



# SIR PADAMPAT SINGHANIA UNIVERSITY

Udaipur

## SCHOOL OF ENGINEERING

### Course Curriculum of 2-Year M. Tech. Degree Programme in Environmental Engineering (Batch- 2018-20)

#### Credit Structure

Postgraduate Core (PC)		Postgraduate Elective (PE)	
Category	Credits	Category	Credits
Departmental Core Subjects	28	Departmental Electives	12
Dissertation, Seminar, Viva	17		
Basic Sciences	3		
Total	48	Total	12
		Grand Total	60

## Distribution of Total Credits & Contact Hours in all Semesters

<b>S. No.</b>	<b>Semester Number</b>	<b>Credits/Semester</b>	<b>Contact Hours/Week</b>
1	I	16	17
2	II	17	19
3	III	15	20
4	IV	12	18
Total		60	-

## Course Structure: M. Tech. (Env.) 2018-20

### Semester - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-569	Environmental Statistical Methods	3	0	0	3
2	CE-570	Environmental Microbiology & Ecology	3	0	0	3
3	CE-582	Air & Noise Pollution	3	0	0	3
4	CE-584	Advanced Environmental Chemistry	3	0	1	4
5	MA-555	Advanced Engineering Mathematics	3	0	0	3
Total Credits						16
Total Contact hours/week						17

### Semester - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-564	Environmental Impact Assessment	3	0	0	3
2	CE-572	Design & operation of water & waste water	3	0	0	3
3	CE-5XX	Departmental Elective - I	3	0	0	3
4	CE-5XX	Departmental Elective - II	3	0	0	3
5	ME-555	Finite Element Methods in Engineering	3	0	2	5
Total Credits						17
Total Contact hours/week						19

### Semester - III

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-577	Environmental System Optimization & Modeling	3	1	0	4
2	CE-5XX	Departmental Elective - III	3	0	0	3
3	CE-5XX	Departmental Elective - IV	3	0	0	3
4	CE-580A	Dissertation - I	0	0	5	5
Total Credits						15
Total Contact hours/week						20

### Semester - IV

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-580B	Dissertation - II	0	0	9	9
2	CE-580C	Dissertation Viva Voce	-	-	-	3
Total Credits						12
Total Contact hours/week						18

### List of Departmental Elective(s) - I

S. No.	Course Code	Course Title	L	T	P	Credit
1	CE-574	Waste Treatment Systems	3	0	0	3
2	ME-575	Industrial Noise Control	3	0	0	3

### List of Departmental Elective(s) - II

S. No.	Course Code	Course Title	L	T	P	Credit
1	CE-575	Solids & Hazardous Waste Management	3	0	0	3
2	CE-576	Rural Sanitation Engineering	3	0	0	3

### List of Departmental Elective(s) - III

S. No.	Course Code	Course Title	L	T	P	Credit
1	CE-578	Bioremediation	3	0	0	3
2	CE-579	Industrial Waste Management	3	0	0	3

### List of Departmental Elective(s) - IV

S. No.	Course Code	Course Title	L	T	P	Credit
1	CE-581	Advanced Environmental Management	3	0	0	3
2	CE-585	Environmental Policies & Legislation	3	0	0	3

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**Semester - I**

**(Departmental Core Subject)**

CE-569	L-T-P-C
Environmental Statistical Methods	3-0-0-3

**Objective:** *The course is designed to offer knowledge about the application of mathematical models for biological application. It provides fundamental ideas on the useful of data analysis, interpretation & inference including plan for future investigation based on experimental data collected from the conduct of biological experiments.*

**Course Content**

Distribution: Binomial, Poisson & Normal distributions - Definitions, Simple problems only (Derivations not included).

Curve Fitting: Principle of Least Squares, Fitting of straight line & parabola - Correlation - Karl Pearson's coefficient of correlation & Spearman's rank correlation - Linear regression.

Sampling Distributions: Sampling Distributions - Tests based on Normal, t, Chi-Square & F-Distributions.

Applications of Variances: One way & Two way classification. Completely Randomized Design - Randomized Block Design - Latin square Design.

Queuing Models: Single & multiple server Markovian queuing models - M/M/1 & M/M/c queuing models & Applications (Derivations not included).

**Text/Reference Books**

1. Fundamentals of Mathematical Statistics. Gupta S.C. & Kapoor V.K. Sultan Chand & sons. Reprint 2003.
2. Probability Statistics & Random Processes. Veerarajan T. TMH. First reprint. 2004.

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**Semester - I**

**(Departmental Core Subject)**

CE-570  
Environmental Microbiology & Ecology

L-T-P-C  
3-0-0-3

**Objective:** *To develop a basic knowledge about the concept of environmental microbiology & apply the same in the field application.*

**Course Content**

Microorganisms - Classification, prokaryotic & eukaryotic cells. Structure, characteristics, nucleic acids, DNA, RNA.

