SIR PADAMPAT SINGHANIA UNIVERSITY
UDAIPUR

School of Engineering

Department of Civil Engineering

Vision

To establish an outstanding center of national and international reputation that brings out civil engineers with high technical competencies; to offer specialized courses dealing with the contemporary issues and cater to the societal needs; to promote consultancy and high-end research to meet the current and future challenges in the field of civil engineering.

Mission

To serve the society by imparting quality of education and skills to its students.

To prepare our students to be the technical, business and global leaders of tomorrow by inculcating technical, communication skills and teamwork.

To promote research and consultancy for industrial and societal needs.

To instill moral, ethical and professionalism values among the students.

M. Tech. Degree Programme
Course Structure

(2021-2023)

SIR PADAMPAT SINGHANIA UNIVERSITY

Udaipur

SCHOOL OF ENGINEERING

Course Curriculum of 2-Year M. Tech. Degree Programme in Civil Engineering (Specialization in Environmental Engineering) (Batch- 2021-23)

Overview

Environmental engineering is the branch of Civil Engineering that is concerned with protecting people from the effects of adverse environmental effects, such as pollution, as well as improving environmental quality. Environmental engineers work to improve recycling, waste disposal, public health, and water and air pollution control. In the modern world, this branch of engineering becomes very important because of the increase in environmental pollution and the adverse impact of climate change due to over-exploitation of natural resources. The Environmental Engineering specialization under the Department of Civil Engineering offers a broad range of subjects that are designed to fulfil present and future demands. The department has well-equipped laboratories and infrastructure facilities for aspiring environmental engineers.

Programme Educational Objectives (PEOs)

PEO1 – Accomplishment: Graduates will lead successful professional life by applying their domain specific knowledge demonstrating leadership skills with ethical attitudes in broad societal context while working in a multi/inter disciplinary setting.

PEO2 – Competence: Graduates will excel in providing ethical solutions as an individual or a member or a leader of a team by investigating, analysing, formulating and solving complex engineering problems for the sustainable development of society.

PEO3 – Expertise: Graduates will exhibit professionalism while communicating with local, national and foreign peers bound with regulations and leading life- long learning.

Program Outcomes (POs)

PO1: Core Knowledge: Graduates will demonstrate an ability to identify, formulate and solve complex engineering problems in the area of specialization and evaluate them to select optimal feasible solution considering safety, environment and other realistic constraints.

PO2: Modern and Advanced Tools: Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems using multidisciplinary approach.

PO3: Research Aptitude: Graduates will demonstrate skill of good researcher to work on a problem, starting from scratch, to research into literatures, methodologies, techniques, tools, and conduct experiments and interpret data to develop methodologies, techniques, modern tools and products for the betterment of society.

PO4: Report Writing: Graduates will be able to present their work unequivocally before scientific community through reports and presentations to give and take clear instructions.

PO5: Ethics and Sustainable Development: Graduates will exhibit the traits of professional integrity and ethics and demonstrate the responsibility to implement the research outcome for sustainable development of the society.

Program Specific Outcomes (PSOs)

PSO1: Professional Excellence (Mastery): Graduates will demonstrate research skills to critically analyse complex Environmental Engineering problem for synthesizing new and existing information for their solutions

PSO2: Research problem solving skills: Graduates will be able to take up real life and/or research related problems in the field of sewer and water supply infrastructure and to create optimal solutions of these problems through comprehensive analysis and designing

Batch 2021-23

Postgraduate Core (PC)		Postgraduate Elective (PE)	
Category	**Credits**	**Category**	**Credits**
Departmental Core Subjects	45	Departmental Electives	12
Basic Sciences Subjects	3		
Total	48	Total	12
		Grand Total	60

Distribution of Total Credits & Contact Hours in all Semesters

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

Course Structure: M. Tech. 2021-23

Semester - I

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-2511	Environmental Statistical Methods	3	1	0	4
2	CE-2512	Air & Noise Pollution	3	0	0	3
3	CH-2102	Advanced Environmental Chemistry	3	0	1	4
4	CE-2514	Urban Drainage & Sewerage System	3	0	0	3
5	MA-3006	Advanced Engineering Mathematics	3	0	0	3
					Total Credits	17
					Total Contact hours/week	18

