Teaching and Examination Schemes with Syllabus

of

Master of Technology

in

(Civil) Environmental Engineering

(Effective 2014-15)

(Approved in the 27th Standing Executive Committee of the Senate dated August 14, 2014)

Department of Civil Engineering

Sardar Vallabhbhai National Institute of Technology, Surat

Vision and Mission of the Institute

Vision

To be one of the leading Technical Institutes disseminating globally acceptable education, effective industrial training and relevant research output

Mission

To be a globally accepted centre of excellence in technical education catalyzing absorption, innovation, diffusion and transfer of high technologies resulting in enhanced quality for all the stake holders

Vision and Mission of the Department

Vision

To be a global centre of excellence for creating competent professionals in Civil Engineering

Mission

• To provide excellent education producing technically competent, globally employable civil engineers who will be leaders in the chosen field

• To undertake research in conventional and advanced technologies fulfilling the needs and challenges of modern society

Foreword

Master of Technology (M.Tech.) programme in Environmental Engineering which started in 1972 is one of the oldest PG programmes of the institute. The programme has produced large number of alumni who work in different part of the country and abroad as environmental entrepreneurs, academicians and as environmental engineers in industry/government. The curriculum of the programme is regularly revised taking inputs from industry and alumni. Rapid changes have occurred in the last few decades as the need for protecting the environment has become more obvious and pollution control regulations have become more stringent The curriculum has undergone changes to reflect these developments.

The syllabus includes core courses, electives, practicals, group project, summer training and dissertation. Through course work spread in the first two semesters, the students are exposed to various techniques and theory of environmental engineering. Through quizzes and assignments students' performance is continuously evaluated. Experiments are regularly updated with latest equipment and software. Dissertation spread over two semesters help students to comprehend a problem, analyse it and develop a detailed methodology to derive valid conclusions through a number of field, laboratory or simulated experiments.

Programme Educational Objectives (PEOs)

The graduates of the M.Tech. Environmental Engineering Programme will:

- Function successfully in a professional environment by utilizing and enhancing their problem-solving and communication skills.
- Pursue lifelong learning, and will be leaders, both in their chosen profession and in other activities
- Promote organizational success with consideration of cost and time management, and demonstrate global and societal awareness, while practicing and promoting ethical behaviour and stewardship of a sustainable environment.

Programme Outcomes (POs)

The outcomes of the Master of Technology programme in Environmental Engineering are:

- An ability to independently carry out research /investigation and development work to solve practical problems.
- An ability to write and present a substantial technical report/document.
- Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate Master program.

Programme Specific Outcomes (PSOs)

- Graduates of the programme will effectively use comprehensive knowledge in environmental engineering to formulate and implement cost effective and sustainable solutions.
- Graduates will demonstrate their knowledge in environmental engineering to plan and manage any project as in individual/team member or leader serving their society ethically.
- Graduates will continue their life-long self-learning in environmental engineering and pursue research in relevant local, regional and global environmental engineering problems.

Teaching Scheme
M.Tech. in (Civil) Environmental Engineering

SEMESTER - I

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	Environmental Chemistry & Micro Biology	CE–601	3-1-0	3	100	25	0	125	4
2	Physico Chemical Processes	CE–603	3-0-0	3	100	-	-	100	3
3	Biological Processes	CE–605	3-1-0	3	100	25	0	125	4
4	Applied Statistics For Engineers	CE–607	3-1-0	3	100	25	-	125	4
5	Elective – I		3-0-0	3	100	0	0	100	3
6	Environmental Engg. Lab	CE–609	0-0-4	-	-	-	100	100	2
7	Seminar – I	CE–611	0-0-2	-	-		50	50	1
		Total	15-3-6	**15**	**500**	**75**	**150**	**725**	**21**

List of Electives I

CE613 Environmental Ethics Law & Policy
CE615 Environmental Health & Risk Management
CE617 Environmental Hydraulics
CE619 Sustainable Waste Management System
CE621 Global Climatic Changes and Disaster Management

Allotment of elective

Explain how the elective course is allotted.