Growth Systems: Microbiology of biological treatment process. Aerobic microorganisms- Anaerobic microorganisms-their environment-Attached & suspended growth systems.

Microbial Treatment: Hydrolysis - Acidogenesis - Acetogenesis - Methanogenesis - Rate of limiting steps Immobilization advantages - Difference between aerobic & anaerobic treatment.

Distribution of Microorganisms: Distribution of microorganisms, coliforms-faecal coliforms - E.coli, Streptococcus faecalis & clostridium welchii, differentiation of coliforms-significance-MPN index.

Ecotoxicology: Ecotoxicology - effects, bioaccumulation - bio-magnification-bioassay-bio monitoring - Saline microbes & their role in salt. Marine eco toxicological testing with organisms with zooplankton/ sea weed.

**Text/Reference Books**

1. Microbiology Pelczar, Jr., M.J., E.C.S., Krieg Noe R. & Pelczar M. F. 5<sup>th</sup> Ed. Tata McGraw Hill Publishing Company Limited. 2006.
2. General Microbiology. Stainer R.Y., Ingraham J.L., Wheelis M.C & Painter P.R. Mac Millan Ed. Ltd. London. 2009.

3. Biological processes in pollution control. Pichai R. & Govindan V.S. Anna University. 2008.



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**Semester - I**

**(Departmental Core Subject)**

CE-582  
Air & Noise Pollution

L-T-P-C  
3-0-0-3

**Objective:** *With increasing noise & air pollution nationally & globally, it is necessary to be familiar with basic information regarding air & noise pollution to allow proper assessment of impacts arising from the various projects or activities & devising appropriate mitigation or control measures.*

**Course Content**

Sources of Air Pollution: Stationary & mobile, fugitive emissions, secondary pollutants; Effects of air pollution in regional & global scale, air pollution episodes; Emission factors, inventory & predictive equations.

Atmospheric Meteorology: Wind profiles, turbulent diffusion, topographic effects, separated flows, temperature profiles in atmosphere, stability, inversions, & plume behavior.

Air Quality Monitoring: Objectives, time & space variability in air quality; air sampling design, analysis & interpretation of air pollution data, guidelines of network design in urban & rural areas. Stack monitoring. Air pollution standards & indices. Dispersion of air pollutants & modeling, Basic concepts, inversion layer & mixing height, atmospheric stability classes, theory & application of acoustic sounding (SODAR) technique. Box model, the Gaussian dispersion model point, area & line sources. Prediction of effective stack height physics of plume rise, Holland's equation, Briggs equation, etc. modifications of Gaussian dispersion models; indoor air quality models. Air Pollution control devices.

Effects of Air Pollution & Air Monitoring Instruments: Human, health, plants, animals & microbes archeological monuments & aesthetics, Orsat apparatus, respirable dust sampler & source monitors.

Noise Pollution: Basics of acoustics & specification of sound; sound power, sound intensity & sound pressure levels; plane, point & line sources, multiple sources; outdoor & indoor noise propagation; psycho-acoustics & noise criteria, effects of noise on health, annoyance rating schemes; special noise environments: Infra-sound, ultrasound, impulsive sound & sonic boom; noise standards & limit values; noise instrumentation & monitoring procedure. Noise indices.

### **Text/Reference Books**

1. Environmental Engineering. Arcadio P.S. & Gregoria A.S. Prentice Hall of India. 1999.
2. Environmental Pollution Control Engineering. Rao C.S. Wiley Eastern Ltd., New Delhi. 1996.
3. Environmental Noise Pollution. Cunniff P.E. McGraw Hill. New York. 1987.
4. Handbook of Noise Measurement. Peterson A.P.G. & Gross P.H. Englewood cliffs New Jersey. Latest Ed.
5. Air Pollution Control Equipment. Brauer E. & Verma Y.B.G. Berlin Heidelberg. 2012.

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**Semester - I**

**(Departmental Core Subject)**

CE-584	L-T-P-C
Advanced Environmental Chemistry	3-0-1-4

**Objective** *At the end of the course the student will be able to understand the fundamental principles of environmental chemistry, water chemistry required in the treatment processes of water & wastewater, to analyze the growth kinetics of microorganisms & to understand the processes in biological treatment systems.*

**Course Content**

General Chemistry:-Basic principles - chemical equations - types of chemical reactions - calculations from chemical equations; gas laws; Equilibrium & Le Chatelier's Principle - factors affecting chemical equilibrium - activity & activity coefficient - ionic strength.

Physical Chemistry:- Thermodynamics - heat & work - enthalpy - entropy - free energy - temperature dependence of equilibrium constant; membrane processes; principles of solvent extraction; ; electrochemistry; chemical kinetics; adsorption.

