PROGRAMME EDUCATIONAL OBJECTIVES (PEOs):

I. 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.

II. 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.

III. Identify, formulate, analyze, develop processes and technologies to meet desired environmental protection needs of society and formulate solutions that are technically sound, economically feasible, and socially acceptable.

PROGRAMME OUTCOMES (POs):

By the time of their graduation, the students are expected:

1. To identify, formulate, and solve environmental engineering problems using the techniques, skills, and modern engineering tools necessary for environmental engineering practice

2. To 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

3. To assess the potential environmental impacts of development projects and design mitigation measures

4. To have basic knowledge about environment protection and operation of pollution control devices

5. To design and conduct experiments, as well as interpret data and communicate effectively

6. To function in multi-disciplinary teams and understand the ethical and professional responsibility

7. To find professional level employment as Environmental Engineers or pursue higher studies

8. To have a knowledge of contemporary environmental issues and an ability to engage in life-long learning
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# ANNA UNIVERSITY: CHENNAI
# AFFILIATED COLLEGES
# M.E. ENVIRONMENTAL ENGINEERING
# REGULATIONS – 2017
# CHOICE BASED CREDIT SYSTEM
# CURRICULA AND SYLLABI

## SEMESTER I

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**Total No. of Credits: 70**
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OBJECTIVES:
- This course is designed to provide the solid foundation on topics in various statistical methods which form the basis for many other areas in the mathematical sciences including statistics, modern optimization methods and risk modeling. It is framed to address the issues and the principles of estimation theory, testing of hypothesis, correlation and regression, design of experiments and multivariate analysis.

UNIT I ESTIMATION THEORY
12

UNIT II TESTING OF HYPOTHESIS
12
Sampling distributions - Small and large samples - Tests based on Normal, t, Chi square, and F distributions for testing of means, variance and proportions – Analysis of r x c tables – Goodness of fit.

UNIT III CORRELATION AND REGRESSION
12
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
12
Analysis of variance – One way and two way classifications – Completely randomized design – Randomized block design – Latin square design - $2^2$ Factorial design.

UNIT V MULTIVARIATE ANALYSIS
12
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.

TOTAL: 60 PERIODS

OUTCOMES:
After completing this course, students should demonstrate competency in the following topics:
- Consistency, efficiency and unbiasedness of estimators, method of maximum likelihood estimation and Central Limit Theorem.
- Use statistical tests in testing hypotheses on data.
- Concept of linear regression, correlation, and its applications.
- List the guidelines for designing experiments and recognize the key historical figures in Design of Experiments.
- Perform exploratory analysis of multivariate data, such as multivariate normal density, calculating descriptive statistics, testing for multivariate normality.

The students should have the ability to use the appropriate and relevant, fundamental and applied mathematical and statistical knowledge, methodologies and modern computational tools.

REFERENCES:

EV5101
ENVIRONMENTAL CHEMISTRY
L T P C
3 0 0 3

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

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

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
REFERENCES:

EV5102 ENVIRONMENTAL MICROBIOLOGY L T P C
3 0 0 3

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 7
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 9
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


TOTAL: 45 PERIODS

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.

REFERENCES:


EV5103  DESIGN OF PHYSICO- CHEMICAL TREATMENT SYSTEMS  L T P C

3 0 0 3

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 III  DESIGN OF MUNICIPAL WATER TREATMENT PLANTS  10

UNIT IV  DESIGN OF INDUSTRIAL WATER TREATMENT PLANTS  10

UNIT V  DESIGN OF WASTEWATER TREATMENT PLANTS  10

OUTCOMES:
• Able to develop 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:

EV5104  TRANSPORT OF WATER AND WASTEWATER  L T P C
3 0 0 3

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 12
Need for Transport of water and wastewater; Planning of Water System –Selection of pipe materials, Water transmission main design- gravity and pumping main; Selection of Pumps-characteristics- economics; Specials, Jointing, laying and maintenance, water hammer analysis; water distribution pipe networks Design, analysis and optimization – appurtenances – corrosion prevention – minimization of water losses – leak detection Storage reservoirs.

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 8
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 7
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.

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

REFERENCES:

TOTAL: 45 PERIODS
EV5111  ENVIRONMENTAL CHEMISTRY LABORATORY  L T P C
0 0 4 2

OBJECTIVES:

- To train in the analysis of physico-chemical parameters with hands on experience

1. Good Laboratory Practices, Quality control, calibration of  8
2. Sampling and Analysis of water (pH, alkalinity, hardness, chloride, Sulphate, turbidity EC, TDS,TS, nitrate, fluoride)’  20
3. Wastewater analysis (BOD, COD, Phosphate, TKN, Oil & Grease, Surfactant and heavy metals).  20

TOTAL: 60 PERIODS

OUTCOME:

- Able to assess quality of environment.

