EN8112  ENVIRONMENTAL MICROBIOLOGY LABORATORY

OBJECTIVE:
- To train the students in the analysis of various biological and microbiological techniques, enzymes assay, pollutant removal and bioreactors.
EXPERIMENTS:
1. Preparation of culture media,
2. Isolation, culturing and Identification of Microorganisms
3. Microorganisms from polluted habitats (soil, water and air)
4. Measurement of growth of microorganisms,
5. Assay of enzymes involved in biotransformation.
6. Biodegradation of organic matter in waste water Analysis of air borne microorganisms,
7. Staining of bacteria.
8. Effect of pH, temperature on microbial growth
10. Effect of pesticides on soil microorganisms.
11. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
12. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques, Effect of Heavy metals on microbial growth.
13. Detection of Anaerobic bacteria (Clostridium sp.)
14. Bioreactors

TOTAL: 45 PERIODS

OUTCOMES:
• The candidate at the end of the experimental exercise would be able to perform field oriented testing of water, wastewater and solid waste for microbial contamination.
• The candidate would be knowledgeable to perform toxicity test.
• The candidate would be able to observe and identify the microbes in the contaminated environment.

REFERENCES:

EN8201 DESIGN OF BIOLOGICAL TREATMENT SYSTEMS

OBJECTIVE:
• To educate the students on the principles and process designs of various treatment systems for water and wastewater and students should gain competency in the process employed in design of treatment systems and the components comprising such systems, leading to the selection of specific process.

UNIT I INTRODUCTION

UNIT II AEROBIC TREATMENT OF WASTEWATER
UNIT III ANAEROBIC TREATMENT OF WASTEWATER

UNIT IV SLUDGE TREATMENT AND DISPOSAL
Design of sludge management facilities, sludge thickening, sludge digestion, biogas generation, sludge dewatering (mechanical and gravity) Layout, PID, hydraulics profile – upgrading existing plants – ultimate residue disposal – recent advances.

UNIT V CONSTRUCTION OPERATIONS AND MAINTENANCE ASPECTS

TOTAL: 45 PERIODS

OUTCOME:
• Developed conceptual schematics required for biological treatment of wastewater and an ability to translate pertinent criteria into system requirements.

REFERENCES:

EN8251 AIR POLLUTION CONTROL ENGINEERING

OBJECTIVE:
• To impart knowledge on the principles and design of control of indoor/particulate/gaseous air pollutant and its emerging trends

UNIT I INTRODUCTION

UNIT II AIR POLLUTION MODELLING
Effects of meteorology on Air Pollution - Fundamentals, Atmospheric stability, Inversion, Wind profiles and stack plume patterns- Transport & Dispersion of Air Pollutants – Modeling Techniques – Air Pollution Climatology.
UNIT III  CONTROL OF PARTICULATE CONTAMINANTS  11

UNIT IV  CONTROL OF GASEOUS CONTAMINANTS  11

UNIT V  INDOOR AIR QUALITY MANAGEMENT  11

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the student is expected to be able to:

- Apply sampling techniques
- Apply modeling techniques
- Suggest suitable air pollution prevention equipments and techniques for various gaseous and particulate pollutants to Industries. Discuss the emission standards

REFERENCES:

EN8252 INDUSTRIAL WASTEWATER POLLUTION - PREVENTION AND CONTROL  L T P C  3 0 0 3

OBJECTIVES:
- To impart knowledge on the concept and application of Industrial pollution prevention, cleaner technologies, industrial wastewater treatment and residue management.
- Understand principles of various processes applicable to industrial wastewater treatment
- Identify the best applicable technologies for wastewater treatment from the perspective of yield production.

UNIT I  INTRODUCTION  8
UNIT II  INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION  8
Prevention vis a vis Control of Industrial Pollution – Benefits and Barriers – Waste management
Hierarchy - Source reduction techniques – Periodic Waste Minimisation Assessments – Evaluation of
Pollution Prevention Options – Cost benefit analysis – Pay-back period – Implementing & Promoting
Pollution Prevention Programs in Industries.

