M.Tech. (Environmental Engineering) Programme

First Semester
1. CE 622 Environmental Chemistry
2. CE 623 Ecology and Environmental Microbiology
3. CE 624N Physical-Chemical Processes
4. CE 625 Air Pollution and Control
5. Elective I
6. Elective II

Second Semester
1. CE 626 Biological Processes I
2. CE 627 Industrial Wastewater Treatment
3. CE 629 Wastewater Treatment Plant Design and Operation
4. CE 655 Biological Processes II
5. Elective III
6. Elective IV

Third Semester
1. CE 721 Water Treatment Plant Design and Operation
2. CE 791E Lab/Project
3. CE 780E General Seminar
4. CE 781E Preliminary Dissertation Seminar

Fourth Semester
1. CE 782E Final Dissertation Seminar
2. CE 798E Dissertation

List of Electives
CE656 Solid and Hazardous Waste Management
CE 657 Environmental Biotechnology and Toxicology
CE 658 Instrumental Methods for Environmental Analysis
CE 659 Sludge Treatment and Disposal
CE 660 Statistical Procedures in Environmental Monitoring
CE 671 Industrial Water Treatment and Corrosion Control
CE 601 Higher Numerical Analysis
CE 651 Engineering and the Environment
CE 652 Transport and Dispersion of Pollutants
CE 653 Environmental Policies and Impact Analysis
CE 621N Water Reclamation and Reuse
CE 654 Advanced Wastewater Treatment Processes
Departmental Courses

<table>
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<tr>
<th>Department</th>
<th>Course No</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
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<td>CE-622</td>
<td>Environmental Chemistry</td>
<td>B.Tech. Civil/Chemical</td>
<td>Theory</td>
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Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

Objective
To appraise the students of the applications of principles of chemistry in water and wastewater treatment and to prepare them as experts in optimising the chemistry based treatment processes.

Outcome
Upon successful completion of the syllabus the students would be able to
1. To understand the essential theoretical background of the principles of chemistry applied to the solutions of environmental problems.
2. To apply the principles of chemistry in solving water and wastewater treatment problems.
3. To analyse the chemistry related issues in water and wastewater treatment.
4. To evaluate the characteristics of raw water, treated water, products of biodegradation of wastewaters and the performance of different units of water and wastewater treatment.

Topics Covered
Unit I
Basic Principles, Chemical Kinetics, Reaction Rates, Oxidation-Reduction reactions, Redox Stoichiometry, Applications of redox Chemistry

Unit II
Chemical Equilibria, Basic concepts from Equilibrium Chemistry, Solubility Product, Common Ion Effect, Solubility Equilibria, Precipitation-Dissolution, Acid-Base Equilibria, Strong and Weak Acids, Carbonate System, pH, Buffers and Buffer Intensity

Unit III
Complex Formation, Log Concentration Diagrams, Metal Hydroxide Precipitation, Metal Speciation, Water stabilization, Langlier Saturation Index, Cadwell-Lawrence Diagram

Unit IV
Organic Chemistry, Aquatic chemistry, Atmospheric chemistry, Toxic Compounds, Organic Solvents, Pesticides, Dioxins, PCBs and PAHs, Surfactants, Laboratory practice for determination of ions and solids

Text Books and/or Reference Materials

Additional Learning Source
2. Web based sources.
Department | Course No | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CE-623 | Ecology and Environmental Microbiology | DC | B.Tech. Civil/Chemical | Theory | 4 | 3 | 0 | 4

Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

Course Objective
1. Provide an overview of the ecology and interaction of biotic and abiotic components in ecosystem
2. To understand how microbes interact with members of their own species and with organisms of another species
3. Fundamental aspects of microbiology applicable to environmental engineering and science.

Course Outcome
Upon successful completion of this course, it is expected that students will be able to:
1. Know the behaviour of different ecosystems and their interface with different natural cycles.
2. Recognize, name and predict important properties of key classes’ organic compounds.
3. Understand the diversity of microbial biochemical reactions and pathways.
4. To evaluate and estimate the impact of microorganisms on natural and engineering processes.