Equilibrium Chemistry:-Variations of Equilibrium relationships; ways of shifting chemical equilibrium; solutions to equilibrium problems - acid base equilibrium - solubility equilibrium - oxidation reduction equilibrium.

Organic Chemistry & Biochemistry:-Organic compounds of interest to environmental engineers, general properties of the functional groups of organic compounds; Enzymes, classification enzymes catalyzed reaction, energy considerations coupling of reaction; Breakdown & synthesis of carbohydrates, fats, proteins under aerobic & anaerobic reactions; CNP cycles under aerobic & anaerobic reactions;. Concepts of BOD, COD, TOC.

Environmental Chemistry:-Fundamentals of surface & colloidal chemistry; chemistry involved in water treatment procedure like coagulations - softening - fluoridation, defluoridation - iron & manganese removal - demineralization - analysis of pesticide & heavy metals; Atmospheric chemistry; soil chemistry.

Environmental Microbiology:- Introduction of microbiology, classification & characterization of microorganisms, viruses; Morphology & structure of bacteria, nutrient requirement, growth of bacteria; Basic microbiology of water & sewage; Basic principals involved in the analysis of fecal indicator bacteria - coli forms & streptococci, plankton analysis, analysis of pseudomonas & streptococci; Pathways of aerobic & anaerobic metabolism, Energy transfer in metabolism, kinetics of microbial growth.

### **List of Experiments**

1. Identify & analyze physical parameters of water & waste water.
2. To determine the concentration of chlorides, fluorides, hardness, DO & other quality parameters.
3. To estimate BOD & COD of given waste water sample.
4. To determine bacterial count in a given sample.

### **Text/Reference Books**

1. Process Chemistry for Water & Wastewater Treatment. Benefield D.L., Judkins F. J. & Weand L.B. 1<sup>st</sup> Ed. Prentice Hall. 1982.
2. Wastewater Microbiology. Bitton G. 3<sup>rd</sup> Ed. Wiley. 2005
3. Environmental Microbiology. Mitchell R. & Gu J.D. 2<sup>nd</sup> Ed. Wiley-Blackwell. 2010.
4. Chemistry for Environmental Engineering & Science. Sawyer C. N., McCarty P. L. & Perkin G.F. 5<sup>th</sup> Ed. McGraw-Hill Inc. 2002.

# Detailed Syllabus for M. Tech. Degree Programme in Environmental Engineering

## Semester - I

### (Basic Sciences Subject)

MA-555 L-T-P-C  
Advanced Engineering Mathematics 3-0-0-3

**Objective:** *To impart in depth knowledge of various mathematical tools applied to diversified problems in structural engineering.*

#### Course Content

Vector & Tensor Analysis in Cartesian system, effect of rotation of coordinate systems. Review of ODEs; Laplace & Fourier methods, series solutions, & orthogonal polynomials. Sturm-Liouville problem. Review of 1st & 2nd order PDEs. Linear systems of algebraic equations. Gauss elimination, LU decomposition etc., Matrix inversion, ill-conditioned systems. Numerical Eigen solution techniques (Power, Householder, QR methods etc.). Numerical solution of systems of nonlinear algebraic equations; Newton-Raphson method. Numerical integration: Newton-Cotes methods, error estimates, Gaussian quadrature. Numerical solution of ODEs: Euler, Adams, Runge-Kutta methods, & predictor-corrector procedures; stability of solutions; solution of stiff equations. Solution of PDEs: finite difference techniques. Probability & Statistics - Probability Distribution, Bays Theorem, Parameter Estimation, Testing of Hypothesis, Goodness of Fit. Laboratory: Basics of programming. Numerical experiments with the algorithms covered in class.

#### Texts/Reference Books

1. Advanced Engineering Mathematics. Kreyzig E. New Age International. 1996.
2. Fundamentals of Matrix Computations. Watkins D. S. John Wiley. 1992.
3. Numerical Methods for Scientific & Engineering Computation. Jain M.K., Iyenger S.R.K. & R.K. Jain. 3rd Ed., New Age International, 1993

4. Continuum Mechanics. Chandrashekaraiah D.S. & Debnath L. Academic Press. 1994.
5. Computational Methods for Partial Differential Equations. Jain M.K., Iyenger S.R.K. & R.K. Jain. New Age International. 1994.
6. Methods of Mathematical Physics. Courant R. & Hilbert D. Wiley. 1989.
7. Advanced Engineering Mathematics. O'Neil P.V. Cengage Learning. 2007.
8. Mathematical Methods for Physicists. Arfken G.B., Weber H.J. & Harris F. 5<sup>th</sup> Ed. Academic Press.