REFERENCES:


EV5112  ENVIRONMENTAL MICROBIOLOGY LABORATORY  L T P C
0 0 4 2

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
7. Analysis of air borne microorganisms,
8. Staining of bacteria.
9. Effect of pH, temperature on microbial growth
11. Effect of pesticides on soil microorganisms.
12. Bacteriological analysis of wastewater (Coliforms, E.coli, Streptococcus) – MPN
13. Bacteriological analysis of wastewater (Coliforms, Streptococcus) - MF techniques, Effect of Heavy metals on microbial growth.
14. Detection of Anaerobic bacteria (Clostridium sp.)
15. Bioreactors(cultivation of microorganisms )

TOTAL: 60 PERIODS
OUTCOMES:
- At the end of experimental exercise, the candidate 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:

EV5201 DESIGN OF BIOLOGICAL TREATMENT SYSTEMS L T P C
3 0 0 3

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:
- Able to develop conceptual schematics required for biological treatment of wastewater
- Ability to translate pertinent criteria into system requirements.

REFERENCES:

EV5202 INDUSTRIAL WASTEWATER MANAGEMENT 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

UNIT II INDUSTRIAL POLLUTION PREVENTION & WASTE MINIMISATION

UNIT III INDUSTRIAL WASTEWATER TREATMENT
UNIT IV WASTEWATER REUSE AND RESIDUAL MANAGEMENT


UNIT V CASE STUDIES


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:


EV5203 AIR AND NOISE 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 MONITORING AND MODELLING

Ambient and Stack Sampling and Analysis of Particulate and Gaseous Pollutants -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  10

UNIT IV  CONTROL OF GASEOUS CONTAMINANTS  10

UNIT V  AUTOMOBILE AND NOISE POLLUTION  11
Vehicular Pollution: Automobile emission- Types of emissions- Exhaust emissions, evaporative emissions, crank-case emissions- Prevention and control of vehicular pollution.
Noise Pollution: Sources and Effects of Noise Pollution – Measurement – Standards –Control and Preventive measures. Sources types and control of indoor air pollutants, sick building syndrome types – Radon Pollution and its control.

TOTAL: 45 PERIODS

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

- Apply sampling techniques and Suggest suitable air pollution prevention equipments and techniques for various gaseous and particulate pollutants.

REFERENCES:

EV5211  ENVIRONMENTAL PROCESSES MONITORING LABORATORY  L T P C
0 0 6 3

OBJECTIVE:
- To develop the skill for conducting Treatability studies of water and wastewater treatment and monitoring of ambient air and noise quality

LIST OF EXPERIMENTS
1. Coagulation and Flocculation  6
2. Batch studies on settling  6
3. Studies on Filtration- Characteristics of Filter media  6
4. Water softening  6
5. Adsorption studies/Kinetics  6
6. Langelier Saturation Index and Silt Density Index- For Membrane Filtration  6
7. Kinetics of suspended growth process (activated sludge process)-and Sludge volume Index 12
8. Sludge Filterability Test 6
9. Anaerobic Reactor systems / kinetics (Demonstration) 6
10. Advanced Oxidation Processes – (Photo catalysis) 6
11. Disinfection for Drinking water (Chlorination) 6
12. Ambient Air Sampling-Determination of PM10, PM2.5, SO₂ and NO₂ 12
13. Noise Monitoring-Determination of Equivalent Noise Level 6

TOTAL: 90 PERIODS

OUTCOME:
• After the completion of the course the students will be able to design and analyse various treatability options for water and wastewater and monitor ambient air and noise quality.

REFERENCES:

EV5212 SEMINAR

OBJECTIVE:
• To work on a specific technical topic in Environmental Engineering and acquire the skills of written and oral presentation.
• To acquire writing abilities for seminars and conferences.

SYLLABUS:
The students will work for two hours per week guided by a group of staff members. They will be asked to give a presentation on any topic of their choice related to Environmental Engineering and to engage in discussion with the audience. A brief copy of their presentation also should be submitted. Similarly, the students will have to present a seminar of not less than fifteen minutes and not more than thirty minutes on the technical topic. They will defend their presentation. Evaluation will be based on the technical presentation and the report and also on the interaction shown during the seminar.

TOTAL: 30 PERIODS

OUTCOME:
• The students will be trained to face an audience and to tackle any problem during group discussion in the Interviews.
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

UNIT II IMPACT IDENTIFICATION AND PREDICTION

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.