Topics Covered
Unit I
- Principles of ecology, Ecosystems, Biotic and Abiotic Components, Trophic Levels, Material and Energy Flow in Ecosystems, Nutrient Cycles, Food chain and Biomagnification, Ecology of Population

Unit II
- Microorganisms in Wastewater Treatment, Microbiological Concepts- cells, classification and characteristics of living organisms, Characterisation Techniques, Microbial Metabolism, Basic metabolic models, Chemistry of carbohydrates, proteins, fats and lipids, Population Dynamics

Unit III
- Microbial Growth Kinetics, Role of Microorganisms in biogeochemical cycles, Microbiological Analysis, Chemical Composition of Biomass, Waterborne Pathogens, Bacteria, Fungi, Yeast, Algae, Protozoa, Enzymes, Microorganisms as Food, Water and Wastewater Treatment Microbiology, Microorganisms and Air Pollution

Unit IV
- Microbiology of Anaerobic Digesters, Sludge Microbiology, Stress on the Microbial Community, Biochemical reactions, Microbiology of aerobic and anaerobic processes, Biochemical pathways, Application of microbiology for pollution control and environmental engineering, Laboratory Practice

Text Books and/or Reference Materials
Course Assessment Methods

Assignment and Quizzes (15%)
Mid Semester Examination (25%)
End Semester Examination (60%)

Course Objective

To educate the student on the working principles, theories and design of various physical and chemical treatment systems for water and wastewater.

Course Outcome

Upon successful completion of the course, the student will be able to:

1. learn about water and wastewater characteristics and, fundamentals of water and wastewater treatment
2. identify and understand the common physical and chemical unit operations encountered in treatment processes
3. select optimized dose of chemicals and evaluate removal efficiencies of physicochemical treatment unit
4. explain the principles of physicochemical processes and apply the knowledge in the process design of water and wastewater treatment

Topics Covered

Unit I

Unit II
Flocculation-Velocity Gradient, Kinetics, Baffled and Paddle Wheel Flocculation, Sedimentation-Discrete, Flocculent and Hindered Settling, Ideal Horizontal Flow Reactor, Up flow Reactor, Design Parameters, Tube Settlers

Unit III
Granular Media Filtration-Rapid and Slow Sand Filter, Particle Removal Mechanisms and Head Loss, Filter Run and Breakthrough, Constant and Declining Rate Filtration, Filter Backwashing, Dissolved Air Flotation-Design Considerations, Water Fluoridation, Iron and Manganese Removal

Unit IV

Text Books and/or Reference Materials


Additional Learning Source

2. Web based sources.
**Course Objective**
To educate the students on various methods of control of particulate and gaseous air pollutants.

**Course Outcome**
Upon successful completion of course the students would be able to
1. Understand the nature of major air pollutants their effects on humans and property.
2. Apply the concepts of meteorology for the dispersion of air pollutants.
3. Evaluate the selection of different control units for particulates and gaseous pollutants
4. Design the different control equipments used for air pollution.

**Topics Covered**

**UNIT I - SOURCES AND CLASSIFICATION OF AIR POLLUTANTS**
Classification, Sources and Effects of air pollutants, Sampling Methods and Measurements of Air Pollutants, Measurement and analyses of primary air pollutants SO₂, NOₓ and SPM using high volume sampler, Ambient Air Quality Standards, Emission Standards

**UNIT II - METEOROLOGY AND DISPERSION OF POLLUTANTS**
Basic Meteorology, Transport, Dispersion and Transformation of pollutants in Air, Adiabatic Lapse Rate, Atmospheric Stability, Dispersion of Pollutants, Air Pollution Dispersion Models, Point, Line and Area Source Models, Inversions, Plume Behaviour, Mixing Height, Plume Rise, Stack Emissions and Design

**UNIT III - PARTICULATE CONTROL METHODS**
Air Pollution Control Techniques, Control of Particulate Matter, Theory and description of control devices and their applications, Equipment’s and their Design, Selection of Control Equipment’s, Engineering Control ConceptsGravity Settling Chamber, Cyclone, Fabric Filter, Electrostatic Precipitator.