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**Semester - II**

**(Departmental Core Subject)**

CE-564	L-T-P-C
Environmental Impact Assessment	3-0-0-3

**Objective:** *To make the students aware of the several norms, policies, rules & regulations of the Environmental Impact Assessment.*

**Course Content**

Introduction, Historical development of EIA, EIA in project cycle, Legal Aspects & objectives of EIA, General Methodology, Public participation in EIA, different components of EIA, mathematical modeling for impact prediction, cumulative impact assessment, documentation of EIA findings, Environmental impact analysis, Mitigation & impact management, case studies & environmental auditing. Concept of socio-economic impact assessment.

**Text/Reference Books**

1. Environmental Impact Assessment - Practical solutions to recurrent problems. Lawrence D.P. Wiley-Interscience. New Jersey. 2003.
2. Environmental Impact Assessment. Canter L.W. McGraw Hill. New York. 1996.

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**Semester - II**

**(Departmental Core Subject)**

CE-572	L-T-P-C
Design & Operation of Water & Waste Water	3-0-0-3

**Objective** *To develop a basic knowledge about the concept of design & operation of water & wastewater & apply the same in the field application.*

**Course Content**

Design of Conventional Water Treatment Units:-Design of conventional water treatment units, - Aeration, chemical dosing tanks, Flash mixers, Flocculators, Sedimentation tanks, Clariflocculators, filter beds, disinfection units - hydraulic profile & layout of conventional treatment units - upgrading of existing plants - Residue management.

Design of Sewage Treatment Plant Units:-Design of sewage treatment plant units - screen chamber, Grit chamber with proportional flow weir, sedimentation tank - Trickling filters, Rotating Biological contactor, activated sludge process & variations, aerated lagoons, waste stabilization ponds - reclamation & reuse - Flow charts, layout, hydraulic profile.

Design of Biological Units:-Attached & suspended growth, Design of units - UASB, up flow filters, Fluidised beds - septic tank & disposal - Layout & Hydraulic profile - Recent advances.

Design of Sludge Units:-Design of Sludge management facilities, sludge thickening, sludge digestion, Biogas generation, sludge dewatering (mechanical & gravity) - upgrading existing plants - ultimate residue disposal - Recent Advances.

Practical Applications: Operational problems - Trouble shooting, Planning, Organising & Controlling of plant operations - capacity building, Case studies on sewage treatment plants - sludge management facilities.



**Texts/Reference Books**

1. Manual on Water Supply & Treatment. CPHEEO. Ministry of Urban Development GOI. New Delhi. 2009.
2. Manual on Sewerage & Sewage Treatment. CPHEEO. Ministry of Urban Development Gol. New Delhi. 2009.
3. Wastewater Engineering, Treatment & Reuse. METCALF & EDDY I. 3<sup>rd</sup> Ed. Tata McGraw-Hill Publishing Company Limited. New Delhi. 2012.
4. Wastewater treatment for pollution control. Arceivala S.J. TMH. New Delhi. 2001.
5. Wastewater Treatment Plant, Planning, Design & Operation. Qasim S.R. Technomic Publications. 2004.

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**Semester - II**

**(Departmental Core Subject)**

ME-555	L-T-P-C
Finite Element Methods in Engineering	3-0-2-5

**Objective:** *To build up the back ground, basic concepts & basic formulation of finite element method to enable the students to understand various element formulations & use them for analysis including programming.*

**Course Content**

Historical background, basic concept of the finite element method, comparison with finite difference method; Variational methods: calculus of variation, the Rayleigh-Ritz and Galerkin methods; Finite element analysis of 1-D problems: formulation by different approaches (direct, potential energy & Galerkin); Derivation of elemental equations & their assembly, solution & its post processing. Applications in heat transfer, fluid mechanics & solid mechanics. Bending of beams, analysis of truss & frame. Finite element analysis of 2-D problems: finite element modelling of single variable problems, triangular & rectangular elements; Applications in heat transfer, fluid mechanics & solid mechanics; Numerical considerations: numerical integration, error analysis, mesh refinement. Plane stress & plane strain problems; Bending of plates; Eigen value & time dependent problems; Discussion about preprocessors, postprocessors & finite element packages.

**List of Experiments**

1. Determination of load required to achieve a desired total extension of the spring.
2. Stress analysis of tapered cantilever with two load cases.
3. Simulation of tuning fork & to compute fundamental eigen mode of tuning fork.

4. Simulation of swirl flow around a rotating disc.
5. Modeling of air box around a device in order to model convective cooling in the box & to determine total heat flux on a boundary of heat sink.
6. Simulation of 1-D Heat transfer with radiation.
7. Simulation of 2-D Heat transfer with convective cooling.