UNIT III  INDUSTRIAL WASTEWATER TREATMENT  10
Removal of Inorganic Constituents – Precipitation, Heavy metal removal, Nitrogen & Phosphorous
removal, Ion exchange, Adsorption, Membrane Filtration, Eletrodialysis & Evaporation – Removal of
Organic Constituents – Biological treatment Processes, Chemical Oxidation Processes, Advanced
Oxidation processes – Treatability Studies.

UNIT IV  WASTEWATER REUSE AND RESIDUAL MANAGEMENT  9
Individual and Common Effluent Treatment Plants – Joint treatment of industrial and domestic
wastewater - Zero effluent discharge systems - Quality requirements for Wastewater reuse –
Industrial reuse , Present status and issues - Disposal on water and land – Residuals of industrial
wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion,
conditioning, dewatering and disposal of sludge – Management of RO rejects.

UNIT V  CASE STUDIES  10
Industrial manufacturing process description, wastewater characteristics, source reduction options
and waste treatment flow sheet for Textiles – Tanneries – Pulp and paper – metal finishing – Oil
Refining – Pharmaceuticals – Sugar and Distilleries

TOTAL: 45 PERIODS

OUTCOMES:
After completion of this course, the students is expected to be able to,
• Define the Principles of pollution prevention and mechanism of oxidation processes.
• Suggest the suitable technologies for the treatment of wastewater.
• Discuss about the wastewater characteristics
• Design the treatment systems

REFERENCES:
1. "Industrial wastewater management, treatment & disposal, Water Environment” Federation
2. Lawrance K.Wang, Yung . Tse Hung, Howard H.Lo and Constantine Yapijakis, “ handlook of
3. Metcalf & Eddy/ AECOM, "water reuse Issues, Technologies and Applications", The Mc Graw-
Hill companies, 2007.

EN8211  UNIT OPERATIONS AND PROCESSES LABORATORY  L T P C
0 0 6 3

OBJECTIVE:
• To develop the skill for conducting Treatability studies of water and wastewater treatment by
various Unit Operations and Processes using laboratory scale models.

LIST OF EXPERIMENTS
1. Coagulation and Flocculation  7
2. Batch studies on settling  10
3. Studies on Filtration- Characteristics of Filter media 7
4. Water softening 7
5. Adsorption studies/Kinetics 7
6. Reverse Osmosis- Silt Density Index 7
7. Kinetics of suspended growth process (activated sludge process)-
   Sludge volume Index 14
8. Anaerobic Reactor systems / kinetics (Demonstration) 10
9. Advanced Oxidation Processes – (Ozonation, Photocatalysis) 14
10. Disinfection for Drinking water 7

TOTAL: 90 PERIODS

REFERENCES:
1. Metcalf and Eddy. Inc. ‘Wastewater Engineering, Treatment, Disposal and Reuse, Third
3. Casey T.J., "Unit Treatment Processes in Water and Wastewater Engineering", John Wileys

EM8351 ENVIRONMENTAL IMPACT AND RISK ASSESSMENT  L T P C
3 0 0 3

OBJECTIVES:
- To expose the students to the need, methodology, documentation and usefulness of
  environmental impact assessment and to develop the skill to prepare environmental management
  plan.
- To provide knowledge related to the broad field of environmental risk assessment, important
  processes that control contaminant transport and tools that can be used in predicting and
  managing human health risks.