Semester - II

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-1521	Environmental Microbiology & Ecology	3	0	0	3
2	CE-1522	Environmental Impact Assessment	3	0	0	3
3	CE-3523	Design & Operation of Water & Wastewater Treatment Units	3	1	0	4
4	CE-XXXX	Departmental Elective - I	3	0	0	3
5	CE-XXXX	Departmental Elective - II	3	0	0	3
					Total Credits	16
					Total Contact hours/week	16

Semester - III

S. No.	Course Code	Course Title	L	T	P	Credit(s)
1	CE-2531	Environmental System Optimization & Modeling	3	1	0	4
2	CE-XXXX	Departmental Elective - III	3	0	0	3
3	CE-XXXX	Departmental Elective - IV	3	0	0	3
4	CE-4500	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-4600	Dissertation - II	0	0	9	9
2	CE-3400	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-2551	Waste Treatment Systems	3	0	0	3
2	CE-1552	Environmental Health & Safety	3	0	0	3

List of Departmental Elective(s) - II

S. No.	Course Code	Course Title	L	T	P	Credit
1	CE-2553	Solid & Hazardous Waste Management	3	0	0	3
2	CE-1554	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-2555	Bioremediation	3	0	0	3
2	CE-2556	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-1557	Advanced Environmental Management	3	0	0	3
2	CE-1558	Environmental Policies & Legislation	3	0	0	3

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester – I

(Departmental Core Subject)

CE-2511	L-T-P-C
Environmental Statistical Methods	3-1-0-4
Prerequisite	Engineering Mathematics

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 Outcomes: *At the end of this course the student will be able to: Organize, manage and present data. Calculate and interpret the correlation between two variables. Employee the principles of linear regression and correlation, including least square method, predicting a particular value of Y for a given value of X and significance of the correlation coefficient. Analyze statistical data using measures of central tendency, dispersion and location. .*

Course Content

Module 01: Distribution

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

Module 02: Curve Fitting

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

Module 03: Sampling Distributions

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

Module 04: Applications of Variances

One way & Two way classification. Completely Randomized Design - Randomized Block Design - Latin square Design.

Module 05: 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

Digital Material

1. Environmental Statistical Methods. NPTEL.
   Link: https://nptel.ac.in/courses/111/105/111105077/

Detailed Syllabus for M. Tech. Degree Programme

in

Civil Engineering
(Specialization in Environmental Engineering)

Semester - I

(Departmental Core Subject)

CE-2512	L-T-P-C
Air & Noise Pollution	3-0-0-3
Prerequisite	Environmental Engineering

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 Outcome: *The students should be able to: Explain basic principles on various aspects of atmospheric chemistry. Identify the major sources, effects and monitoring of air and noise pollutants. Understand the key transformations and meteorological influence on air and noise . Relate and analyse the pollution regulation on its scientific basis.*

Course Content

Module 01: 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.

Module 02: Air Quality Monitoring

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.

Module 03: 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.

Module 04: 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.

Digital Material

1. Environmental Air Pollution Prof. Mukesh Sharma
   https://nptel.ac.in/courses/105/104/105104099/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - I

(Departmental Core Subject)

CH-2102	L-T-P-C
Advanced Environmental Chemistry	3-0-1-4
Prerequisite	Engineering Chemistry

Objective *The objective of this course is to impart fundamental principles of environmental chemistry and water chemistry required in the treatment processes of water & wastewater; to enable students analyze the growth kinetics of microorganisms and understand the processes in biological treatment systems.*

Course Outcomes: *On completion of the course student will be able to: understand the fundamental principles of environmental chemistry, water chemistry required in the treatment processes of water & wastewater; analyze the growth kinetics of microorganisms; to understand the processes in biological treatment systems.*

Course Content

Module 01: 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.

Module 02: Physical Chemistry

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

Module 03: Equilibrium Chemistry

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

Module 04: 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.

Module 05: 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.