**Text/Reference Books**

1. An introduction to the Finite Element Method. Reddy J.N. McGraw-Hill New York.1993.
2. Concepts & Applications of Finite Element Analysis. Cook. R.D., Malkus D.S. & Plesha M.E. 3<sup>rd</sup> Ed. John Wiley New York. 1989.
3. Finite Element Procedures in Engineering Analysis. Bathe K.J. Prentice-Hall, Englewood Cliffs, NJ, 1982.

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**Semester - III**

**(Departmental Core Subject)**

CE-577	L-T-P-C
Environmental System Optimization & Modeling	3-1-0-4

**Objective:** *To impart in depth knowledge with various methods of optimization related to environmental engineering.*

**Course Content**

Systems Approach Concept & Analysis: Model Classification, Terminology of Models, Model Building, Fundamental of Modeling, Transport Law, Chemical Equilibrium, Phase Equilibrium Routh's Law, Relative Velocity & Chemical Kinetics.

Process Modeling: Linear equilibrium system, Batch Reactor, pH system, Planning Models, Municipal solid waste management, Integrated Solid waste Management, Reuse & Recovery in paper, Plastic, glass & aluminum waste.

Water Modeling: Modeling of wastewater management systems. Modeling of pesticide management; Modeling of Modeling of municipal wastewater treatment, Model formulization & their solution, Numerical Techniques of Linear equations, Matrix inversion method, Gasses elimination & gas sidal method.

Programming Model: Silent feature of optimizations, Linear programming problem, Simplex method, Principles of problem in dual problem. Direct simplex method, Graphical Method - Optimum solution & their analysis (Minimization & Maximization) At least one problem of each method along with optimum solution.

Air Dispersion Mode: Pollutant standard index criteria, toxic air pollutants, Motor vehicle emission, the point source Gaussian Plume models, Transportation Models & Empirical equations related to air pollution dispersion models.

**Text/Reference Books**

1. Handbook of Environmental & Ecological Modeling. Halling S. B. Nielsen S.N. & Jorgensen S.E. Lewis Publishers Inc. 1995.
2. Fundamentals of Atmospheric Modeling. Jacobson M. Z. Kluwer Academic Press. 2002.
3. An Introduction to Water Quality Modeling. James A. 2<sup>nd</sup> Ed. 1992.
4. Techniques for Environmental System Analysis. Pantell R.H. Wiley. NY. 2001.
5. System Analysis & Design. Aguilar R.J. & Prentice H. Englewood Cliffs. N.J. 1993.

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**Semester - III**

**(Departmental Core Subject)**

CE-580A  
Dissertation - I

L-T-P-C  
0-0-5-5

**Course Content**

The Dissertation for M.Tech programme consists of two parts: Dissertation - I & Dissertation - II. Dissertation - I is undertaken during the III Semester. The Dissertation is by far the most important single piece of work in the post-graduate programme. It provides the opportunity for student to demonstrate independence & originality, to plan & organize a large Dissertation over a long period & to put into practice some of the techniques students have been taught in the course. Students will choose a dissertation, in consultation with a faculty member, who will act as the Supervisor. Dissertation involves a combination of sound background research, a solid implementation, or piece of theoretical work, & a thorough evaluation of the dissertation's output in both absolute & relative terms. The very best dissertations invariably covers some new ground, e.g. by developing a complex application which does not already exist, or by enhancing some existing application or method to improve its functionality, performance etc. The student will prepare the Dissertation report as per the prescribed format/guidelines, & present the same as a seminar at the end of the semester. The Dissertation will be evaluated continuously over the span of the III Semesters, as per the approved procedure.

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**Semester - IV**

**(Departmental Core Subject)**

CE-580B  
Dissertation - II

L-T-P-C  
0-0-9-9

**Course Content**

After completion of Dissertation - I, students will undertake the Dissertation - II in the IV Semester. The idea conceived & progress made in the Dissertation-I shall be extended as Dissertation - II under the supervision of a faculty member. Students shall complete the theoretical & practical aspect of the project. Thereafter they will prepare a report, as per the prescribed format/ guidelines, incorporating the results, their analysis & interpretation. The report, duly certified by the Supervisor, should be submitted to the Head of the Department. The report should also be presented as a seminar at the end of the semester. Progress made by the student will be continuously monitored throughout the semester & evaluated as per the approved procedure.

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**Semester - IV**

**(Departmental Core Subject)**

CE-580C  
Dissertation Viva Voce

L-T-P-C  
0-0-0-3

**Course Content**

Dissertation Viva Voce is the verbal defense of the dissertation carried out by the student in front of a panel of examiners. The objective of Viva Voce examination is to confirm that the piece of work submitted as a dissertation is student's own work, he/she has a sound understanding of the subject of the dissertation, aware of the recent works in the area of dissertation, methodology adopted, & importance/relevance/merits of the output in relation with the existing results in the area.