UNIT I INTRODUCTION
Historical development of Environmental Impact Assessment (EIA). EIA in Project Cycle. Legal and
Regulatory aspects in India. – Types and limitations of EIA –.EIA process- screening – scoping -
setting – analysis – mitigation. Cross sectoral issues and terms of reference in EIA – Public
Participation in EIA

UNIT II IMPACT IDENTIFICATION AND PREDICTION
Matrices – Networks – Checklists –Cost benefit analysis – Analysis of alternatives – Software
packages for EIA – Expert systems in EIA. Prediction tools for EIA – Mathematical modeling for
impact prediction – Assessment of impacts – air – water – soil – noise – biological — Cumulative
Impact Assessment –

UNIT III SOCIAL IMPACT ASSESSMENT AND EIA DOCUMENTATION
Social impact assessment - Relationship between social impacts and change in community and
institutional arrangements. Individual and family level impacts. Communities in transition
Documentation of EIA findings – planning – organization of information and visual display materials –
Report preparation.

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN
Environmental Management Plan - preparation, implementation and review – Mitigation and
Rehabilitation Plans – Policy and guidelines for planning and monitoring programmes – Post project
audit – Ethical and Quality aspects of Environmental Impact Assessment- Case Studies
UNIT V ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT


OUTCOMES:
- After the completion of course, the student will be able to understand the necessity to study the impacts and risks that will be caused by projects or industries and the methods to overcome these impacts.
- The student will also know about the legal requirements of Environmental and Risk Assessment for projects.

REFERENCES:
3. World Bank –Source book on EIA

EN8001 ADVANCED OXIDATION PROCESS

OBJECTIVES:
- Identify the most critical issues and challenges that limit the use of conventional treatment processes in planning, design and operation of modern water and wastewater treatment facilities.
- Thorough understanding of the fundamentals of Advanced Oxidation Processes (AOPs) and also Photochemistry and ozone chemistry, its application to AOPs for the removal of contaminants or the detoxification of contaminated waters.
- Develop in-depth knowledge that can be used to devise and design effective AOP treatment systems to meet not only current but also anticipated regulatory requirements, and enhance the independent learning and critical thinking skills.

UNIT I Introduction to AOPs

UNIT II Heterogeneous Process
UNIT III Homogenous AOPs
Ozone, electro-chemical oxidation, ultrasonication, UV – Photolysis, Hydrogen Peroxide and Ultraviolet Radiation (H2O2/UV), Fenton and Photo Fenton’s Oxidation, chemical and non-chemical AOPs, advantages and disadvantages of homogeneous processes.

UNIT IV Enhancement Of Quantum Yield

UNIT V Industrial Applications and Economic assessment of AOTs
Application of AOPs for industries like textile, petroleum pharmaceutical and petrochemical industry.

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, graduates are expected to attain the following outcomes:
• Apply AOPs to solve pollution problems
• Comprehend the basic principles of advanced water treatment processes, capabilities/constraints of their application in water treatment and have knowledge on the design and operation of these processes.
• Select an appropriate treatment process for a specific application, and identify appropriate pre-treatment and post treatment schemes, and cleaning protocols for these processes.

REFERENCES:

EN8002 COMPUTING TECHNIQUES IN ENVIRONMENTAL ENGINEERING

OBJECTIVES:
▪ To educate the students to know about computing techniques
▪ Develop the different numerical technique and logic like ANN, Fuzzy
▪ To educate the students on aspects data management
▪ Develop the model Applications for monitoring and management of environment

UNIT I COMPUTING PRINCIPLES
UNIT II    ARTIFICIAL INTELLIGENCE  

UNIT III    FUZZY LOGIC
Fuzzy sets, fuzzy numbers, fuzzy relations, fuzzy measures, fuzzy logic and the theory of uncertainty and information; applications of the theory to inference and control, clustering, and image processing - Network analysis models - WATER CAD, SEWER CAD - EPANET

UNIT IV    DATA MANAGEMENT
Data base structure - Data acquisition - Data warehouse - Data retrieval-Data format Attribute - RDBMS - Data analysis - Network data sharing - Statistical Analysis (SYSTAT) - Regression - factor analysis - histogram - scatter diagram - Goodness of fit