Module 06: 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

S. No.	Title of the Experiment	Module
1.	Identify & analyze physical parameters of water & waste water.	05
2.	To determine the concentration of chlorides, fluorides, hardness, DO & other quality parameters. .	04
3.	To estimate BOD & COD of given waste water sample.	04

4.	To determine bacterial count in a given sample.	06

Text/Reference Books

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

Digital Material

1. Wastewater treatment and recycling. https://nptel.ac.in/courses/105/105/105105178/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - I

(Departmental Core Subject)

CE-2514	L-T-P-C
Urban Drainage and Sewerage System	3-0-0-3
Pre-requisite	Environmental Engineering

Objective: *To understand the fundamental concepts and techniques of hydraulics and hydrology in the analysis, design, and operation of water resources systems.*

Course Outcome: *Upon successful completion of this course, the student will have reliably demonstrated the ability to: Evaluate the implications for the design and operation of urban drainage systems by incorporating the chemical and biological processes that take place within sewer systems. Elaborate drainage system designs by integrating information on hydrological, hydraulic, economic and practical engineering procedures.*

Course Content

Module 01: Urban Hydrological Cycle, Effects of Urbanization on Catchment Hydrology, Need for Urban Drainage System, Planning Objectives, Interaction of Urban and Surrounding Areas, Approaches to Urban Drainage. Types of sewerage system: Combined system, Separate System, Partially separate system, Patterns of Collection System, Components of sewerage system, design and planning of sewerage systems

Module 02: Quantity estimation of Sewage: Sources of Sanitary Sewage, Dry Weather Flow, Evaluation of Sewage Discharge, Design Period, Design Discharge, Population

forecasting Quantity Estimation of Storm Water: Factors Affecting the Quantity of Storm water, Storm hyetographs – Rainfall excess calculations, time of concentration, Methods for Estimation of Quantity of Storm Water

Module 03: Hydraulic Design of Sewers and Storm Water Drains: Difference Between Water Supply Pipes and Sewer Pipes, Requirements of Design and Planning of Sewerage System, Hydraulic Formulae for Determining Flow Velocities, Minimum and maximum Velocity, Hydraulic characteristics of circular sewer running full or partially full Design of Storm Water Drains for Separate System: Important points for design Sewer materials, Laying of Sewer Pipes, Hydraulic Testing of Sewers

Module 04: Sewer Appurtenances: Manholes, Drop manholes, Lamp holes, Clean-outs, Street inlets, Catch basins, Flushing Tanks, Grease & Oil traps, Inverted Siphons, and Storm Regulators Maintenance, cleaning and ventilation of Sewers Sewage and Storm water Pumping Stations: Types of Pumps, Pumping System Design, Types of Pumping Stations

Text/Reference Books

1. Hall M.J. Urban Hydrology.Elsevier Applied Science Publishers
2. Geiger, W.F. Marsalek, J.Zudima and Rawls, G.J. (1987 “Manual on Drainage in Urban Areas”, 2 Volumes, UNESCO, Paris.)
3. Garg. S. K. (2010). Sewage Disposal and Air Pollution Engineering. Khanna Publisher. New Delhi
4. Geiger. W.F. and Jayakumar. K.V. (Ed.). Lecture Notes of the V International Course on Urban Drainage in Developing Countries. Regional Engineering Collage, Warangal.
5. Wanielista, M.P. and Yousef, Y.A. Stormwater Management. John Wiley and Songs. Inc. New York

Digital Material:

Urban Drainage Systems: https://www.youtube.com/watch?v=yB4FCF_aPKs

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester-I

(Basic Sciences Subjects)

MA-3006 L-T-P-C
Advanced Engineering Mathematics 3-0-0-3
Pre-requisites: Applied Mathematics-II & III

Objective: *In this course certain advanced numerical techniques with probability and statistics will be discussed. These concepts play a very important role in all the fields of engineering.*

Course Outcomes: *After completion of the course a successful student can acquire fundamental knowledge in solution of System of Linear and Non-linear algebraic equations, Numerical solution of ODEs & PDEs and Probability and Statistics.*

Student can develop skills in analyzing the ill conditioned systems, properties of functions through numerical integration, properties of numerical solutions of differential equations, error estimates, stability of solutions and they can apply the statistical techniques for various engineering problems

Course Content

Module 01: **Solution of linear systems of algebraic equations**

Linear system of algebraic equations. Gauss elimination, LU decomposition etc., Matrix inversion, ill-conditioned systems. Numerical eigen solution techniques (Power, Householder, QR methods etc.).