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**Semester - II**

**(Departmental Elective - I)**

CE-574  
Waste Treatment Systems

L-T-P-C  
3-0-0-3

**Objective:** *At the end of the course the student will be able to identify & assess the characteristics of waste water & their impacts, plan & design the components of waste water treatment systems, understand underlying principles of processes involved in secondary waste water treatment systems & to design sludge treatment & disposal methods.*

**Course Content**

Introduction: Wastewater Characteristics, Standards of Disposal, Treatment Objective & Strategies, Layouts of Primary, Secondary & Advanced Treatment Units.

Design of Preliminary & Primary Treatment Operations: Screens, Grit Chambers, Skimming Tank, Primary & Secondary Sedimentation Tanks.

Biological Treatment Processes: Types, Kinetics of Plug Flow & Completely Mixed Systems.

Attached Growth Processes: Trickling Filters (Standard Rate, High Rate), Biofilters, Practices, Features & Design, Operational Difficulties & Remedial Measures, Rotating Biological Contactors.

Suspended Growth Processes: Activated Sludge Process, Modifications & Design Equations, Process Design Criteria, Oxygen & Nutrient Requirements - Classification & Design of Oxidation Ponds, Lagoons.

Sludge Treatment And Disposal: Sludge Thickening, Aerobic & Anaerobic Sludge Digestion Processes, Design of Digester Tank, Sludge Dewatering, Ultimate Disposal, Sludge Drying Beds, Other Methods of Sludge Treatment.

**Text/Reference Books**

1. Biological Process Designs for Wastewater Treatment. Benefield L.D. & Randall C.D. Prentice Hall Pub. Co. 1980.
2. Wastewater Engineering - Collection, Treatment, Disposal & Reuse. Metcalf & Eddy. 4th Ed. McGraw Hill Pub. Co. 2003.
3. Fundamentals of Biological Wastewater Treatment. Wiesmann U, Choi S In & Dombrowski E.M. 1<sup>st</sup> Ed. Wiley. 2007.

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**Semester - II**

**(Departmental Elective - I)**

ME-575  
Industrial Noise Control

L-T-P-C  
3-0-0-3

**Objective:** *This course discusses the noise measurement, their sources & control methods & mechanisms in detail.*

**Course Content**

Principles of sound generation & propagation, sound attenuation, sound absorption, sources of industrial noise, effects of noise, noise measurement units & instruments, identification of source of noise, noise evaluation procedures, acoustical enclosures, design of reactive & absorptive mufflers, active noise control, designing for quieter machines & processes, case studies.

**Text/Reference books**

1. Noise & Vibration Control. Beranek L.L. McGraw-Hill. 1971.
2. Industrial Noise & Vibration Control. Irwin J.D. & Graf E.R. Prentice Hall. 1979.
3. Handbook of Noise Control. Harris C.M. McGraw-Hill. 1979.
4. Noise Control in Internal Combustion Engines. Baxa. Wiley. 1982.
5. Noise Control for Engineers. Lord H.W., Gately W.S. & Evensen H.A. McGraw-Hill. 1987.
6. Machinery Noise & Diagnostics. Lyon R. H. Butterworths. 1987.

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**Semester - II**

**(Departmental Elective - II)**

CE-575  
Solids & Hazardous Waste Management

L-T-P-C  
3-0-0-3

**Objective:** *At the end of the course the student will be able to examine physical & chemical composition of hazardous wastes, analyze activities associated with the management of solid waste, understand method to recover materials, conserve products & to generate energy from solid & hazardous wastes & to design & locate waste containment systems as per regulatory standards.*

**Course Content**

Solid Waste: Definitions, Characteristics, And Perspectives Types of solid wastes, sources of solid wastes, properties of solid wastes, solid waste management: an overview

Engineering Systems for Solid Waste Management: Solid waste generation; on-site handling, storage & processing; collection of solid wastes; transfer & transport; processing techniques; ultimate disposal.

Engineering Systems for Resource & Energy Recovery: Processing techniques; materials-recovery systems; recovery of biological conversion products; recovery of thermal conversion products; recovery of energy from conversion products; materials & energy recovery systems.

Hazardous Waste Management: Introduction; Concern about Hazardous Waste Management; Characteristics of Hazardous Waste; Transportation & Disposal of Hazardous Waste; Control of Hazardous Waste.

**Text/Reference Books**

1. Integrated Solid Waste Management - Engineering Principles & Management Issues. Tchobanoglous G, Theisen H & Vigil SA. McGraw-Hill. 1993.

2. Solid Waste Engineering. Vesilind P.A., Worrell W. & Reinhart D. Brooks/Cole Thomson Learning Inc. 2002.
3. Environmental Engineering. Peavy, H.S., Rowe D.R. & Tchobanoglous G. McGraw Hill Inc. New York. 1985.