UNIT V    SIMULATION SOFTWARE IN ENVIRONMENTAL STUDIES
Surface water quality models -HSPF, QUAL2K, Ground Water Flow models - Visual MODFLOW- FEFLOW - Atmospheric Dispersion Models - ARMOD, CALPUFF

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to understand the computing techniques.
- Ability to apply the principle of soft computing for solving Environmental problems
- Ability to assess the Environmental Impacts using ANN and Fuzzy logic.
- Ability to employ modern advanced computing tools in environmental studies

REFERENCE:

EN8003    DESIGN OF ENVIRONMENTAL ENGINEERING STRUCTURES

OBJECTIVES:
- To educate the structural design principles
- To educate the students on aspects of water retaining structures design
- Educating the design of masonry and steel structures used in environmental engineering

UNIT I    INTRODUCTION AND DESIGN OF PIPES
Environmental Engineering structures - Introduction -Concept of elastic method, ultimate load method and limit state method – Advantages of Limit State method over other methods – Limit State philosophy as detailed in current IS Code. Structural design of - Concrete, Prestressed Concrete, Steel and Cast-iron piping mains, - anchorage for pipes - massive outfalls, Advances in the manufacture of pipes
UNIT II  DESIGN OF WATER RETAINING STRUCTURES  9
IS Codes for the design of water retaining structures - Design of concrete roofing systems – Cylindrical, Spherical and Conical shapes using membrane theory - Design of circular, rectangular, spherical and Intze type of tanks - Design of prestressed concrete cylindrical tank, Settling tanks, Clariflocculators, Filters

UNIT III  DESIGN OF WASTEWATER RETAINING STRUCTURES  9
Structural design of wastewater treatment units - Grit chamber, Parshall flume, Aeration tank, Anaerobic baffle reactor, Sludge digester, UASBR, Sludge thickener, Sludge drying beds.

UNIT IV  STEEL STRUCTURES  9

UNIT V  SPECIAL STRUCTURES  9
Design of masonry walls, pillars and footings as per NBC and IS Codes - Structural design of underground reservoirs and swimming pools, Intake towers - effect of earth pressure and uplift considerations – design of - Cyclone separator – Scrubber

TOTAL : 45 PERIODS

OUTCOMES:
- Ability to apply the principle of limit state design.
- Ability to do structural design of concrete and steel pipes
- Ability to do the structural design of a complete water and wastewater treatment plant.
- Ability to do air pollution control devices design
- Ability to design underground water storage structures

REFERENCES:

EN8004  ENVIRONMENTAL REACTION ENGINEERING  L  T  P  C
3  0  0  3

OBJECTIVES:
- An ability to identify and address current and future societal problems related to environment within a broader framework of sustainable development.
- An ability to apply a multi-disciplinary approach to conceive, plan, design, and implement solutions to problems in the field of environmental reaction engineering.
- Understanding the impact of solutions to environmental engineering problems in a global, scientific, and societal systems context.
UNIT I  INTRODUCTION

UNIT II  POLLUTANTS AND REACTIONS IN ENVIRONMENT

UNIT III  REACTORS MODELLING AND DESIGN
Ideal systems modeling and design, reactor concepts, ideal reactors, reaction rate measurements, hybrid system modeling and design, sequencing batch reactor, reactors in series and reactors in recycle. Non-ideal system modeling and design, non-ideal reactor behavior, RTD analysis, PFDR model

UNIT IV  MASS TRANSFER AND ITS APPLICATIONS IN ENVIRONMENTAL ENGINEERING
Principles of diffusion and mass transfer between phases, Gas absorption, humidification operations, leaching and extraction, drying of solids, fixed-bed separation, membrane separation process, fluid solid surface reactions, Gas-liquid bulk phase reaction, adsorption.