**UNIT IV - GASEOUS AND NOISE CONTROL METHODS**
Control of Gaseous Pollutants-Oxides of Nitrogen and Sulphur, Sources and effects of noise pollution, Kinetics of noise, Measurement and control of noise pollution, Climate Change, Odour Removal, Atmospheric Chemistry, Photochemical Smog, Global Change-Greenhouse Effect and Global Warming, Ozone Layer Depletion, Acid Rain, Air Emissions from Wastewater Treatment Facilities and their Control

**Text Books and/or Reference Materials**

**Additional Learning Source**
- [http://nptel.ac.in/courses/105102](http://nptel.ac.in/courses/105102)
- [http://mjcetenvsci.blogspot.in/2013/11/air-pollution-causes-effects-and.html](http://mjcetenvsci.blogspot.in/2013/11/air-pollution-causes-effects-and.html)
3. To analyse the problems related to troubleshooting of the wastewater treatment plant and to apply the corrective measures for the same.

4. To evaluate the effect of various factors responsible for the biodegradation of organics including toxicants.

**Topics Covered**

**Unit I**
- Principles of Biological Treatment, Treatment Kinetics, Substrate Removal Efficiency, Reactor Profiles, Continuous Flow Reactors-Hydraulic and Performance Characteristics (Pulse and Step Input Response)

**Unit II**

**Unit III**

**Unit IV**
- Biological Nutrient Removal, Nitrification and Denitrification- Process Kinetics, Treatment Plants for Nitrification and Denitrification, Anaerobic Ammonium Oxidation, Biological Removal of Toxic and Recalcitrant Organic Compounds, Biological Phosphorus Removal, Treatment Plants for Phosphorus Removal

**Text Books and/or Reference Materials**


**Additional Learning Source**

2. Web based source

**Department**
- Civil Engineering

**Course No**
- CE-627

**Course Title**
- Industrial Wastewater Treatment

**Course Designation**
- DC

**Pre-Requisites**
- B.Tech. Civil/Chemical

**Course Type**
- Theory

**Credit Hours**
- 4

**Contact Hours**
- 3 1 0 4

**Course Assessment Methods**
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**
To provide knowledge on sources, characteristics and treatment options for specific pollutants in wastewater arising out of industrial processes.

**Course Outcome**
Upon successful completion of this course, the student will be able to:
1. understand about sampling, quantification and analysis of industrial wastewater
2. identify and apply basic concepts of wastewater treatment for handling industrial wastewater
3. understand processes in industries and pollutional effects of industrial waste on environment
4. demonstrate the process of developing an overall treatment strategy for an industrial waste stream through case studies

**Topics Covered**

Unit I
Unit II

Unit III
Characteristics and Treatment of Various Industrial Effluents, Pollution Control and Case Studies in Selected Process Industries-Chlor Alkali Industry, Electroplating Industry, Fertiliser and Tannery

Unit IV
Identification of treatment flowsheets and wastewater treatment for selected industries- Sugar Industry, Distillery, Brewery, Paper and Pulp, Dairy, Slaughterhouse and Petroleum Refinery

Text Books and/or Reference Materials

Additional Learning Source
1. Comprehensive Industry Document Series, Central Pollution Control Board, New Delhi, India.
2. Web based sources

Department Course No Course Title Course Designation Pre-Requisites Course Type Credit Hours Contact Hours Total Contact Hours

Civil Engineering CE- 629 Wastewater Treatment Plant Design and Operation DC B.Tech. Civil/Chemical Theory 4 3 1 0 4

Course Assessment Methods
Assignment and Quizzes (15%) Mid Semester Examination (25%) End Semester Examination (60%)

Course Objective
Students will be able to apply the knowledge of wastewater treatment unit operations and processes, hydraulics and waste management & planning to prepare one full size treatment plant with all units and detailed engineering.