Module 02: Numerical solution of systems of nonlinear algebraic equations

Numerical solution of systems of nonlinear algebraic equations; Newton-Raphson method. Numerical integration: Newton-Cotes methods, error estimates, Gaussian quadrature.

Module 03: Numerical solution of ODEs

Numerical solution of ODEs: Euler, Adams, Runge-Kutta methods, and predictor-corrector procedures;

Module 04: Solution of PDEs

Stability of solutions; solution of stiff equations. Solution of PDEs: finite difference techniques.

Module 05: Probability and Statistics

Probability and Statistics – Probability Distribution, Bays Theorem, Parameter Estimation, Testing of Hypothesis, Goodness of Fit.

Text/Reference Books

1. Advanced Engineering Mathematics. Kreyszig E. 10th Ed., Wiley Eastern 2012.
2. Numerical Methods for Scientific and Engineering Computation. Jain M. K.,Iyengar S. R. K. and Jain R. K.3rd Ed., New Age International 1993.
3. Computational Methods for Partial Differential Equations, Jain M.K., Iyenger S.R.K. and R. Jain, R.K. New Age International, 1994
4. Methods of Mathematical Physics Courant R. and Hilbert D. Wiley, 1989.
5. Mathematical Methods for Physicists. Arfken G. B., Weber H. J. and Harris F. 5th Ed., Academic Press.

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Core Subject)

CE-1521 L-T-P-C
Environmental Microbiology & Ecology 3-0-0-3

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

Course Outcome: *Students will be able to relate the role of microorganisms in environment. They will be able to correlate and critically think upon the utilization of microorganisms in environmental cleaning.*

Course Content

Module 1: Basic microbiology, cell structure

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

Module 2: Microbial growth and biological treatment system

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

Module 3: Microbial Treatment

Hydrolysis, Acidogenesis, Acetogenesis, Methanogenesis, Rate of limiting steps Immobilization advantages, Difference between aerobic & anaerobic treatment.

Module 4: Distribution of Microorganisms

Distribution of microorganisms, coliforms, fecal coliforms, *E. coli*, *Streptococcus fecalis* &

Clostridium welchii, differentiation of coliforms, significance-MPN index.

Module 5: Ecotoxicology

Effects, bioaccumulation, biomagnification, bioassay, biomonitoring, 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. 5th Ed. Tata McGraw Hill Publishing Company Limited. 2006.
2. General Microbiology. Stainer R.Y., Ingrahum 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.

Digital Material

1. Environmental Microbiology. NPTEL.
   Link: https://nptel.ac.in/courses/105/107/105107173/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Core Subject)

CE-1522	L-T-P-C
Environmental Impact Assessment	3-0-0-3
Prerequisite	Environmental Engineering

Objective: *The objective of this course is to make the students aware of the several norms, policies, rules & regulations of the Environmental Impact Assessment.*

Course Outcomes: *At the end of this course the student will be able to: (i) Identify environmental attributes for the EIA study. (ii) Identify methodology and prepare EIA reports. (iii) Specify methods for prediction of the impacts.*

Course Content

Module 01: Introduction to Enivornmental Impact Assessment

Introduction, Historical development of EIA, EIA in project cycle, Legal Aspects & objectives of EIA, General Methodology, Public participation in EIA, different components of EIA.

Module 02: Methodology

General Methodology, Public participation in EIA, different components of EIA.

Module 03: Impact prediction and assessment

Mathematical modeling for impact prediction, cumulative impact assessment, documentation of EIA findings.

Module 04: Impact Analysis, mitigation and management

Environmental impact analysis, Mitigation & impact management, case studies & environmental auditing.

Module 05: Socio-economic Impact Assessment

Concept of socio-economic impact assessment.