UNIT V  BIOLOGICAL REACTION ENGINEERING

TOTAL: 45 PERIODS

OUTCOMES:
Upon completion of the course, graduates are expected to attain the following outcomes:
• Successfully apply advanced concepts of fundamental sciences and engineering to identify, formulate, and solve complex environmental engineering problems, also to design, analyze, and develop technologies to meet desired needs of society, both, professionally and ethically.
• Be knowledgeable of contemporary issues and research challenges/opportunities related to chemical and environmental engineering, and engage in life-long learning to keep abreast of such issues.
• Use advanced techniques, skills, and modern scientific and engineering tools for problems related to professional practice in the field of environmental reaction engineering.

REFERENCES
OBJECTIVES:
- To introduce about ecological modeling, single and multi species modeling on a brief.
- To educate about the modeling of CSTR and the kinetics of reaction taking place in it.
- Introduce the concepts of river and stream water modeling, water quality parameters modeling.
- To educate about the microbial energetic in various reactors systems.
- To elaborate the computational techniques for modeling

UNIT I  ECOLOGICAL SYSTEM

UNIT II  CONTINUOUS-FLOW REACTOR MODELING

UNIT III  WATER QUALITY MODELING

UNIT IV  MICROBIAL DYNAMICS AND ENERGETICS

UNIT V  COMPUTER BASED SOLUTIONS

TOTAL: 45 PERIODS

OUTCOME:
- Developed conceptual schematics required for system analysis and an ability to translate pertinent criteria into system requirements

REFERENCES

OBJECTIVE:
- To understand the principles and design of recovering materials and energy from wastes through mechanical, biological and thermal methods and manage the undesirable by-products.
UNIT I  MECHANICAL PROCESSING FOR MATERIAL RECYCLING  

UNIT II  BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY  

UNIT III  BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY  

UNIT IV  THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY  

UNIT V  CASE STUDIES ON WASTE RECYCLING  

TOTAL: 45 PERIODS

OUTCOMES:
On completion of the course, the candidate should:
• Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of materials and energy from waste;
• Appreciate the increasing importance of waste and resource management in achieving environmental sustainability.
Be able to analyse and describe the potential of solid waste as a secondary raw material, and the associated problems and possibilities in a sustainable society.

REFERENCES:
3 Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies JG Press October 2005
OBJECTIVE:
- To introduce the emerging concepts of climate modeling and projecting future climate change, understand data analysis and application.

UNIT I Climate Change and Climate Variability

UNIT II IPCC SRES Scenarios
Intergovernmental Panel on Climate Change (IPCC) - An Overview - Key Assumptions - Scenario Family - Storyline (A1, B1, A2, B2).

UNIT III Global Climate Model (GCM) and Regional Climate Model (RCM)
Some typical GCMs (HadCM3Q-UK Met Office) - Issues with GCMs - Introduction to RCMs and LAMs - some typical RCMs like PRECIS, SimCLIM, MAGICC/SCENGNE - Advantages and Disadvantages of GCMs and RCMs.

UNIT IV Downscaling Global Climate Model - An Overview
Need for downscaling - Selection of GCMs for regional climate change studies - Ensemble theory – Selection of - Ensembles, Model Domain (Spatial domain and temporal domain), Resolution and climate variables - Lateral boundary conditions - Methods of downscaling (Statistical and Dynamical) - examples from each and their limitations.

UNIT V Analysis /Post processing
a. Model validation - post processing – Introduction to Analysis tools - Ferret, R, Grads, IDL, SPSS, ArcGIS
b. Climate change Impact - Vulnerability assessment – adaptation strategies.

TOTAL: 45 PERIODS

REFERENCES:

OBJECTIVES:
- To educate the Coastal and Marine environment.
- To educate the ocean dynamics
- To sources of marine pollution and methods for monitoring, modeling and control.