SEMESTER – II

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	Solid and Hazardous Waste Management	CE–602	3-1-0	3	100	25	0	125	4
2	Environmental Impact Assessment	CE–604	3-0-0	3	100	-	-	100	3
3	Industrial Waste Management	CE–606	3-1-0	3	100	25	0	125	4
4	Air Pollution and Control	CE–608	3-1-0	3	100	25		125	4
5	Elective –II		3-0-0	3	100	0	0	100	3
6	Advanced Environmental Eng. Lab	CE–612	0-0-4	-	--	-	100	100	2
7	Seminar–II	CE–614	0-0-2	-	-	-	50	50	1
		Total		**15**	**500**	**75**	**150**	**725**	**21**

List of Electives II

CE616 Environmental System Modeling

CE618 Advanced Water and Waste Water Treatment System

CE622 Industrial safety and Environment

CE624 Application of GIS and Remote Sensing in Env. Engg

CE626 Cleaner Production and Environmental Sustainable Management

Allotment of elective

Electives are allotted based on students' interest and availability of faculty for offering a course. A course is offered if a minimum number of students are opted for that course.

SEMESTER – III

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	(*) Summer training Report	CE–801	0-0-0	-	-	-	100	100	1
2	Project	CE–803	0-0-6	-	-	-	100	100	3
3	Dissertation Preliminary	CE–805	0-0-8	-	-	-	200	200	4
		Total					**400**	**400**	8

SEMESTER – IV

Sr No	Course	Code	Scheme	Examination Scheme				Total	Credit
				Theory		Tuto.	Pract		
				Hour	Mark	Mark	Mark		
1	Dissertation	CE–802	0-0-20	-	-	-	400	400	10
		Total					**400**	**400**	**10**

Assessment of Performance

Assessment of Theory Courses

The evaluation pattern for the theory courses, *as of now*, shall be as under:

Mid-semester examination: 30 marks
Assignment/Quizzes: 20 marks
Tutorials (if applicable): 25 marks
End-semester exam: 50 marks

The mid- and end-semester examinations are of 1.5 hours and 3 hours, respectively.

Assessment of Seminar

Internal assessment of 40% weightage by guide(s) and Final assessment of 60% weightage by a panel of examiners

Assessment of Dissertation/Projects

Internal assessment of 40% weightage by guide(s) Final assessment of 60% weightage by a panel of examiners including an examiner from outside the institute

For more details please refer to the institute website
https://www.svnit.ac.in/Data/Notice/AcademicRegulations2013-2014.pdf

Course-wise Detailed Syllabus

Semester I

L	T	P	C
3	1	0	4

CE 601 ENVIRONMENTAL CHEMISTRY AND MICROBIOLOGY

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1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Explain the use of Chemistry and Microbiology in water and wastewater treatment units.
CO2	Identify suitable treatment processes of water and wastewater.
CO3	Evaluate the physico-chemical and microbial characteristics.
CO4	Determine the reaction rates and bio-kinetic constants for use in environmental processes
CO5	Apply knowledge of Chemistry and Microbiology for various environmental issues.

2. Syllabus

ENVIRONMENTAL CHEMISTRY (15 Hours)

- **BASIC PRINCIPLES (05 Hours)**
  Physical and chemical properties of water and their significance in environmental engineering – Types of chemical reactions – stoichiometric calculations – solutions – chemical equilibrium. Acid- base equilibria – alkalinity, acidity, buffers and buffer index - Chemical thermodynamics – Oxidation–Reduction– Mass transfer and transport of impurities in water and air –diffusion, dispersion – Physical and chemical interactions due to various forces, suspensions and dispersions.