UNIT IV ENVIRONMENTAL MANAGEMENT PLAN

UNIT V ENVIRONMENTAL RISK ASSESSMENT AND MANAGEMENT

TOTAL: 45 PERIODS

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:

EV5311 INDUSTRIAL TRAINING

OBJECTIVE:
- To train the students in the field work so as to have a firsthand knowledge of practical problems related to Environmental Engineering in carrying out engineering tasks.
- To develop skills in facing and solving the field problems.

SYLLABUS:
The students individually undertake training in reputed Industries during the summer vacation for a specified period of two weeks. At the end of training, a detailed report on the work done should be submitted within ten days from the commencement of the semester. The students will be evaluated through a viva-voce examination by a team of internal staff.

OUTCOME:
- They are trained in tackling a practical field/industry orientated problem related to Environmental Engineering.

EV5312 PROJECT WORK (PHASE I)

OBJECTIVE:
- To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
- To develop the methodology to solve the identified problem.
- To train the students in preparing project reports and to face reviews and viva-voce examination.

SYLLABUS:
The student individually works on a specific topic approved by faculty member who is familiar in this area of interest. The student can select any topic which is relevant to his/her specialization of the programme. The topic may be experimental or analytical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner.

TOTAL: 180 PERIODS

OUTCOME:
- At the end of the course the students will have a clear idea of his/her area of work and they are in a position to carry out the remaining phase II work in a systematic way.
**EV5411 PROJECT WORK (PHASE II)**

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**OBJECTIVE:**
- To solve the identified problem based on the formulated methodology.
- To develop skills to analyze and discuss the test results, and make conclusions.

**SYLLABUS:**
The student should continue the phase I work on the selected topic as per the formulated methodology. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated through based on the report and the viva-voce examination by a panel of examiners including one external examiner.

**OUTCOME:**
- On completion of the project work students will be in a position to take up any challenging practical problem and find better solutions.

**EV5001 ECOLOGICAL ENGINEERING**

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**OBJECTIVES:**
- To impart knowledge on the principles of ecological engineering that strengthen the functions of ecosystems, restore devastated ecosystems, and utilize the functions of ecosystems to develop ecological engineering designs for environmental management.

**UNIT I**
**ECOSYSTEMS & ECOTECHNOLOGY**
10
- Aim, scope and applications of ecology – Development and evolution of ecosystems – Principles and concepts pertaining to communities in ecosystem – Energy flow and material cycling in ecosystems – productivity in ecosystems.

**UNIT II**
**SYSTEMS APPROACH IN ECOLOGICAL ENGINEERING**
10

**UNIT III**
**ECOLOGICAL ENGINEERING PROCESSES**
8
- Self-organizing design and processes – Multi seeded microcosms – Interface coupling in ecological systems – Concept of energy – Determination of sustainable loading of ecosystems.

**UNIT IV**
**ECOTECHNOLOGY FOR WASTE TREATMENT**
12

TOTAL: 360 PERIODS
UNIT V  CASE STUDIES
Case studies of Integrated Ecological Engineering Systems and their commercial prospects.

TOTAL: 45 PERIODS

OUTCOME
- After the completion of the course the students will be able to determine sustainable loadings of ecosystems.

REFERENCES:

EV5002  SOLID AND HAZARDOUS WASTE MANAGEMENT

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
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- Integrated solid waste management.

UNIT II  WASTE CHARACTERIZATION AND SOURCE REDUCTION
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
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
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.
UNIT V WASTE DISPOSAL


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
• Design the different elements of waste management systems.

REFERENCES:

EV5003 OPERATION AND MAINTENANCE OF TREATMENT SYSTEMS L T P C
3 0 0 3

OBJECTIVE:

• To educate the student on the various Operation & Maintenance aspects of Water treatment systems, sewer systems, sewage treatment plants and Effluent Treatment Plants.