UNIT I MARINE ENVIRONMENT
Seas and oceans, Continental area, Coastal zone, Properties of sea water, Principles of Marine Geology, coastal features – Beaches, Estuaries, Lagoons–The oceans and climate
UNIT II OCEAN HYDRODYNAMICS 10
Wave Theory, Waves in shallow waters – Refraction, Diffraction and Shoaling, Approximations for deep and shallow water conditions – Tidal Classification - General circulation of ocean waters - Ocean currents - Coastal sediment transport - Onshore offshore sediment transport - Beach formation and coastal processes - Tsunamis, storm surge, El Niño effect.

UNIT III MARINE POLLUTION SOURCES AND EFFECTS 8
Sources of Marine Pollution – Point and non-point sources, Pollution caused by Oil Exploration, Dredging, Offshore Structures, Agriculture Impacts of pollution on water quality and coastal ecosystems – Marine discharges and effluent standards

UNIT IV MONITORING OF MARINE POLLUTION 10
Basic measurements - Sounding boat, lead lines, echo sounders – current meters - tide gauge - use of GPS – Measurement of coastal water characteristics – sea bed sampling – Modeling of Pollutant transport and dispersion - Oil Spill Models - Ocean Monitoring satellites – Applications of Remote Sensing and GIS in monitoring marine pollution

UNIT V MARINE POLLUTION CONTROL AND ICZM 10
Design of out falls-Pollution Control strategies – Selection of optimal Outfall locations - National and International Treaties, Coastal Zone Regulation – Total Maximum Daily Load applications – Protocols in Marine Pollution – ICZM and Sustainable Development

TOTAL: 45 PERIODS

OUTCOMES:
• Ability to know about marine environment. And learnt the physical concepts lying behind the oceanic currents and natural processes of various activities happening over the marine environment.
• Acquired knowledge on the marine pollution and the effect of the same on the ecology.
• Should have gained knowledge on remote sensing and various other techniques for measuring and monitoring oceanic environment parameters.
• Should have acquired knowledge on control of marine pollution and sustainable development.

REFERENCES:
3. "Problems of Marine Pollution": India and Canada, Raghavan, Sudha , Eastern Book Corporation, Delhi, India,

EM8073 REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT  L T  P  C
3  0  0  3

OBJECTIVES:
▪ To educate the students on aspects of Remote Sensing
▪ Develop the different remote sensing technique
▪ To educate the students on aspects of GIS and data management.
▪ Develop the GIS Applications for monitoring and management of environment

UNIT I REMOTE SENSING ELEMENTS 8
UNIT II REMOTE SENSING TECHNOLOGY 9
Classification of Remote Sensing Systems, Aerial photographs, Photographic systems – Across track and along track scanning, Multispectral remote sensing, Thermal remote sensing, Microwave remote sensing – Active and passive sensors, RADAR, LIDAR

UNIT III SATELLITE REMOTE SENSING 10
Satellites and their sensors, satellite orbits, Indian space programme - Research and development - ISRO satellites, LANDSAT, ERS, SPOT, TERRA and NOOA satellite series, Characteristics of Remote Sensing data, Satellite data Products

UNIT IV IMAGE PROCESSING AND GEOGRAPHICAL INFORMATION SYSTEM 10
Photogrammetry – Visual image interpretation, Digital image processing – Image rectification, enhancement, transformation, Classification, Data merging, GIS Concepts – Spatial and non spatial data, Vector and raster data structures, Data analysis, Database management – RS – GIS Integration, Image processing software, GIS software

UNIT V CASE STUDIES 9
Monitoring and management of environment, Conservation of resources, Sustainable land use, Coastal zone management – Limitations – Case studies

TOTAL: 45 PERIODS

OUTCOMES:
- Ability to identify the environmental problems using Remote sensing
- Ability to apply the principle of RS and GIS for solving Environmental problems
- Ability to assess the Environmental Impacts using RS and GIS
- Ability to employ modern engineering tools in environmental studies
- Ability to function on a multi-disciplinary team