- **ANALYSIS (10 Hours)**
  Basic concepts of quantitative analytical chemistry – Instrumental methods of analysis – Determination of turbidity, colour, pH, acidity, alkalinity, hardness, residual chlorine and chlorine demand, chlorides, dissolves oxygen demand, nitrogen, solids, iron and manganese, fluoride, sulphate, phosphorous and phosphate, grease, volatile acids, gas analysis – Preparation of standard solutions – Drinking water and wastewater standards – Trace organics and inorganics

ENVIRONMENTAL MICROBIOLOGY (30 hours)

- **INTRODUCTION (12 Hours)**
  Microorganisms – Classification, prokaryotic and eukaryotic cells, structure, characteristics, nucleic acids, DNA and RNA, Viruses, their detection and quantification – Microscopy – Measurements and Isolation of Microorganism – Different Cultures – Media and Techniques of Staining and Enumeration of microorganism

- **MICROBIAL METABOLISM AND GROWTH (06Hours)**
  Enzyme and enzyme kinetics – Metabolism – Respiration – Fermentation – Glycolysis – Kreb's cycle – Carbohydrate – Protein, lipids, significance of energetic – Chemical

composition of cell and nature of organic matter used by microorganisms – Metabolic classification of microorganisms: phototrops, chemotrops, applications in environmental engineering.

- **MICROBIOLOGY OF WATER AND WASTEWATER (12 Hours)**
  Distribution of microorganisms in natural water – Indicator organisms – Coliforms – Faecal coliforms – *E.coli*, *Streptococcus faecalis* – Differentiation of coliforms – Significance – MPN–M.F. techniques – Microbiology of wastewater treatment processes such as activated sludge process – Trickling filter – Anaerobic processes. – Introduction to Microbiology of Soil and Air and Industrial Microbiology – Microbiology of bioremediation and solid waste treatment.

(Total Lectures: 45 hours)

3. Books Recommended

1. Maier R.M, Pepper I.L and Gerba C.P. Environmental Microbiology, Elsevier– AP, New York
2. Pelczar Jr, M.J., Chan E.C.S., Krieg R.N., and Pelczar M.F, Microbiology, Tata McGraw–Hill, New Delhi, 1996.
3. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
4. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall , New Delhi.1996.
5. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw–Hill, New Delhi, 2000.

4. CO-PO-PSO Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	3	2	2
CO2	1	0	3	3	2	2
CO3	2	1	3	3	2	2
CO4	2	1	3	3	3	3
CO5	3	2	3	3	3	3

CE 603 PHYSICO-CHEMICAL PROCESSES

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Describe physical and chemical phenomena that form the basis for the design of unit processes
CO2	Apply theoretical knowledge of corresponding physicochemical phenomena in the treatment processes
CO3	Design physicochemical treatment processes to meet treatment goals for a given pollution scenario
CO4	Apply advanced treatment processes to treat water and wastewater
CO5	Develop conceptual schematics for the treatment of water and wastewater

2. Syllabus

- **SEDIMENTATION AND COAGULATION (10 Hours)**
  Types of settling and their mathematical analysis – Coagulation: mechanism of coagulation – Colloid chemistry – Modelling coagulation process – Effect of turbidity and alkalinity – Chemistry of coagulants – Design of coagulation process

- **FLOW THROUGH BED OF SOLIDS (08 Hours)**
  Type of filters – Modelling filtration process – Mechanism– Ion exchange units – Contacting towers – Flow through expanded beds – Flow through porous plates and membranes

- **GAS TRANSFER AND DISINFECTION (08 Hours)**
  Mechanism of gas transfer – Film coefficients and equilibrium relationship – Gas dispersers – Packed columns – Tray columns – Spray units – Applications in environmental engineering – Disinfection – Mechanism – Different agents

- **ADVANCED TREATMENT OPERATIONS (14 Hours)**
  Adsorption – Isotherms – Advance Oxidation Process- Membrane processes – Reverse osmosis – Electro dialysis – Desalination – Softening – Ion exchange – Removal of specific chemical contaminants such as fluorides, arsenic, nitrates and organics

- **DESIGN OF TREATMENT UNITS (05 Hours)**
  Design concepts of Unit operations and processes in Water and Wastewater Treatment

3. Practicals

1. Determination of Physical characteristics of water (pH, Turbidity, Electrical conductivity, Solids)
2. Determination of Total Hardness, Calcium Hardness, Magnesium Hardness of waters ample
3. Determination of Chlorides and Phosphate of water sample.