Text/Reference Books

3. Environmental Impact Assessment - Practical solutions to recurrent problems. Lawrence D.P. Wiley-Interscience. New Jersey. 2003.
4. Environmental Impact Assessment. Canter L.W. McGraw Hill. New York. 1996.
5. Environmental Impact Analysis: Process and Methods. James. T. Maughan. CRC Press. 2017.

Digital Material

1. Environmental Impact Assessment. NPTEL.
   Link: https://nptel.ac.in/courses/120/108/120108004/
2. Website of Ministry of Environment, Forest and Climate Change, Government of India. Link: http://moef.gov.in/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Core Subject)

CE-3523 L-T-P-C
Design & Operation of Water & Wastewater Treatments Units 3-1-0-4
Prerequisite Environmental Engineering

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

Course Outcomes: *On completion of the course students will be able to: develop the ability to select and design appropriate treatment unit to remove and or treat pollutants, contamination present in water or wastewater; comprehend the challenges involved in the operation of treatment plants.*

Course Content

Module 01: 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.

Module 02: 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.

Module 03: Design of Biological Units

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

Module 04: 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.

Module 05: Practical Applications: Operational problems

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

Text/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 GoI. New Delhi. 2009.
3. Wastewater Engineering, Treatment & Reuse. METCALF & EDDY I. 3rd 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.

Digital Material

1. Introduction to Water & Waste Water Engineering. Prof. B. S. Murty. https://nptel.ac.in/courses/105/106/105106119/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - III

(Departmental Core Subject)

CE-2531 L-T-P-C
Environmental System Optimization & Modelling 3-1-0-4
Prerequisite Environmental Engineering

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

Course Outcomes: *On completion of the course students will be able to: Understand the concept of environmental systems and their modeling; and learn different techniques used in modeling. Design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability*

Course Content

Module 01: Systems Approach Concept & Analysis

Model Classification, Terminology of Models, Model Building, Fundamental of Modeling, Transport Law, Chemical Equilibrium, Phase Equilibrium Rooth's Law, Relative Velocity & Chemical Kinetics.

Module 02: Process Modeling

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

Module 03: 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.

Module 04: 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.

Module 05: 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. Kluer Academic Press. 2002.
3. An Introduction to Water Quality Modeling. James A. 2nd 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.

Digital Material

1. Water Resources Systems : Modeling Techniques and Analysis Prof. P.P. Mujumdar https://nptel.ac.in/courses/105/108/105108130/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - III

(Departmental Core Subject)

CE-4500 L-T-P-C
Dissertation - I 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 exit, 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.

Detailed Syllabus for M. Tech. Degree Programme

in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - IV

(Departmental Core Subject)

CE-4600	L-T-P-C
Dissertation - II	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.

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - IV

(Departmental Core Subject)

CE-3400	L-T-P-C
Dissertation Viva Voce	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.

Detailed Syllabus for M. Tech. Degree Programme

in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Elective - I)

CE-2551	L-T-P-C
Waste Treatment Systems	3-0-0-3
Prerequisite	Environmental Engineering

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 Outcomes*: Upon successful completion of this course, it is expected that students will be able to: Understand the principles of behavior of microorganisms in the treatment of municipal and industrial wastewaters. Apply the concepts of kinetics and mass balance in the design of biological treatment systems for wastewater. Analyse the problems related to troubleshooting of the wastewater treatment plant and to apply the corrective measures for the same. Evaluate the effect of various factors responsible for the biodegradation of organics including toxicants*

Course Content

Module 01: Introduction to Waste Water

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

Module 02: Design of Preliminary & Primary Treatment Operations

Screens, Grit Chambers, Skimming Tank, Primary & Secondary Sedimentation Tanks.

Module 03: Biological Treatment Processes

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.

Module 04: 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. 1st Ed. Wiley. 2007.