REFERENCES:

EN8071 AIR QUALITY MODELING AND MAPPING L T P C 3 0 0 3

OBJECTIVES:
- To introduce the fundamentals of air pollution with a background on historical perspective on air pollution.
- To introduce the theory of dispersion of air pollution in the atmosphere. To discuss the major approaches for air pollution modeling
- To demonstrate the features and the use of most widely used commercial and freely available air quality models

UNIT MODELING CONCEPT 8
Overview of different types of models-deterministic and stochastic approach- Steps in model development- numerical and simulations models- calibration and validation of models- Limitations-Transport phenomena- Mass balance analysis-Model development and decision making.
UNIT II AIR POLLUTION MODELING
Chemistry of air Pollutants - Atmospheric reactions, sinks for air pollution – Transport of air Pollutants - Meteorological settling for dispersal of air pollutants – Vertical structure of temperature and stability, atmospheric motions, Wind and shear, self cleaning of atmosphere; transport and diffusion of stack emissions – atmospheric characteristics significant to transport and diffusion of stack emission – stack plume characteristics.

UNIT III AIR QUALITY MODELS
Types modeling technique, modeling for nonreactive pollutants, single source, short term impact, multiple sources and area sources, Fixed box models- diffusion models – Gaussian plume derivation-modifications of Gaussian plume equation- long term average-multiple cell model- receptor oriented and source oriented air pollution models- model performance, accuracy and utilization-air Quality Index - air quality mapping

UNIT IV INDOOR AIR QUALITY MODELS

UNIT V SOFTWARE PACKAGE APPLICATIONS
Commercial air quality models - ADMS, Airviro and USEPA models

TOTAL: 45 PERIODS

OUTCOME:
- Developed conceptual schematics required for air quality modeling and an ability to translate pertinent criteria into air pollution control.

REFERENCES:

EN8072 LANDFILL ENGINEERING AND REMEDIATION TECHNOLOGY

OBJECTIVE:
- To understand the important characteristics and design principles of the waste containment and remediation industry as well as know the relevant regulations and engineering design requirements of landfills and contaminated site remediation

UNIT I LANDFILL BASICS
Waste management Hierarchy- Need for landfills – Environmental Protection by Landfills- Landfill Classification – Sanitary and Secure Landfills - Components and Configuaration - Legal framework for landfilling – Landfill Site investigation- Regional Landfills- Environmental control using site design – Landfill Design Tasks
UNIT II  LANDFILL LINERS AND COVER SYSTEMS  10

UNIT III  LEACHATE AND LANDFILL GAS MANAGEMENT  9

UNIT IV  LANDFILL OPERATION AND CLOSURE  8

UNIT V  CONTAMINATED SITE REMEDIATION  10

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the Course, the Candidate should:
- Have an overview of the Indian and international landfill regulations and guidelines for the design, construction, operation and management of landfills
- understand the design and construction of landfills, processes in landfills, methods for management and treatment of landfill gas and leachate
- have an in-depth understanding of the key pollutants in leachate and gas, their potential environmental impacts and the engineering design and performance of control systems used to manage and treat pollutant and waste emissions from sites.
- Be able to apply a risk based assessment of contaminated sites and implement site remediation technologies

REFERENCES:

EN8073 MEMBRANE SEPARATION FOR WATER AND WASTEWATER TREATMENT 3 0 0 3

OBJECTIVE:
• To introduce the concept and principles of membrane separation and its applications in water and wastewater treatment.