4. Determination of Residual chlorine of water sample
5. Study of Jar test for different coagulant dose.
6. Determination of physical characteristics of waste water
7. Determination of DO, BOD and COD of waste water sample
8. Determination of oil and grease of waste water sample
9. Determination of Nitrates and Sulphates of waste water sample
10. Determination of Heavy metals from industrial wastes
11. Charge balance of ions in water

(Total Lectures: 45 hours)

4. Books Recommended

1. W R Fox and A T McDonald, Wastewater Engineering: Treatment and Reuse, Wiley and Sons Inc., New York, 2006.
2. A K Qasim and E M Motley, Water Works Engineering, Wiley-Interscience, New York, 2013.
3. K G Weber, Physicochemical Processes for Water Quality Control, CRC Press, New York, 1997.4.
4. D Hendricks, Water Treatment Unit Processes, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1998.
5. F M. White, Biological Process Design for Wastewater Treatment, The McGraw Hill Companies, New York, 2008

5. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	0	3	2	2	2
CO2	3	0	3	3	3	2
CO3	3	1	3	3	3	2
CO4	3	1	3	3	3	2
CO5	3	2	3	3	3	2

CE 605- BIOLOGICAL PROCESSESS

L	T	P	C
3	1	0	4

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Explain reactions, reactors and biological treatment processes.
CO2	Understand the Concepts of microbial growth and substrate utilization.
CO3	Differentiate various biological processes.
CO4	Design of various biological treatment process units.
CO5	Design nutrient removal/recovery systems through biological processes.

2. Syllabus

- **REACTORS AND REACTOR ANALYSIS (10 Hours)**
  Reactions and reaction kinetics – Types of reactors and their analysis – Hydraulic characteristics of reactors.

- **KINETICS OF BIOLOGICAL GROWTH (07 Hours)**
  Nutrition and growth conditions – Effect of environmental conditions–Bacterial growth in terms of numbers and mass – Growth curve – Interpretation of curve – Substrate limited growth – Monod's expression – Substrate utilization and cell growth – Effect of Endogenous metabolism – Inhibition – Effect of temperature – Application of growth and substrate removal kinetics to biological treatment.

- **AEROBIC PROCESSES (12 Hours)**
  Suspended and attached growth systems – Modelling suspended growth – Activated sludge process – Types and their design concepts – Different attached growth systems and their design concepts. – Advanced Membrane Biological Processes

- **ANAEROBIC TREATMENT PROCESSES (06 Hours)**
  Microbiology – Different types – Design considerations of UASB and attached growth systems.

- **NUTRIENT REMOVAL AND POND TREATMENT PROCESSES (06 Hours)**
  Biological processes for nitrogen and phosphorus removal – Nitrification and Denitrification processes and their design concepts – Different pond treatment systems

- **BIOLOGICAL PROCESSES FOR SLUDGE PROCESSING** (04 Hours)
  Anaerobic and aerobic digestion

(Total Lectures: 45 hours)

3. Books Recommended

1. Metcalf and Eddy Inc, Wastewater Engineering: Treatment and Reuse, Tata McGraw Hill, New Delhi, 2007.
2. Benefield L.D. and Randall C.W. Biological Process Design for Wastewater Treatment, Prentice Hall, New Delhi,1980.