Digital Material

Wastewater Management Dr. M.M. Ghangrekar
https://nptel.ac.in/courses/105/105/105105048/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Elective - I)

CE-1552	L-T-P-C
Environmental Health & Safety	3-0-0-3
Prerequisite	Environmental Engineering

Objective: *To Train and motivate students in maintaining and improving the quality of the environment and preventing & abating environment pollution. This has the blending mixture of both Learning and Skills*

Course Outcomes: *Upon successful completion of this course, the student will have reliably demonstrated the ability to: Identify a variety of biological, chemical and physical hazards and recommend prevention and control measures, including confined space entry. Identify applications of environmental health and safety protocols and procedures. Utilize current legislation and regulations including the Occupational Health and Safety Act, Workplace Hazardous Materials Information System (WHMIS), Environmental Protection Act and Transportation of Dangerous Goods Act.*

Course Content

Module 01: Scope and Importance

Need for public awareness about our environment; Economic and social security; Environment impact of transportation and Mining. Environmental impact assessment (EIA) — purpose, procedure and benefits of EIA; Biodiversity and its conservation; Sustainable development. Global warming and greenhouse effect, urbanization, acid rain, ozone layer depletion, nuclear accident and holocaust.

Module 02: Environmental pollution

Causes, effects and control measures of air pollution, water pollution, soil pollution, marine pollution, noise pollution and nuclear hazards, Solid waste management-urban and industrial waste-causes, effects and control measures.

Module 03: Renewable and non-renewable natural resources

Forest resource, Water resource, Mineral wealth / resource, Food resource, Energy resources, Growing energy needs, renewable and non-renewable energy sources, Use of alternate energy sources, Land resource and land degradation, Role of an individual in conservation of natural resources, equitable use of resources for sustainable life styles.

Module 04: Role of Government in environment protection

Legal aspects of environment protection, NGO initialization, National Committee on environmental Planning (NCP), Environmental Appraisal Committee (EAC), central and state boards for prevention and control of pollution, goals of environment impact policy, case studies, Disaster management floods, earth quake, cyclone, landslides, role of individual in prevention of pollution.

Text/Reference Books

1. Environmental Studies. Joshep B. Tata Mc Graw Hill. 2005.
2. Environmental Pollution Control. Rao C.S. New Age International Pvt. Ltd Publishers. 2006.
3. Environmental Studies. Manjunath D.L. Pearson Education Publishers. 2007.
4. Text Book of Environmental Studies. Yaji R.K. United Publishers. 2006.
5. Centre for Environmental Education. Essential learning's in Environmental education. 1990.
6. Principles of Environmental Science and Engineering. Venugopal Rao P. Prentice Hall. 2006.

Digital Material

1. Wastewater Management Dr. M.M. Ghangrekar https://nptel.ac.in/courses/105/105/105105048/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Elective - II)

CE-2553	L-T-P-C
Solids & Hazardous Waste Management	3-0-0-3
Prerequisite	Environmental Engineering

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 Outcomes*: Upon successful completion of this course, it is expected that students will be able to: Explain municipal solid waste management systems with respect to its physical properties, and associated critical considerations in view of emerging technologies. Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid waste. Select the appropriate method for solid waste collection, transportation, redistribution and disposal. Describe methods of disposal of hazardous solid waste.*

Course Content

Module 01: 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.

Module 02: 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.

Module 03: 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.

Digital Material

1. Solids & Hazardous Waste Management, Dr. Indumathi Nambi https://nptel.ac.in/courses/105/106/105106056/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - II

(Departmental Elective - II)

CE-1554	L-T-P-C
Rural Sanitation Engineering	3-0-0-3
Prerequisite	Environmental Engineering

Objective: *The objective of this course is to understand rural sanitation planning, wastewater collection disposal techniques, industrial hygiene and sanitation & low cost solid waste management systems.*

Course Outcomes: *On completion of this course students will be able to: learn planning of wastewater collection system in rural areas, treatment and disposal of wastewater; understand industrial hygiene, sanitation and various solid waste management techniques.*

Course Content

Module 01: 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.

Module 02: Industrial Hygiene And Sanitation

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

Module 03: 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

6. Municipal & Rural Sanitation. Eulers V.M. & Steel E.W. 6th Ed. McGraw Hill Book Company. 1965.
7. Text Book of Preventive & Social Medicine. Park J.E. & Park K. Banarsidas Bhanot. 1972.
8. Rural Water Supply & Sanitation. Wright F.B. & Robert E. Krieger Publishing Company. Huntington. New York. 1977.
9. Environmental History of Water: Global Views on Community Water Supply & Sanitation. Juuti P., Tapio S. K. & Vuorinen H. IWA Publishing (Intl Water Assoc). 2007.