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**Semester - II**

**(Departmental Elective - II)**

CE-576  
Rural Sanitation Engineering

L-T-P-C  
3-0-0-3

**Objective:** *The subject deals with the concepts of identifying the problems pertaining to sanitation & designing low cost waste management systems.*

**Course Content**

Rural Sanitation: Introduction to rural sanitation- Community & sanitary latrines - Planning of wastewater collection system in rural areas- Treatment & Disposal of wastewater - Compact & simple wastewater treatment units & systems in rural areas- stabilization ponds - septic tanks - Imhoff tank- soak pits- low cost excreta disposal systems- Effluent disposal.

Industrial Hygiene And Sanitation: Occupational Hazards- Schools- Public Buildings Hospitals- Eating establishments- Swimming pools - Cleanliness & maintenance & comfort- Industrial plant sanitation.

Solid Waste Management: Disposal of Solid Wastes- Composting- land filling incineration- Biogas plants - Rural health - Other specific issues & problems encountered in rural sanitation.

**Text/Reference Books**

1. Municipal & Rural Sanitation. Eulers V.M. & Steel E.W. 6<sup>th</sup> Ed. McGraw Hill Book Company. 1965.
2. Text Book of Preventive & Social Medicine. Park J.E. & Park K. Banarsidas Bhanot. 1972.
3. Rural Water Supply & Sanitation. Wright F.B. & Robert E. Krieger Publishing Company. Huntington. New York. 1977.

4. Environmental History of Water: Global Views on Community Water Supply & Sanitation. Juuti P., Tapio S. K. & Vuorinen H. IWA Publishing (Intl Water Assoc). 2007.

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Environmental Engineering**

**Semester - III**

**(Departmental Elective - III)**

CE-578  
Bioremediation

L-T-P-C  
3-0-0-3

**Objective:** *The subject deals with the fundamental principles of bioremediation processes, identification of bioremediation processes for different pollutants.*

**Course Content**

Fundamental Aspects of Environmental Microbiology Structure & Functions of Prokaryotic Cells -Structure & Functions of Eukaryotic Cells.

Taxonomy of Microorganisms: Bacteria- Algae, Fungi & Protozoa -Study of Microbial Structure -Light Microscopy -Dark-field & Phase-contrast Microscopy - Electron Microscopy -Environmental Significance of Bacteria, Fungi, & Algae - Microbial Metabolism, Growth & Biokinetics - Microbial Nutrition & Metabolism - Microbial Growth & Energy - Enzymes & Their structures - Biokinetic Models - Batch & Continuous Chemostat Studies - Determination of Biokinetic Parameters

Microbiology Reactions Suspended Growth Reactors - Biofilm Reactors - Batch Reactors - Completely Stirred Tank Reactors - Plug Flow Reactors - Reactors in Series - Engineering Design of Reactors. Biofilm Processes Trickling Filters & Biological Towers

Bioremediation for Soil Environment: Environment of Soil Microorganisms -Soil Organic Matter & Characteristics -Soil Microorganisms Association with Plants - Pesticides & Microorganisms -Petroleum Hydrocarbons & Microorganisms.

**Text/Reference Books**

1. Bioremediation Principles. Ergas, S.J., Chang D.P.Y., Schreoder E.D. & Eweis J.B. WCB/McGraw-Hill. 1998.



2. Environmental Biotechnology: Principles & Applications. Rittmann B.E. & McCarty P.L. McGraw Hill. 2001.

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**Semester - III**

**(Departmental Elective - III)**

CE-579  
Industrial Waste Management

L-T-P-C  
3-0-0-3

**Objective:** *The subject deals with the concepts of identifying & designing treatment options for handling industrial wastewater involving the effects of disposal of industrial wastes.*

**Course Content**

Introduction: General Characteristics of Industrial Effluents, Effects on Environment - ISI tolerance limits for discharging industrial effluents into surface water, into public sewers & onto land for irrigation - Toxic chemicals from industry.

Pretreatment Of Industrial Wastewater: Necessity of pretreatment - Equalization - Segregation - Process Changes - Salvaging - By product Recovery. Removal by Reverse Osmosis, Ion Exchange, Electro dialysis, Solvent Extraction, Floatation. - Removal of Refractory Organics -Removal of Nitrogen & Phosphorus. Major Industrial Effluents: Sources, Characteristics & treatment.

Food Industries: Sugar, Dairy, Distilleries

Chemical Industries: Paper & Pulp, Tanneries, Textiles, Fertilizers, Pharmaceuticals, Cement & Steel.