3. Schroeder E.D. , Water and Wastewater Treatment, 4th edition ,McGraw–Hill, New Delhi,1997
4. Karia G.L. and Christian R.A. Wastewater Treatment: Concepts and Design Approach, Prentice Hall, New Delhi, 2013.
5. Hendricks, D. 'Water Treatment Unit Processes – Physical and Chemical' CRC Press, New York , 2006

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	0	2	3	2	2
CO2	2	0	2	3	2	2
CO3	3	0	3	3	2	2
CO4	3	1	3	3	2	3
CO5	3	1	3	3	3	3

CE 607- APPLIED STATISTICS FOR ENGINEERS

L	T	P	C
3	1	0	4

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Analyse and interpret engineering data
CO2	Use hypothesis testing for various types of data
CO3	Apply different sampling distributions to engineering data
CO4	Develop simple linear regression and correlation
CO5	Design statistical experiments

2. Syllabus

- **INTRODUCTION (08 Hours)**
  Graphical presentation of data: dot and scatter plots – Frequency distribution and histogram – Box plot and time plots – Numerical distribution of data: Measures of Central tendency – Dispersion – Skewness and kurtosis – Measuring association – Grouped data.

- **SAMPLING DISTRIBUTIONS (10 Hours)**
  Random variables and expectation – Discrete and continuous random variables – Sampling distributions – Important discrete distributions – Binomial – Poisson and geometric distributions – Normal distribution – Central limit theorem.

- **PARAMETER ESTIMATION (05 Hours)**
  Point estimation – Confidence interval estimation.

- **TESTS OF HYPOTHESIS (08 Hours)**
  Tests of hypothesis on single sample and two samples – Goodness of fit – Tests based on Normal – t – Chi–square – F distributions.

- **SIMPLE LINEAR REGRESSION AND CORRELATION (05 Hours)**
  One way and two way classification

- **DESIGN OF EXPERIMENTS (09 Hours)**
  Completely randomized single factor experiment – Analysis of variance – Randomized block design – Latin square design – 2^2 factorial design.

(Total Lectures: 45 hours)

3. Books Recommended

1. Box G.E.P, Hunter J.S. and Hunter W.G. Statistics for Experimenters, John Wiley and Sons, 2005
2. Berthouex P.M and Brown L.C. Statistics for Environmental Engineers, CRC Press, 2002.
3. Freund J.E. and Miller I.R., Probability and Statistics for Engineers, Prentice–Hall of India, 1994.
4. Walpole R.E. Myers R.H., Myers S.L. and Ye K. Probability and Statistics for

Engineers and Scientists, Pearson Education, New Delhi, 2002.
5. Dallan E Johnson, Applied multivariate methods for data analysis, Thomson & Duxbburg Press, Singapore, 2002

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	3	3	2	2
CO2	1	1	3	3	2	2
CO3	2	2	3	3	3	3
CO4	2	2	3	3	3	3
CO5	2	2	3	3	2	3

CE 609- ENVIRONMENTAL ENGINEERING LAB

L	T	P	C
0	0	4	2

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand sampling methods for water and wastewater
CO2	Analyse the physico-chemical and biological characteristics of a given sample
CO3	Select the treatment option based on the sample characteristics
CO4	Evaluate impacts of water and wastewaterquality on environment..

2. Practicals

CHEMISTRY PRACTICAL (30 Hours)

1. Determination of Physical characteristics of water (pH, Turbidity, electrical conductivity, Solids)
2. Determination of Total Hardness, Calcium Hardness, Magnesium Hardness of water sample
3. Determination of Chlorides, Nitrates, Phosphate and Sulphate of water sample.
4. Determination of Residual chlorine of water sample
5. Study of Jar test for different coagulant dose.
6. Determination of physical characteristics of waste water (pH, Turbidity, colour, solids, temp.)
7. Determination of DO, BOD and COD of waste water sample
8. Determination of oil and grease of waste water sample
9. Determination of Nitates and Sulphates of waste water sample
10. Determination of Heavy metals from industrial waste

MICROBIOLOGY PRACTICAL ` (30 Hours)

1. Study of Compound and Phase Microscope.
2. Study of staining technique.
3. Study of isolation techniques for bacteria.
4. Determination of Residual chlorine of water sample.\
5. Study of MPN test and multiple tube technique.
6. Application of Plate cont method for bacterial growth.
7. Effects of pH on growth of bacteria.
8. Effects of Osmotic Pressure on growth of bacteria.