UNIT I ELEMENTS OF OPERATION AND MAINTENANCE

UNIT II  OPERATION AND MAINTENANCE OF WATER INTAKES AND SUPPLY SYSTEMS

UNIT III  OPERATION AND MAINTENANCE OF SEWER SYSTEMS
Components and functions of sewer system – Conduits or pipes – Manholes – Ventilating shaft – Maintenance of collection system – Operational Problems– Clogging of pipes – Hazards – Precautions against gas hazards – Precautions against infections – Devices for cleaning the conduits – Preventive and corrective maintenance of sewage pumps –operation and maintenance of sewage pumping stations- Maintenance Hazards and Operator Protection -Case Studies

UNIT IV  OPERATION AND MAINTENANCE OF PHYSICO-CHEMICAL TREATMENT UNITS
Operation and maintenance in screen chamber, Grit Chamber and clarifiers- - Operation issues, trouble shooting guidelines and record keeping requirements for clarifier, Equalization basins, Neutralization unit - Chemical storage and mixing equipment - Chemical metering equipment - Flash mixer –Filters, thickeners and centrifuges- Filter Press - Start-up and maintenance inspection - Motors and Pumps - Hazards in Chemical Handling – Jar Test - Chlorination Equipment - Membrane process systems- SDI and LSI determination- Process Chemistry and Chemical dosage calculations- Case Studies

UNIT V  OPERATION AND MAINTENANCE OF BIOLOGICAL TREATMENT
Construction, Operation and Maintenance aspects of activated sludge process, trickling filters, anaerobic digester, SBR, UASBR, MBRs- Startup and Shutdown Procedures-DO, MLSS and SVI monitoring- Trouble shooting guidelines – Interaction with other Treatment Processes - Planning, Organizing and Controlling of plant operations – capacity building, case studies of Retrofitting- Case studies

TOTAL: 45 PERIODS

OUTCOMES:
- The students who complete the course would have acquired the knowledge required to operate and maintain water treatment plants and wastewater treatment plants including trouble shooting.

REFERENCES:
1. Ananth S Kodavasal, The STP Guide-Design, Operation and maintenance, Karnataka State Pollution Control Board, Bangalore,2011
OBJECTIVES:

- To impart knowledge on the policies, legislations, institutional framework and enforcement mechanisms for environmental management in India.

UNIT I  INTRODUCTION  9

UNIT II  WATER (P&CP) ACT, 1974  8
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Water Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT III  AIR (P&CP) ACT, 1981  8
Power & functions of regulatory agencies - responsibilities of Occupier Provision relating to prevention and control Scheme of Consent to establish, Consent to operate – Conditions of the consents – Outlet – Legal sampling procedures, State Air Laboratory – Appellate Authority – Penalties for violation of consent conditions etc. Provisions for closure/directions in apprehended pollution situation.

UNIT IV  ENVIRONMENT (PROTECTION) ACT 1986  13
Genesis of the Act – delegation of powers – Role of Central Government - EIA Notification – Sitting of Industries – Coastal Zone Regulation - Responsibilities of local bodies mitigation scheme etc., for Municipal Solid Waste Management - Responsibilities of Pollution Control Boards under Hazardous Waste rules and that of occupier, authorisation – Biomedical waste rules – responsibilities of generators and role of Pollution Control Boards

UNIT V  OTHER TOPICS  7
Relevant Provisions of Indian Forest Act, Public Liability Insurance Act, CrPC, IPC -Public Interest Litigation - Writ petitions - Supreme Court Judgments in Landmark cases.

TOTAL: 45 PERIODS

OUTCOMES:

On completion of the course the students will have

- the knowledge on the National environmental legislations and the policies
- be able to plan programmes to comply with the legal requirements related to organizations

REFERENCES:

1. CPCB “Pollution Control acts, Rules and Notifications issued there under “Pollution Control Series – PCL/2/1992, Central Pollution Control Board, Delhi, 1997.
OBJECTIVE:
- To educate the students on the various instrumental methods of monitoring the quality of air, water and soil.

UNIT I INTRODUCTION
Wet Chemistry methods and their limitations-Instrumental Methods, Selection of method Precision and Accuracy, Error in measuring signals- Quality control & assurance Sample preservation, Sample preparation and analyte isolation.

UNIT II SPECTROSCOPIC METHODS
Principles, techniques and applications of spectrophotometry, fluorimetry, nephelometry and turbidimetry, Atomic Absorption Spectrometry (Flame, graphite furnace and hydride generation), Atomic Emission Spectrometry (AES), flame and Inducted Coupled Plasma (ICP) – TOC Analyzer

UNIT III CHROMATOGRAPHIC METHODS
Column, Paper and thin layer chromatography (TLC)- Principles, techniques and applications of GC, GC-MS, High performance liquid chromatography (HPLC) and Ion chromatograph (IC)- Hyphenated techniques for Environmental contaminant (trace organics) analysis.

UNIT IV ELECTRO AND RADIO ANALYTICAL METHODS
Principles, techniques and applications of Conductometry, potentiometry, coulometry, AOX analyzer Amperometry, polarography, New Activation Analysis (NAA), X-ray Fluorescence (XRF) and X-ray Diffraction (XRD) methods.