**Text/Reference Books**

1. Industrial Wastewater Management, Treatment & Disposal. WEF Manual of practice No. FD-3. 3<sup>rd</sup> Ed. WEF Press & McGraw Hill. 2008.
2. Liquid Waste from Industry - Theories, Practice & Treatment. Numersorn N.L. Addison-Wesley. 1971.
3. Industrial Waste Water Treatment. Patwardhan A.D. PHI Learning. 2009.
4. Wastewater Treatment. Rao M.N. & Dutta A.K. IBH Publ. 1995.

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**Semester - III**

**(Departmental Elective - IV)**

CE-581	L-T-P-C
Advanced Environmental Management	3-0-0-3

**Objective:** *The subject deals with the concepts of strategies & polices used to promote cleaner production in industry & identifying strategies & polices used to promote cleaner production in industry.*

**Course Content**

Environmental Management Standards: Development, trade & environment linkages - Environmental guidelines - Business & Citizen Charters for Sustainable Production & Consumption - National policies on environment, abatement of pollution & conservation of resources - Environmental quality objectives - Environmental standards - Concentration & Mass standards Effluent & stream standards - Emission & ambient standards -Minimum national standards - Measuring performance evaluation: Indicators, Benchmarking - Systems approach to environmental management

Preventive Environmental Management: Pollution control vis a vis Pollution Prevention - Opportunities & Barriers - Cleaner production & Clean technology, closing the loops, zero discharge technologies - source reduction, raw material substitution, toxic use reduction & elimination, process modification - Cleaner Production Assessment- Material or resource balance - CP option generation & feasibility analysis

Environmental Management System: EMAS, ISO 14000 - EMS as per ISO 14001- benefits & barriers of EMS - Concept of continual improvement & pollution prevention - environmental policy - initial environmental review - aspect & impact analysis - legal & other requirements objectives & targets - environmental management programs - structure & responsibility - training awareness & competence- communication -

documentation & document control - operational control - monitoring & measurement - management review.

Environmental Audit & Applications: Environmental management system audits as per ISO 19011- Roles & qualifications of auditors - Environmental performance indicators & their evaluation - Non-conformance - Corrective & preventive actions -compliance audits - waste audits & waste minimization planning - Environmental statement.

### **Text/Reference Books**

1. Environmental Management Systems & Cleaner Production. Hillary R. Wiley Publishers. 1997.
2. Installing Environmental management Systems - a step by step guide. Sheldon C. & Yoxon M. Earthscan Publications Ltd. London. 1999.
3. ISO 14001/14004: Environmental management systems - Requirements & Guidelines - International Organisation for Standardisation. 2004.
4. Environmental Management Systems: An Implementation Guide for Small & Medium-Sized Organizations. <sup>2nd</sup> Ed. NSF International. Ann Arbor. Michigan. January 2001.

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in  
Environmental Engineering**

**Semester - III**

**(Departmental Elective - IV)**

CE-585	L-T-P-C
Environmental Policies & Legislation	3-0-0-3

**Objective:** *To develop a basic knowledge about the environmental policies & legislation.*

**Course Content**

Introduction to Law: Basics of jurisprudence - Criminal law - Common Law - Relevant sections of the Code of Civil Procedure - Indian Penal Code.

Fundamental Rights: Introduction - Fundamental Rights - Directive Principles of State Policy - Article 48 (A) & 51-A(g) Judicial enforceability - Constitution & Resources management & pollution control - Indian Environmental Policy (1992).

Regulatory Boards: Administrative regulations - constitution of Pollution Control Boards Powers, functions, Accounts, Audit - Constitutional remedies writ jurisdiction Article 32, 226 136 special reference to Mandamus & Certiorari for pollution abatement.

Water Act: Water (prevention & control of pollution) Act 1974 as amended by Amendment Act 1988. Water (prevention & control of pollution) Rules 1975 Water (prevention & control or Pollution) Cess Act. 1977 as amended by Amendment Act 1987 & relevant notifications.

Hazardous Waste Regulation: Relevant notifications in connection with Hazardous Wastes (management & handling) Biomedical wastes (management & handling), Noise pollution, Ecolabelling.

**Text/Reference Books**

1. Constitution of India. 12<sup>th</sup> Ed. Eastern Book Company Lucknow. 2007.

2. Constitutional Law of India. Pandey J.N. 31<sup>st</sup> Ed. Central Law Agency Allahabad. 2007.
3. Administrative Law 1. Kesari U.P.D. Universal Book Trade Delhi. 2008.
4. Environmental Law. Tiwari H.N. Allahabad Law Agency. 2007.
5. Environmental Law & Policy in India (cases, Materials & Statutes). Divan A. & Noble M. Tripathi Bombay. 2001.
6. Environmental Policy, Forest Policy, Bare Acts. Government Gazette Notification.