(Total Contact Time: 60 Hours)

3. Books Recommended

1. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
2. Benefield, Judkins and Weand – Process Chemistry for Water and Wastewater Treatment, Prentice Hall, New Delhi,1980.

3. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw–Hill, 2000.
4. De. A.K., "Environmental Chemistry", New Age International Ltd., New Delhi, 1995.
5. Standards Methods for the Examination of Water & Waste water", American Public health Association, Washington. D.C. 2005.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	2	2	3	1	3
CO2	2	3	2	3	2	3
CO3	3	3	3	3	3	3
CO4	3	3	3	3	3	3

CE 611- SEMINAR – I

L	T	P	C
0	0	2	1

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Collect the information on given specific area/topic.
CO2	Update with latest knowledge through exhaustive literature survey.
CO3	Collate the information to prepare a report.
CO4	Communicate effectively through skilful presentation.

2. Syllabus

- Each candidate is required to present one seminar on any chosen topic connected with the field of specialization. The topic shall be chosen in consultation with the concerned faculty. Preparation and Presentation of a seminar is intended to investigate an in–depth review of literature; to prepare a critical review and to develop confidence for making a good presentation. Assessment is based on the presentation and contents of the seminar report prepared. A report has to be submitted in the prescribed format and seminar shall be evaluated by the respective department committee.

- Expert Lectures can be arranged from various Environmental Consultants so that can student can get the exposure to field related problem

3. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	3
CO2	3	3	1	1	2	3
CO3	2	3	1	1	2	2
CO4	1	3	1	1	2	2

CE 613- ENVIRONMENTAL ETHICS, LAW AND POLICY

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Demonstrate substantive knowledge of the major environmental laws and policies currently in place at the national and international levels.
CO2	Describe the process of environmental policy development for decision makers.
CO3	Apply environmental ethics theory to real-world environmental conflicts and issues.
CO4	Develop competence in problem-based practice in the application of the law
CO5	Develop critical thinking about the integration of science, ethics and law for achieving sustainable development goals.

2. Syllabus

- **CURRENT PERSPECTIVES OF ENVIRONMENTAL PROTECTION (09 Hours)**
  Present perspectives on practical environmental issues; – Current practices of environmental solutions through engineering, technology, legislation etc; – Need for environmental ethics in today's scenario; – Introduction to Environmental Ethics; – Pollution – The scientific vs. philosophical view;

- **ETHICS vs. LAW, POLICY & MANAGEMENT (12 Hours)**
  Moral Psychology, the environment and ethics; – Religious and cultural views; – Ethics and policy, ethics and management, ethics and law; – Important Indian environmental legislation and acts such as Water Act-1974, Air Act-1981; – Important rules under Environment Protection Act (EPA) – 1986 such as Biomedical Waste Rules-1998, EIA Rules-1994, Coastal Regulation Zone- 1999, Municipal Solid waste rules, Hazardous Waste Rules-2008 etc.

- **INTERNATIONAL ISSUES AND ETHICS & LAWS (14 Hours)**
  Solution of international global and local issues through environmental ethics; – Ethics & Social Responsibility; – Global Ecology and the Shadow of Development; – The Global Ecological Crisis; – Holistic Environmental Ethics; – Towards Global Justice and Planetary Health. International environmental laws and protocols such as Stockholm Conference, Montreal Protocol, Rio Earth Summit, Kyoto Summit; – Role of UN authorities in protection of global environment; – Global environmental issues and environmental laws to control global warming, ozone depletion, acid rain, hazardous waste;

- **ENVIRONMENTAL POLICY (10 Hours)**
  National Environmental policy; – Environmental guidelines and regulations; – Environmental auditing, monitoring and reporting, environmental labeling studies by Central / State bodies; Theory of corporate strategies; – Beyond environmentalism and sustainability issues

(Total Lectures: 45 hours)

3. Books Recommended

1. Gurdip Singh, Environmental law in India, Macmillan India, New Delhi. 2005
2. Thakur Kailash, Environmental protection law and policy in India, Deep and Deep publishers. Simla, 2007.