UNIT I MEMBRANE FILTRATION PROCESSES 10
Solid Liquid separation systems - Theory of Membrane separation – mass Transport Characteristics - Cross Flow filtration - Membrane Filtration- Flux and Pressure drop - Types and choice of membranes, porous, non porous, symmetric and assymmetric – Plate and Frame, spiral wound and hollow fibre membranes – Liquid Membranes

UNIT II MEMBRANE SYSTEMS 10

UNIT III MEMBRANE BIOREACTORS 9
Introduction and Historical Perspective of MBRs, Biotreatment Fundamentals, Biomass Separation MBR Principles, Fouling and Fouling Control, MBR Design Principles, Design Assignment, Alternative MBR Configurations, Commercial Technologies, Case Studies

UNIT IV PRETREATMENT SYSTEMS 8
Membrane Fouling – Control of Fouling and Concentration Polarisation-Pretreatment methods and strategies – monitoring of Pretreatment – Langlier Index, Silt Density Index, Chemical cleaning , Biofoulant control

UNIT V CASE STUDIES 8
Case studies on the design of membrane based water and wastewater treatment systems – zero Liquid effluent discharge Plants – Desalination of brackish water.

TOTAL: 45 PERIODS

OUTCOMES:
On Completion of the Course the student will
- be familiar with main membrane processes, principles, separation mechanisms, and applications
- understand the selection criteria for different membrane processes
- know the principle of the most common membrane applications and
- carry out design of project for a particular membrane technology application.
REFERENCES:

REFERENCES:

EN8074  RURAL WATER SUPPLY AND ON SITE SANITATION  L T P C

OBJECTIVE:
• To educate the students on the principles of rural water supply and sanitation and to develop understanding of factors governing the aspects in rural water supply and sanitation.

UNIT I DEVELOPMENT OF WATER SOURCES  9
Sources of water – Surface and ground water sources – Development of deep bore wells; Estimation of yield – Alternate sources of water supply – Rain water harvesting - pumps – Types and selection of pumps for deep bore wells – Construction, operation and maintenance.

UNIT II WATER TREATMENT  9

UNIT III SANITATION  9
Basic requirement of sanitation; Decentralized / onsite wastewater management; small bore / settled effluent sewer system – Design and operation.

UNIT IV SEWAGE TREATMENT  9

UNIT V SEWAGE DISPOSAL AND REUSE  9
Methods of disposal, Land disposal, sewage farms – Artificial recharge of ground water; Recycle and Reuse of sewage – Grey water Harvesting – Salt water intrusion and remediation – Ground water pollution and remediation.

TOTAL: 45 PERIODS
OUTCOME:
- Ability to identify problems in rural water supply and sanitation and to develop conceptual schemes required for the treatment of water and wastewater for rural applications.

REFERENCES:
2. CPHEEO Manual on "Sewerage and Sewage Treatment", Govt. of India (1999).

EN8075 WATER QUALITY MODELING L T P C
3 0 0 3

OBJECTIVES:
- To introduce the fundamentals of mathematical models for water quality and the importance of model building.
- To acquaint with various water flow models and their kinetics.
- To educate about the water parameters modeling and various ground water quality modeling.
- To demonstrate the features and the use of most widely used computerized models for water quality

UNIT I MODELING CONCEPTS
Engineers and water quality-Mathematical models-Overview of different types of models-- Steps in model development - Importance of model building - balance - calibration and verification of models- conservation of mass- mass balance analysis -chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT II COMPLETELY AND INCOMPLETELY MIXED SYSTEM
Transport phenomena – Advection, diffusion, dispersion- simple transport models – Plug flow models- Application of PFR model to streams-MFR model to estuaries-Steady state and time variable solutions-completely mixed systems, concept and models in Completely Stirred Tank Reactors, mass balance equations, loading types, feed forward vs. feedback reactor systems.

UNIT III WATER QUALITY ENVIRONMENTS

UNIT IV GROUNDWATER QUALITY MODELING
Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement, seawater intrusion – basic concepts and modeling

UNIT V COMPUTER METHODS
Exposure to computer models for surface water and groundwater quality - QUAL2E Model and its application

TOTAL: 45 PERIODS

OUTCOME:
- Developed conceptual schematics required for modeling and an ability to translate pertinent criteria into system requirements