Course Outcome
At the end of this course, the students are expected to be able to:
1. Understanding of different types of wastewater treatment arrangements and preliminary treatment.
2. Know about complete wastewater treatment plant.
3. Integration of different components of wastewater treatment.
4. Detailing of all units of treatment Plant

Topics Covered
Unit I
Wastewater treatment flowsheets, Bar Screens- Design and Hydraulics, Fine Screens and Micro screens, Grit Chamber, Proportional Weir

Unit II
Sedimentation Tanks- Inlet and Outlet Design, Flow Distribution, Biological Waste Treatment- Activated Sludge Process, Extended Aeration

Unit III

Text Books and/or Reference Materials

Additional Learning Source
Course Assessment Methods
Assignment and Quizzes (15%)
Mid Semester Examination (25%)
End Semester Examination (60%)

Course Objective
The objective of Biological Process – II is to prepare students to learn the basics of anaerobic treatment fundamentals including behaviour and kinetics of microorganisms which would give students an insight into anaerobic technology used for design of wastewater treatment plants.

Course Outcome
Upon successful completion of the course the students would be able to
1. To understand the fundamentals of anaerobic treatment processes for the design of anaerobic wastewater treatment plants.
2. To apply the concepts of microbiology, kinetics including various metabolic pathways involved, in improving the performance of the anaerobic treatment plants employed for wastewater.
3. To analyse the issues related to the failure of the process and subsequently apply the corrective measures for improving the performance of anaerobic microorganisms.
4. To evaluate the effect of various factors affecting the performance of anaerobic treatment process.

Topics Covered
Unit I
Bioreactor Engineering, Anaerobic Treatment Fundamentals, Applications, Process Monitoring and Control, Kinetics of Anaerobic Treatment, Application of Anaerobic Digestion to Waste Treatment, Conversion, Environmental Factors
Unit II
Anaerobic Treatment Processes, pH value and Stability in Anaerobic Digester, Suspended Growth and Fixed Film Processes, Anaerobic Process Design
Unit III
Anaerobic Contact Process, Fixed Film Anaerobic Reactor Design, UASB Process Design for various types of Wastewaters, Anaerobic Lagoons
Unit IV
Anaerobic Sludge Digestion, Post Treatment of Effluents from Anaerobic Reactors, Refractory Organics, Biogas Utilization, Selected case studies

Text Books and/or Reference Materials
2. R.E. Speece, “Anaerobic Biotechnology for Industrial Wastewaters” Archae Press USA

Additional Learning Source
2. Web based source
Course Objective

To provide a sound theoretical and practical knowledge base on water treatment and operation of water treatment plants.

Course Outcome

On completion of the course, students should be able to:

1. understand water demand and design of intake structures
2. understand various unit operations and unit processes involved in water treatment
3. select the most suitable water treatment process technology to treat water given its characteristics and taking into account the required water quality standards
4. perform preliminary design calculations for unit processes in water treatment plants including the engineering process layout and hydraulic profile

Topics Covered

Unit I
Treatment flowsheets, Mass balance calculations, Treatment Plant Hydraulics, Head Loss Types and Calculations, Manifold Hydraulics, Flow measurement

Unit II
Population Forecasting, Water Use and Demand, Intake Facilities, Design of Aeration Systems

Unit III

Unit IV
Sedimentation Tank Design, Membrane Unit Design, Chemical Precipitation, Disinfection and Sludge Handling

Text Books and/or Reference Materials


Additional Learning Source

2. Web based sources
1. to develop the skill for conducting studies on various unit operations and processes using laboratory scale models
2. to model and design systems using analytical tools from engineering practice
3. to design and conduct experiments, and analyze and interpret the experimental data
4. to summarize, interpret, and present experimental information in formal reports and via oral presentations.

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**Course Assessment Methods**
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**
To educate the students to apply the principles, tools and techniques to prepare and present technical report.

**Course Outcome**
1. understand the in depth knowledge of a particular topic related to environmental engineering
2. Apply the outcome of the thorough literature review for the solution of the problems related environmental engineering.
3. able to write comprehensive technical reports
4. Developments in presentation skills.

**Topics Covered**

**Text Books and/or Reference Materials**
3. How to Write a Seminar Report Paraphrasing and Summarizing by Han Xiao Institute of Informatics
4. Technische Universitat Munchen, Germany xiaoh@in.tum.de January 30, 2013.

Additional Learning Source
http://www.wikihow.com/Write-a-Seminar-Paper

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**Course Assessment Methods**
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**
This is aimed at training the students to analyse independently any problem posed to them. The work may be analytical, experimental, design or combination of these. The dissertation report is expected to exhibit clarity of thought and expression, critical appreciation of the existing literature and analytical and/or experimental or design skill.

**Course Outcome**
At the end of the course the student will be able to:
1. Identify and define a topic relevant to planning, analysis and design of an environmental engineering system based on the social, economical and environmental considerations
2. Make a critical review of the available literature and interpret the results
3. Conduct independent research to formulate and solve the chosen problem
Prepare technical report on the study carried out and publish the results

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**Course Assessment Methods**
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- Mid Semester Examination (25%)
- End Semester Examination (60%)

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**Course Outcome**
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4. Prepare technical report on the study carried out and publish the results
## Departmental Electives

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### Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

### Course Objective
Students will be able to apply the knowledge of water and wastewater treatment to make it fit for its reclamation and future reuse.

### Course Outcome
At the end of this course, the students are expected to be able to:
1. Know about effluent disposal standards and standards for reuse of water for various applications.
2. Routine and advance wastewater treatment processes to address water conservation.
3. Wastewater reuse application.
4. Sustainability through water reclamation and reuse

### Topics Covered
- **Unit I**
  - Introduction, Effluent quality from wastewater treatment plants, Water reclamation processes
- **Unit II**
  - Wastewater Reuse Applications-Land Irrigation and Groundwater Recharge, Treatment Processes for Water Reuse, Adsorption and Advanced Oxidation Processes
- **Unit III**
  - Advanced wastewater treatment, Reverse Osmosis Membranes for Wastewater Reclamation, UV Disinfection for Wastewater Reuse, Treatment flowsheets for various uses
- **Unit IV**
  - Reuse of water for irrigation, industry, ground water recharge and potable water, Cooling Tower Reuse, Indirect Potable Reuse, Aquaculture, Industrial Reuse, Case Studies of Different Countries

### Text Books and/or Reference Materials

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### Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)
Course Objective
To introduce students with the numerical methods generally used in the engineering fields. The emphasis will be on understanding the concepts of the numerical methods and on applying the concepts for solving various problems. MATLAB and Microsoft Excel will be used as tools to solve the problems using the different numerical methods.

Course Outcome
Upon successful completion of this course, it is expected that students will be able to:
1. Be aware of the mathematical background for the different numerical methods introduced in the course.
2. Understand the different numerical methods to solve for the roots of the algebraic equations and to solve system of linear and non-linear equations.
3. Understand the different numerical methods for interpolation, differentiation, integration and solving set of ordinary and partial differential equations. Use the built in functions in MATLAB and EXCEL.

Topics Covered
Linear equations and eigenvalue problems Accuracy of approximate calculations Nonlinear equations, interpolation Differentiation and evaluation of single and multiple integrals Numerical solution of differential equation, finite difference methods, Initial and boundary value problems Newton’s method, variational and weighted residual methods, Introduction of FEM

Text Books and/or Reference Materials
1. Introductory Methods of Numerical Analysis Paperback – 2012 Sastry S.S

Unit III
Hazardous Waste- Definition, Generation and Classification, Storage, Transportation, Processing and Handling, Waste Minimisation and Recovery Alternatives, Toxicology, Pollution Prevention, Hazards in Processing and Treatment, Hazardous Waste Treatment Processes- Physical separation, Chemical treatment, Thermal Treatment, Stabilization and Solidification

Unit IV

Text Books and/or Reference Materials

Additional Learning Source
1. Manual on Solid Waste Management (CPHEEO), Ministry of Urban Development, Government of India

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Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

Course Objective
1. To develop a basic knowledge about the instrumental monitoring of environment and apply the same in the field application.

Course Outcome
1. understand the principles of analysis involved in the advanced environmental analysis
2. apply the different techniques used for sample collection and interpretation of results
3. Demonstrate the ability to learn independently and communicate results, information or arguments effectively in writing analytical reports.
4. evaluate the suitability of various techniques for analysis of different pollutants

Topics Covered
UNIT I-ENVIROMENTAL SAMPLING DESIGN AND TECHNIQUES
Environmental sampling design and techniques. Sample preparation for environmental analysis. Theory and methods of analysis of air, water, wastewater and gases.

UNIT II-PRINCIPLES OF INSTRUMENTATION AND METHODS

UNIT III-ATOMIC SPECTROSCOPY AND CHROMATOGRAPHIC METHODS FOR ENVIROMENTAL ANALYSIS
Spectral Methods of Analysis, Chromatographic Methods of Analysis, Miscellaneous Methods of analysis, Atomic Absorption Spectrometry, Gas Chromatography, Flame Photometry.

UNIT IV-OTHER INSTRUMENTAL METHODS IN ENVIRONMENTAL ANALYSIS
UV-Visible and Infrared Spectroscopic Methods in Environmental analysis, Mass Spectrometry, High Performance Liquid Chromatography, Gas-Liquid Chromatography, ICP- mass spectrometry

Text Books and/or Reference Materials


Additional Learning Source


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Course Assessment Methods

- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

Course Objective

The objective is to impart the knowledge of global environmental issues, their causes and effects and the methods to control them.

Course Outcome

1. understand the different processes affecting environmental pollution
2. able to develop environmentally friendly technologies for sustainable development.
3. Analyse the different global environmental issues.
4. To develop energy efficient technologies for water and wastewater treatment.

Topics Covered

Unit I
- Renewable Biological Resources, Energy Resources and Mineral Resources, Air, Water and Soil Resources, Major Environmental Concerns, Natural Hazards and Processes, Energy Consumption for Wastewater Treatment
- Dams and Environment, Automobiles and the Environment, Batteries and the Environment
- Electric Power Plants, Refrigeration and the Environment, Global Climate and Hazards, Controlling Urban Smog, PCBs in the Environment

Text Books and/or Reference Materials

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**Course Assessment Methods**
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**
To study the behaviour of the contaminants and their transport and dispersion process.

**Course Outcome**
1. Understand the nature of various contaminants & their mode of transport in water and soil.
2. Apply the concepts of different dispersion models for the transport of pollutants.
3. Analyze the suitability/applicability of dispersion models.
4. Evaluate the fate of pollutants in water and soil

**Topics Covered**

Unit I
Impacts of pollutants on environment, Environmental Pollution, Physical Processes of Pollutant Transport and Dispersion

Unit II
Effluent disposal into lakes, rivers and oceans, Ocean outfall design

Unit III
Dispersion of contaminants in air, Dispersion Models and Concepts, Behaviour of Pollutants in the Soil

Unit IV
Fate and Transport in Aquatic Systems, Dispersion of contaminants in surface and ground water, Transport Processes for Rivers and Streams, Water Quality Models, Fate and Transport Models for Groundwater

**Text Books and/or Reference Materials**

**Additional Learning Source**
http://www.epa.gov/scram001/
1. The object of this course is to provide a working knowledge of current environmental impact assessment regulations, methods and practice.

**Course Outcome**

Upon successful completion of course the students would be able to
1. understand the different tools used for the evaluation of EIA of different projects
2. apply the methods involved in the assessment and analysis of tools required for impact assessment.
3. evaluate the suitability of different tools and models of EIA.
4. Prepare EIA reports and environmental management plans.

**Topics Covered**

**UNIT I-INTRODUCTION TO EIA**
Environmental Impact Assessment- Definitions and Concepts, Rationale and Historical Development of EIA, Organisation, Scope and Methodologies of EIA, Basic Steps in EIA Process, Public Participation in Environmental Decision Making and Management Dimensions

**UNIT II-METHODS OF IMPACT ANALYSIS AND CASE STUDIES**
Project Screening and Scoping for EIA, Use of Risk Analysis in EIA, Environmental Risk Management, Health Risk Assessment, Risk Characterization, Socioeconomic Impact Assessment, Environmental Setting, Disposal of pollutants in environment and their effects, Socio economic environment, Methods of impact analysis, EIA techniques for industrial facility construction and operation, Legal aspects- Legislation in the Indian context, Acts related to air and water, Case Studies

**UNIT III- PREDICTION AND ASSESSMENT TECHNIQUES IN EIA**
Prediction and Assessment of of Impacts on the Air Environment, Prediction and Assessment of Impacts on the Surface Water Environment, Prediction and Assessment of Impact on the Groundwater Environment and Land Environment, Air and water quality criteria, standards, framework for environmental assessment, Prediction and assessment of impact on air water and biological environment

**UNIT IV- EIA MANAGEMENT**

**Text Books and/or Reference Materials**


**Additional Learning Source**


**Department** | **Course No** | **Course Title** | **Course Designation** | **Pre-Requisites** | **Course Type** | **Credit Hours** | **Contact Hours** | **Total Contact Hours**
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CE-654 | Advanced Wastewater Treatment Processes | DE | B.Tech. Civil/ Chemical | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Methods**

Assignment and Quizzes (15%)
Mid Semester Examination (25%)
End Semester Examination (60%)

**Course Objective**

1. An elective course that has been designed based on fundamental principles and advance approaches to deal with the water pollution and to safeguard water resources through the use of advance technologies.
2. It focuses on theory and conceptual design of advance wastewater treatment systems for treating municipal and industrial wastewater.
3. Advance methods for physical, chemical, and biological processes are presented such as adsorption processes, oxidation processes, reverse osmosis, ozone treatment, membrane separation, membrane bio-reactors, MLE etc.
4. It also incorporates the principles of reactor theory, kinetics, models and scientific equations to design the advance wastewater treatment systems to achieve a desirable treatment goal.
5. This course helps to develop a basic foundation for higher studies and research in advance technologies for environmental protection.

**Course Outcome**

Students who successfully complete this course will be able to:
1. Learn how to select an appropriate treatment scheme(s) to remove critical pollutants from the wastewater using advance methods for reuse and recycle of treated effluent
2. Ability to use theoretical and engineering concepts to design treatment systems based on advance methods
3. Introduce students to the current developments, advancements, literature, unit operations and processes used in the treatment of wastewater
4. Capable to face challenges and apply their knowledge to deal with the water pollution control measures and environmental degradation.

**Topics Covered**

**Unit I**

**Unit II**
- Advanced Oxidation Processes-Reactions of OH Radicals, UV/H₂O₂/Ozone Processes, Fenton Based Systems, Membrane Processes-Principles of Different Membrane Processes, Membrane Modules, Classification and Configurations of Membrane Processes, Membrane System Components and Design Considerations

**Unit III**

**Unit IV**
- Electrodialysis, Treatment Strategies for Arsenic, Nitrates, Iron and Manganese and Radionuclides, Chemical Phosphorus Removal, Emerging Trends and Concerns in Wastewater Treatment, Small and Package Plants for Wastewater Treatment

**Text Books and/or Reference Materials**

1. Hand Tchobanoglous Crittenden Howe Trussell, “Water Treatment Principles and Design” CBS Publication

**Department** | **Course No** | **Course Title** | **Course Designation** | **Pre-Requisites** | **Course Type** | **Credit Hours** | **Contact Hours** | **Total Contact Hours** | **L** | **T** | **P**
--- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | ---
Civil engineering | CE-657 | Environmental Biotechnology and Toxicology | DE | B.Tech. Civil/ Chemical | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Methods**

- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**

1. Know the basic functioning of a microorganism and how their structure dictates their function in the environment
2. Understand the bases for microbial metabolism of environmental toxicants
3. Know various techniques to change and supplement microorganisms in the laboratory and environment
4. Understand the principles of bioremediation and basic design and application of different treatment system

Outcome
Upon successful completion of this course, it is expected that students will be able to:
1. Explain the significance of microbial diversity in environmental systems, processes and biotechnology
2. Describe existing and promising technologies that are important in the area of environmental biotechnology;
3. Undertake a range of practical approaches relevant to environmental microbiology and biotechnology and be able to record, report and discuss data
4. Identify toxicants in water and wastewater treatment, effects of pollutants on biological treatment of wastewaters.

Topics Covered
Unit I
Introduction to Biotechnology and Waste, Environmental Biochemistry, Basics of Microbiology, Microbes and Metabolism
Unit II
Genetic Manipulation, Integrated Environmental Biotechnology, Stoichiometry and Bacterial Energetics, Microbial kinetics, Biofilm Kinetics
Unit III
Introduction to general toxicity, toxicology organic and inorganic compounds, Reactors, Activated sludge Process, Lagoons, Aerobic Biofilm Process, Nitrification, Denitrification, Phosphorus Removal, Bioremediation
Unit IV

Text Books and/or Reference Materials

Course Assessment Methods
Assignment and Quizzes (15%)  
Mid Semester Examination (25%)  
End Semester Examination (60%)

Course Objective
To provide a comprehensive knowledge of properties of sludges and different options for processing and disposing specific sludges.

Course Outcome
Upon successful completion of the course, the student will be able to:
1. characterize different types of sludge and understand different treatment and handling alternatives for sludge
2. understand the advantages, disadvantages, shortcomings and solutions to problems that may arise within sludge treatment process
3. obtain a good knowledge about sludge chemical conditioning and dewaterability improvement
4. evaluate and select treatment and disposal options for specific sludges

Topics Covered
Unit I
Sources of Sludge, Sludge Characteristics, Sludge Digestion- Aerobic and Anaerobic
Unit II
Sludge Dewatering, Sand Bed Drying, Sludge Treatment and Stabilisation
Unit III
Sludge Conditioning, Gravity Thickening, Centrifugation, Vacuum Filtration, Pressure Filtration
Unit IV
Thermal Drying/Heat treatment, Composting, Wet Oxidation, Ultimate Disposal, Biosolids Processing, Resource Recovery and Beneficial Uses

Text Books and/or Reference Materials

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<td>Statistical Procedures in Environmental Monitoring</td>
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Course Assessment Methods
- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

Course Objective
The objective of the course is to impart knowledge related to data handling and analysis that would assist the students in their research outcomes.

Course Outcome
1. to understand a broad range of statistical design and analysis methods that are particularly well suited to pollution data
2. to learn key statistical techniques in easy-to-comprehend terms and use practical examples, and case studies to illustrate procedures
3. to show how to use statistical sample survey methods to estimate average and total amounts of pollutants in the environment and analyse pollution data
4. to understand how to determine the number of field samples and measurements needed and estimate the magnitude of trends

Topics Covered
Unit I
Statistical characteristics of data, Normal/Gaussian Distribution, Confidence interval
Unit II
Probability plots, Regression analysis
Unit III
Statistical aspects of data analysis, Risk assessment
Unit IV
Design of experiments, Optimisation Methods

Text Books and/or Reference Materials
**Course Assessment Methods**

- Assignment and Quizzes (15%)
- Mid Semester Examination (25%)
- End Semester Examination (60%)

**Course Objective**

The objective of Industrial Water Treatment and Corrosion Control is to prepare the students to acquire knowledge about the various advanced treatment processes adopted for the treatment of industrial water supplies and to learn about corrosion of materials and its control measures.

**Course Outcome**

Upon successful completion of the course the students would be able to

1. To understand the basics of water quality criteria requirement for industries and to learn about the problems associated with industrial cooling waters.
2. To apply the concepts of chemistry and electrochemistry for prevention of corrosion and scale formation in cooling water systems and heat exchangers.
3. To analyse the issues related to the failure of cooling water equipment and fouling due to scale deposits.
4. To evaluate the factors affecting the performance of industrial water systems regarding corrosion, scale formation and fouling.

**Topics Covered**

Unit I
Water quality criteria for industrial water supplies, filtration and reverse osmosis process for wastewater reuse.

Unit II
Cooling water systems and their types, Blowdown and its characteristics Problems in cooling water systems, Corrosion, scale formation and fouling.

Unit III
Methods of Corrosion Control, Types of Inhibitors, Cathodic and Anodic protection. Anticorrosive coatings.

Unit IV
Factors affecting scale deposition and fouling. Scaling and fouling control. Biofilm formation and its control.

**Text Books and/or Reference Materials**

1. David Hendricks, "Fundamentals of Water Treatment Unit Processes Physical, Chemical and Biological", CRC Press IWA Publishing

**Additional Learning Source**

2. Web based source