Digital Material

1. Wastewater treatment and recycling.
   https://nptel.ac.in/courses/105/105/105105178/#

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - III

(Departmental Elective - III)

CE-2555 L-T-P-C
Bioremediation 3-0-0-3

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

Course Outcome: *Students will be able to design the model and layout for soil bioremediation through use of microorganisms.*

Course Content

Module 1: Fundamental Aspects of Environmental Microbiology

Structure & Functions of Prokaryotic Cells, Structure & Functions of Eukaryotic Cells.

Module 2: 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.

Module 3: Microbial Metabolism

Growth & Biokinetics, Microbial Nutrition & Metabolism, Microbial Growth & Energy. Enzymes & Their structures. Biokinetic Models, Batch & Continuous Chemostat Studies - Determination of Biokinetic Parameters.

Module 4: Bioreactors

Microbiology Reactions Suspended Growth Reactors, Biofilm Reactors, Batch Reactors,

Completely Stirred Tank Reactors, Plug Flow Reactors, Reactors in Series, Engineering Design of Reactors. Bioflim Processes Trickling Filters & Biological Towers

Module 5: 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.

Digital Material

1. Environmental Remediation Of Contaminated Sites. NPTEL https://nptel.ac.in/courses/105/107/105107181/

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - III

(Departmental Elective - III)

CE-2556	L-T-P-C
Industrial Waste Management	3-0-0-3
Prerequisite	Environmental Engineering

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 Outcomes**: Upon successful completion of this course, it is expected that students will be able to: Sample and analyze the characteristics of industrial wastewaters. Analyze the effects of disposal of industrial wastes. Identify and design treatment options for handling industrial wastewater. Identify and design treatment options for handling industrial wastewater*

Course Content

Module 01: 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.

Module 02: Pretreatment Of Industrial Wastewater

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.

Module 03: Industries

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. 3rd 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.

Digital Material

2. Industrial wastewater treatment , S.C. Jain
   https://www.youtube.com/watch?v=JBSP6ayaIjU

Detailed Syllabus for M. Tech. Degree Programme
in
Civil Engineering
(Specialization in Environmental Engineering)

Semester - III

(Departmental Elective - IV)

CE-1557	L-T-P-C
Advanced Environmental Management	3-0-0-3
Prerequisite	Environmental Engineering

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 Outcomes*: Upon successful completion of this course, it is expected that students will be able to: Analyse and compare how strategies and methods such as environmental management systems are used to improve organization's contributions to sustainable development. Identify, analyze and evaluate sustainability aspects and propose indicators for formulation of targets and action plans for the sustainable development of an organization. Collect, analyze and present data on environmental impacts and resource flows, in order to monitor and evaluate the environmental performance of organizations*

Course Content

Module 01: 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

Module 02: 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

Module 03: 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.

Module 04: 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.

Digital Material

1. Introduction to Environment Management Systems

   https://www.youtube.com/watch?v=gsfHHnxSOm4

Detailed Syllabus for M. Tech. Degree Programme

in

Civil Engineering

(Specialization in Environmental Engineering)

Semester - III

(Departmental Elective - IV)

CE-1558	L-T-P-C
Environmental Policies & Legislation	3-0-0-3
Prerequisite	Environmental Engineering

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

Course Outcomes*: Upon successful completion of this course, it is expected that students will be able to: Be familiar with the laws, policies and institutions in the field of environment. Acquire the skills needed for interpreting laws, policies and judicial decisions in a holistic perspective. Acquire the ability to evaluate the role of law and policy in conservation and management of natural resources and prevention of pollution*

Course Content

Module 01: Introduction to Law

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

Module 02: 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).

Module 03: 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.

Module 04: 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.

Module 05: 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. 12th Ed. Eastern Book Company Lucknow. 2007.
2. Constitutional Law of India. Pandey J.N. 31st 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.

Digital Material

1. Environemental Legislation in India

   https://www.youtube.com/watch?v=QzP2mnrVdeY