UNIT V CONTINUOUS MONITORING INSTRUMENTS
Principles, techniques and applications of NDIR analyzer for CO, chemiluminescent analyzer for NOx Fluorescent analyzer for SO2 Particulates analysis- Auto analyzer for water quality using flow injection analysis.

OUTCOMES:
- The students can understand the concept of various instrumentation techniques.
- The students can adopt the methodologies involved in air quality monitoring.

REFERENCES:
OBJECTIVES:
- To understand the Earth’s Climate System and the concept of Global Warming.
- To comprehend the impact of climate change on society and its mitigation measures.

UNIT I EARTH’S CLIMATE SYSTEM

UNIT II OBSERVED CHANGES AND ITS CAUSES

UNIT III IMPACTS OF CLIMATE CHANGE

UNIT IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES

UNIT V CLEAN TECHNOLOGY AND ENERGY

TOTAL : 45 PERIODS

OUTCOME:
- The students can understand the concept of climate change and its consequences.
- The students can adopt the methodologies in finding the changes in climate

REFERENCES
1. Al core ‘inconvenient truth” – video form
3. IPCC Fourth Assessment Report – The AR4 Synthesis Report,
OBJECTIVES:
- To educate the Coastal and Marine Environment.
- To educate the ocean dynamics.
- To find sources of marine pollution and methods for monitoring, modeling and control.

UNIT I  MARINE AND COASTAL ENVIRONMENT  9
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  9
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  9
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  MARINE POLLUTION MONITORING  9
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  COASTAL MANAGEMENT  9
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:
OBJECTIVE:
- This course introduces the basic concept of mathematical modeling and process simulation techniques of environmental disturbances with reference to air, water and groundwater domains.

UNIT I  MODELING CONCEPTS  12
Casual and statistical models - Characteristics - Steps in model development - Importance of model building - conservation of mass and mass balance - calibration and verification of models; Transport phenomena – Advection, diffusion, dispersion, simple transport models; chemical reaction kinetics – Law of mass action, Rate constants, reaction order, types of reactions, equilibrium principles.

UNIT II  WATER QUALITY MODELING  10

UNIT III  AIR POLLUTION MODELING  9
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 IV  AIR QUALITY MODELS  9
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.

UNIT V  APPLICATIONS  5
Software package applications: Air quality modeling and water quality modeling.

TOTAL: 45 PERIODS

OUTCOME:
- After the completion of this course, the student will be able to develop conceptual schematics required for air and water quality modeling and an ability to translate pertinent criteria into air and water pollution control.

REFERENCES:
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 asymmetric – 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:
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
10

UNIT II  ARTIFICIAL INTELLIGENCE
9

UNIT III  FUZZY LOGIC
9
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.

UNIT IV  DATA MANAGEMENT
9
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  ENVIRONMENTAL modeling using MATLAB
8
Introduction to MATLAB Software – Environmental modeling principles and MATLAB Applications – Pollutants transport, decay and degradation modeling using MATLAB. Case studies.

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

REFERENCES:
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


UNIT II: LANDFILL LINERS AND COVER SYSTEMS


UNIT III: LEACHATE AND LANDFILL GAS MANAGEMENT


UNIT IV: LANDFILL OPERATION AND CLOSURE


UNIT V: CONTAMINATED SITE REMEDIATION


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
- To understand the design and construction of landfills, processes in landfills, methods for management and treatment of landfill gas and leachate
- To 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:

EV5011 ENVIRONMENTAL RISK ASSESSMENT

OBJECTIVE:

- 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

Sources of Environmental hazards – Environmental and ecological risks – Environmental risk assessment framework – Regulatory perspectives and requirements – Risk Analysis and Management and historical perspective; Social benefit Vs technological risks; Path to risk analysis; Perception of risk, risk assessment in different disciplines.

UNIT II ELEMENS OF ENVIRONMENTAL RISK ASSESSMENT

UNIT III: TOOLS AND METHODS FOR RISK ASSESSMENT


UNIT IV: RISK MANAGEMENT


UNIT V: APPLICATIONS


TOTAL: 45 PERIODS

OUTCOMES:

- Ability to identify fate and behaviour of toxics and persistent substances in the environment.
- Ability to apply the principle of risk management for solving Environmental problems

REFERENCES:


EV5012 REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL MANAGEMENT

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

UNIT II  REMOTE SENSING TECHNOLOGY
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
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
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  REMOTE SENSING AND GIS APPLICATIONS
Monitoring and management of environment, Conservation of resources, Sustainable land use, Coastal zone management – Limitations

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

REFERENCES: