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

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-622	Environmental Chemistry	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%)

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

1. Sawyer C, McCarty P and Parkin G, “Chemistry for Environmental Engineering and Science”, Tata McGraw Hill Edition.
2. Larry D Benefield, “Process Chemistry for water and wastewater Treatment”, Prentice Hall Publications
3. Colin Baired and Michael Cann, “Environmental Chemistry” W.H.Freeman& Co Ltd. U.S.A

Additional Learning Source

1. Rittman Bruce “Environmental Biotechnology”, McGraw Hill Publications
2. Web based sources.

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-623	Ecology and Environmental Microbiology	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

1. Provide an overview of the ecology and interaction of biotic and biotic 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

1. Pelczar,*Microbiology*Tata McGraw-Hill Education, Aug-1998
2. Bruce E. Rittmann ,Perry L. Mccarty, *Environmental Biotechnology: Principles and Applications* McGraw-Hill Higher Education 2001
3. Ralph Mitchell, *Environmental Microbiology*, Wiley-Blackwell Publishing, 2nd Edition, 2009
4. Sawyer, C.N. and P.L. McCarty, G.F. Parkin 2003, Chemistry for Environmental Engineering, Fifth Edition, McGraw- Hill Book Company, New York.
5. Edward Kormondy, *Concepts of Ecology*, 4th Edition, Prentice Hall Publishing
6. EugenOdum, *Fundamentals of Ecology*, 5th Edition, Brooks/Cole Publishers

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

Civil Engineering	CE-624N	Physical-Chemical Processes	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

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

Water Quality, Gas Transfer-Gas Liquid Equilibrium, Two Film Theory, Kinetics, Oxygen Transfer, Aeration Systems, Ammonia Stripping, Coagulation-Colloids, Diffuse Layer Theory, Particle Stability, Mechanisms of Destabilization

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

Chemical Precipitation-Lime-Soda Softening, Split Treatment, Ion Exchange-Materials and Reactions, Ion Selectivity, Ion Exchange Equilibrium, Regeneration, Disinfection-Kinetics of Disinfection, Disinfectant Types, Available Chlorine, , Membrane Separation Processes, Desalination

Text Books and/or Reference Materials

1. Hendricks, D. 'Water Treatment Unit Processes – Physical and Chemical' CRC Press, New York 2006
2. Fair, Geyer and Okun, Water and Wastewater Engineering: VOi 1 &2 John Wiley & Sons 1978.
3. W.J. Weber, Physicochemical Processes for Water Quality Control, John Wiley & Sons, 1972.
4. Casey, T.J. Unit treatment processes in water and wastewater Engineering, John Wiley and Sons, London 1993
5. Sincero and Sincero, Environmental Engineering: A Design Approach, Prentice Hall India Learning, 2009.
6. Larry D Benefield, "Process Chemistry for water and wastewater Treatment", Prentice Hall Publications

Additional Learning Source

1. Metcalf and Eddy, Wastewater Engineering, Treatment and Reuse, 4th Edition, Tata McGraw Hill,New Delhi, 2003.
2. Web based sources.

Department	**Course No**	**Course Title**	**Course Designation**	**Pre-Requisites**	**Course Type**	**Credit Hours**	**Contact Hours**			**Total Contact Hours**
							L	**T**	**P**	
Civil Engineering	CE-625	Air Pollution and Control	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

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 SO_2, NO_x and SPM using high volume sampler, Ambient Air Quality Standards, Emission Standards

UNIT II-MATEOROLOGY 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

1. Richard W.Boubel et al, "Fundamentals of Air Pollution", Academic Press, New York, 2004.
2. Noel de Nevers, "Air Pollution control Engg." McGraw-Hill, New York,2005.
3. 3. M.N. Rao et al, "Air Pollution", Tata McGraw Hill, 2009.

Additional Learning Source

http://nptel.ac.in/courses/105102
http://mjcetenvsci.blogspot.in/2013/11/air-pollution-causes-effects-and.html

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-626	Biological Processes I	DC	B.Tech. Civil/ Chemical	Theory	4	3	1	0	4

Course Assessment Methods

1. Assignment and Quizzes (15%)
2. Mid Semester Examination (25%)
3. End Semester Examination (60%)

Course Objective

The objective of Biological Process – 1 is to prepare students to learn the basics of mass balance concepts, kinetics of biological treatment process which would help them to design biological Treatment Processes based on aerobic systems for water and wastewater treatment

Course Outcome

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

1. To understand the principles of behaviour of microorganisms in the treatment of municipal and industrial wastewaters.
2. To apply the concepts of kinetics and mass balance in the design of biological treatment systems for wastewater.

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

Aerobic Systems-Aerobic Biological Treatment, Kinetics of Organics Removal, Substrate Utilization and Biomass Growth, Monod's Kinetics, Estimation of Kinetic Parameters, Cell Yield, Sludge Settling, Nutrient Requirements, Activated Sludge Process Description and its Modifications, Process Design, Process Performance Evaluation and Troubleshooting, Extended Aeration, Design of Aeration Systems, Design of Secondary Settlers, Sludge Bulking and Foaming

Unit III

Biofilm Processes, Trickling Filter, Biotowers, Substrate Removal Attached Growth System, Rotating Biological Contactors, Oxidation Ditches, Stabilisation Ponds and Aerated Lagoons- Types and their Description, Design, Operation and Maintenance, Aerobic Digestion, Sequencing batch reactor and Process Design, Wetland Treatment Systems, Membrane Bioreactor, Moving Bed Biofilm Reactor

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

1. Metcalf and Eddy "Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition.
2. Rittman Bruce "Environmental Biotechnology", McGraw Hill Publications
3. Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications.
4. Syed R Qasim, "Wastewater Treatment Plants – Planning, Design and Operations, CRC Press

Additional Learning Source

1. Clifford W. Randall and Larry W. Benefield "Biological Process Design for wastewater Treatment". Prentice Hall Publications
2. Web based source

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-627	Industrial Wastewater Treatment	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

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

Industrial Waste Survey, Waste Characterization, Treated Effluent Disposal Standards, Effects of Industrial Wastewater on Receiving Water Bodies and Municipal Sewage Treatment Plants, Wastewater Sampling techniques, Flow Measurement, Waste Management Strategies and Programs, Waste Reduction-Volume and Strength Reduction, Flow Equalization and Proportioning

Unit II

pH control and Neutralization, Zero Discharge Concepts, Removal of Specific Pollutants in Industrial Effluents, Oil and Grease Removal, Removal of Inorganic and Organic Constituents, Overview of Wastewater Treatment Processes, Removal of Cyanides and Chromium

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

1. Eckenfelder, W.W., 'Industrial Water Pollution Control', Mc-Graw Hill, 2000.
2. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001.
3. Paul L. Bishop, 'Pollution Prevention: - Fundamentals and Practice', Mc-Graw Hill International, Boston, 2000.
4. Nelson, L. Nemerow(2000), Industrial water Pollution, Addison-Wesley Publishing Company.
5. Mahajan S.P. Pollution Control in Process Industries, Tata McGraw Hill Publishing Company,1998

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
							L	T	P	
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

Biofilter, UASB Reactor, Fluidised/Expanded Bed System, Ponds and Lagoon Design, Design of Nitrogen and Phosphorus Removal System, Disinfection Systems, Sludge Drying Beds

Text Books and/or Reference Materials

1. Metcalf and Eddy "Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition.
2. Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications.
3. Syed R Qasim, "Wastewater Treatment Plants – Planning, Design and Operations, CRC Press

Additional Learning Source

Web based learning

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-655	Biological Processes II	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

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

1. Metcalf and Eddy ”Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition.
2. R.E. Speece, “Anaerobic Biotechnology for Industrial Wastewaters” Archae Press USA
3. Ronald L Droste, “Theory and Practice of water and Wastewater Treatment”, Wiley Publications.
4. Syed R Qasim, “Wastewater Treatment Plants – Planning, Design and Operations, CRC Press

Additional Learning Source

1. G.L. Karia and R.A. Christian, “Wastewater Treatment Concepts and Design Approach” Prentice Hall Publications.
2. Web based source

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

Civil Engineering	CE-721	Water 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

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
Design of Chemical Mixing, Flocculation Process Design, Filter Design, Ion Exchange Process and Equipment Design
Unit IV
Sedimentation Tank Design, Membrane Unit Design, Chemical Precipitation, Disinfection and Sludge Handling

Text Books and/or Reference Materials

1. Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications
2. ASCE and AWWA. "Water Treatment Plant Design, Fifth Edition, McGraw Hill Publishing, 2012.
3. Qasim, S.R., Motley, E.M. and Zhu.G. Water works Engineering – Planning, Design and Operation, Prentice Hall, New Delhi, 2002
4. R.L.Sank, Water treatment plant for practising engineers, Ann Arbor Science.

Additional Learning Source

1. CPHEEO, Manual on water supply and Treatment, Ministry of Urban Development, GOl, New Delhi, 1999.
2. Web based sources

Department	**Course No**	**Course Title**	**Course Designation**	**Pre-Requisites**	**Course Type**	**Credit Hours**	**Contact Hours**			**Total Contact Hours**
							L	**T**	**P**	
Civil Engineering	CE-791E	Lab/Project	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

To provide hands-on experience with unit operations and processes commonly applied in modern environmental engineering research and practice.

Course Outcome

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.

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-780E	General Seminar	DC	B.Tech. Civil/ Chemical	Theory	--	-	2	0	2

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

1. Manser, M., Curtis, S., Pickering, D.: The Facts on File Guide to Good Writing.
2. Checkmark Books (2006).
3. How to Write a Seminar Report Paraphrasing and Summarizing by Han Xiao Institute of Informatics
4. TechnischeUniversit¨atM¨unchen, Germany xiaoh@in.tum.de January 30, 2013.

Additional Learning Source

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

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-781E	Preliminary Dissertation and Seminar	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

This is aimed at training the students to analyse independently any problem posedto 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 anenvironmental engineering system based on the social, economical andenvironmental 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

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-782E	Final Dissertation and Seminar	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

This is aimed at training the students to analyse independently any problem posedto 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
4. .Prepare technical report on the study carried out and publish the results

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-798E	Dissertation	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

This is aimed at training the students to analyse independently any problem posedto 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 anenvironmental engineering system based on the social, economical andenvironmental 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
4. Prepare technical report on the study carried out and publish the results

Departmental Electives

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-621N	Water Reclamation and Reuse	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

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

1. Metcalf and Eddy "Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill Edition.
2. Ronald L Droste, "Theory and Practice of water and Wastewater Treatment", Wiley Publications.

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-601	Higher Numerical Analysis	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

To introduce students with the numerical methods generally used in the engineering fields. The emphasis willbe 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

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-656	Solid and Hazardous Waste Management	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

1. Understanding of problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc.
2. Knowledge of legal, institutional and economic aspects of management of solid wastes.
3. Become aware of Environment and health impacts solid waste mismanagement
4. Understand engineering, financial and technical options for waste management

Course Outcome

Upon successful completion of this course, it is expected that students will be able to:

1. Explain municipal solid waste management systems with respect to its physical properties, and associated decisive considerations in view of emerging technologies
2. Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid and hazardous waste.
3. Select the suitable method for solid waste collection, transportation, redistribution and disposal.
4. Describe safe and engineered methods of disposal of municipal solid waste and hazardous waste

Topics Covered

Unit I

Municipal Solid Waste Characterization- Physical and Chemical Properties, Storage, Collection, Analysis of Collection System, Transportation, Reuse, Source Separation, Processing and Material Separation Techniques, Conveyors, Shredders, Screening, Magnetic Separation, Recycling and Resource Recovery

Unit II

Municipal Solid Waste Disposal- Sanitary Landfills- Landfill Cover and Liner, Design of Leachate Collection System, Leachate Treatment, Landfill Gas Collection and Recovery, Bioreactor Landfill, Composting, Anaerobic Digestion, Waste to Energy Conversion, Incineration, Pyrolysis and Gasification

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

Hazardous Waste Disposal, Incineration, Landfilling, Deep well Injection, Ground Water Contamination, Radioactive Waste-Sources, Health effects, Radioactive Waste Management, Medical and Infectious Waste, Construction and Demolition Debris, Electronic Waste

Text Books and/or Reference Materials

1. Tchobanoglous, G., H. Theisen and S. Vigil, 1993, *Integrated Solid Waste Management*, McGraw-Hill Inc. Singapore.
2. George Tchobanoglous (Author), Frank Kreith,*Handbook of Solid Waste Management*, McGraw-Hill Professional; 2 edition (2002)
3. Vesilind P.A., Worrell W. and Reinhart D.R., "Solid Waste Engineering", Thomson Books.

Additional Learning Source

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

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-658	Instrumental Methods for Environmental Analysis	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. 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

Principles of instrumentation. Laboratory experiments using advance electronic instrumentation, Ion selectivity electrodes- theory and applications. Principles in colorimetric and spectrophotometric analysis. Gravimetric analysis, colorimetric analysis. Electrochemical Methods: Working principles of Electrodes, Electro-Analytical Techniques

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 ENVIROMENTAL 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

1. DA Skoog, FJ Holler, SR Crouch. Principles of Instrumental Analyses, 6th Ed. Saunders,NY2007.
2. JM Miller.Chromatography: Concepts and Contrasts, 2nd Ed., John Wiley, New York, New York, 2005. HH Willard, LL Merritt Jr, JA Dean, FA Settle Jr. Instrumental Methods of Analysis, 7th Ed., Wadsworth, Belmont, California, 1988.
3. RM Silverstein ,GC Bassler, TC Morrill. Spectrometric Identification of Organic Compounds, 5th Ed., John Wiley, New York, New York, 1991.
4. LH Keith. Principles of Environmental Sampling, Amer. Chem. Soc., Washington DC, 1988.
5. JP Lodge Jr(Ed). Methods of Air sampling and Analysis, Intersociety Committee, Lewis Publishers, Boca Raton, FL, 1989. 7

Additional Learning Source

1. LS Clesceri, AE Greenberg, RR Trussell. Standard Methods for the Examination of Water and Wastewater, 20th Ed., Amer. Publ. Health Assoc., Washington DC.,1998

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-651	Engineering and the Environment	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

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
Unit II
Dams and Environment, Automobiles and the Environment, Batteries and the Environment
Unit III
Electric Power Plants, Refrigeration and the Environment, Global Climate and Hazards, Controlling Urban Smog, PCBs in the Environment
Unit IV
Energy Efficient Wastewater Treatment Technology, Human Exposure to Toxic Metals, CFCs and the Ozone Hole, Global Warming and the Greenhouse Effect, Economics and the Environment

Text Books and/or Reference Materials

1. Noel de Nevers, "Air Pollution control Engg." McGraw-Hill, New York,2005.
2. Gerard Kiely, “Environmental Engineering” McGraw-Hill, New York,2007

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-652	Transport and Dispersion of Pollutant	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

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 air 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

1. Thibodeaux, L.J, "Environmental Chemo dynamics: Movement Of Chemicals In Air, Water and Soil", edition 2., Wiley – Interscience, New York, 2006.
2. Cusssler, E.L, "Diffusion: Mass Transfer In Fluid Systems",Cambridge University press, 2004.
3. Water Quality Hazards And Dispersion Of Pollutants by WlodzimierzCzernuszenko, PawelRowinski. Publisher:springer. ISBN:0387233210.
4. Smagorinsky J. (1974). Global atmospheric modelling and numerical accumulation of climate. In Hess W.N. (ed.) Weather and Climate Modification., John Wiley and Sons, New York.
5. Pollutant Dispersion in Built Environment. byTingzhen Ming (Author), Chong Peng (Author), Tingrui Gong (Author), Zhengtong Li (Author). Publisher: Springer; 1st ed. 2017 edition (22 February 2017) Language: English ISBN-10: 981103820

Additional Learning Source

http://www.epa.gov/scram001/

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-653	Environmental Polices and Impact Analysis	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. 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

Environmental Management- Principles, Problems and Strategies, , Environmental Appraisal, Environmental Impact Factors and Areas of Consideration, Environmental Audit- Definitions and Concepts, Life Cycle Assessment, Environmental Impact Statement, Environmental Impact Factors and Areas of Consideration

Text Books and/or Reference Materials

1. Lawrence, D.P., "Environmental Impact Assessment - Practical solutions to recurrent problems", Wiley-Interscience, New Jersey 2003.
2. Petts, J., "Handbook of Environmental Impact Assessment", Vol., I and II, Conwell Science London. 2009.
3. Canter, L.W., "Environmental Impact Assessment", McGraw-Hill, New York. 2006
4. Biswas, A.K. and Agarwala, S.B.C.,"Environmental Impact Assessment for Developing Countries", Butterworth Heinemann, London. 2004
5. The World Bank Group, "Environmental Assessment Source Book Vol. I", II and III. The World Bank, Washington. 2001

Additional Learning Source

1. www.epa.ie/monitoringassessment/assessment/eia/
2. www.environmentallawsofindia.com/environmental-impact-assessment.html

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

Adsorption Processes-Fundamentals, Physical and Chemical Adsorption, Factors influencing adsorption, Carbon Adsorption, Adsorption Kinetics in Batch reactors, Breakthrough Curves, Adsorption Isotherms, Batch and Continuous Flow Systems, Design of GAC and PAC Adsorption Systems, Adsorbent Regeneration

Unit II

Advanced Oxidation Processes-Reactions of OH Radicals, UV/H_2O_2/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

Reverse Osmosis- RO Process Fundamentals, Modules, Water Flux, Rejection, Recovery, RO Process Design, Nanofiltration, Ultrafiltration, Microfiltration, Membrane Fouling and Scaling

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
2. Mahaela I Stephen, "Advanced Oxidation Process for water Treatment Fundamentals and Applicatons" American water works Association.

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

Identification of toxicants in water and wastewater treatment, dose-response relationship, effects of pollutants on biological treatment of wastewaters. Effects of environmental toxicants on humans and microorganisms.

Text Books and/or Reference Materials

1. Pelczar,*Microbiology*Tata McGraw-Hill Education, Aug-1998
2. Bruce E. Rittmann ,Perry L. Mccarty, *Environmental Biotechnology: Principles and Applications* McGraw-Hill Higher Education 2001
3. Ralph Mitchell, *Environmental Microbiology*, Wiley-Blackwell Publishing, 2nd Edition, 2009
4. Sawyer, C.N. and P.L. McCarty, G.F. Parkin 2003, Chemistry for Environmental Engineering, Fifth Edition, McGraw- Hill Book Company, New York.

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-659	Sludge Treatment and Disposal	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

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

1. B.R. Gurjar, Sludge Treatment and Disposal,CRC Press (2001).
2. CleversonVitorioAndreoli, Marcos Von Sperling, Sludge Treatment and Disposal, IWA Publishing, 2007

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-660	Statistical Procedures in Environmental Monitoring	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

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 anlysis, Risk assessment
Unit IV
Design of experiments, Optimisation Methods

Text Books and/or Reference Materials

Richard Gilbert, Statistical methods for environmental pollution monitoring, Van Nostrand Reinhold Company New York, 1987.

Department	Course No	Course Title	Course Designation	Pre-Requisites	Course Type	Credit Hours	Contact Hours			Total Contact Hours
							L	T	P	
Civil Engineering	CE-671	Industrial Water Treatment and Corrosion Control	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

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
2. Mars G Fontana, “Corrosion Engineering” McGraw Hill Publication
3. Natarajan Manivasakam, “Industrial Water Quality Requirements”, Chemical Publishing Book.
4. James W McCoy, “The Chemical Treatment of Boiler water” Chemical Book Publishing

Additional Learning Source

1. Natarajan Manivasakam, “Industrial Water Analysis Handbook”, Chemical Publishing Book.
2. Web based source