3. Ministry of Environment and forest, Government of India Environmental Impact Assessment Notification, New Delhi, 2006.
4. Holmes Rolston, A New Environmental Ethics: The Next Millennium for Life on Earth, Routledge 2011
5. Paul Pojman & Louis P. Pojman, Environmental Ethics, Cengage Learning 2011.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1	3	2	1	3
CO2	3	3	1	1	1	2
CO3	3	1	3	3	1	3
CO4	3	2	3	3	2	3
CO5	3	1	3	3	2	3

CE 615-ENVIRONMENTAL HEALTH AND RISK MANAGEMENT

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the significance of health and hygiene.
CO2	Correlate epidemiology with environmental exposure and diseases.
CO3	Integrate the health and sanitation approaches.
CO4	Understand environmental risk characterization and consequences determination.
CO5	Design risk management tools and programmes.

2. Syllabus

- **INTRODUCTION (12 Hours)**
  Dimensions of environmental health – Causative agents of diseases – Social factors – Urban problems – Housing and health – Economy and health – Climate and other atmospheric elements – Violence – Chronic and communicable diseases – Occupational health – Epidemiological data – Occupational health hazards – Environmental exposure and diseases – industrial toxicants – Ergonomics – Controlling stress of life.

- **ASSESSMENT ENVIRONMENT HEALTH (09 Hours)**
  Epidemiology – Out break Epidemiology – Disease control – disease prevention – morbidity and mortality – Foodborne and waterborne diseases outbreaks – Integrated Approach to Health and Sanitation.

- **ELEMENTS OF ENVIRONMENTAL RISK ASSESSMENT (12 Hours)**
  Hazard identification and accounting – Fate and Behaviour of toxics and persistent substances in the environment – Receptor exposure to Environmental Contaminants – Dose Response Evaluation – Exposure Assessment – Exposure Factors, Slope Factors – Dose Response calculations and Dose Conversion Factors – Risk Characterization and consequence determination – Vulnerability assessment – Uncertainty analysis – Event tree and fault tree modelling and analysis.

- **TOOLS FOR RISK MANAGEMENT (12 Hours)**
  HAZOP and FEMA methods – Risk communication and Risk Perception – comparative risks – Risk based decision making – Risk based environmental standard setting – Design of risk management programs – Case studies on risk assessment and management programme.

(Total Lectures: 45 hours)

3. Books Recommended

1. Cutter, S.L., Environmental Risk and Hazards, Prentice-Hall of India Pvt. Ltd., New Delhi, 1999.
2. Kofi Asante Duah, "Risk Assessment in Environmental management", John Wiley and sons, Singapore, 1998.
3. Kasperson, J.X. and Kasperson, R.E. and Kasperson,R.E., Global Environmental Risks, V.N.University Press, New York, 2003.
4. Mark Burman, Risks and Decisions for Conservation and environmental management,

Cambridge University Press. London
5. Susan L Cutter, "Environmental Risks and Hazards" Prentice Hall of India, New Delhi, 1999.
6. Joseph F Louvar and B Diane Louver, Health and Environmental Risk Analysis Fundamentals with applications, Prentice Hall, New Jersey, 1997.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	0	0	0	1	0	1
CO2	0	0	0	1	0	1
CO3	1	1	0	2	1	1
CO4	2	2	1	2	0	1
CO5	3	2	1	2	1	1

CE 617 ENVIRONMENTAL HYDRAULICS

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the concepts of fluid flow analysis.
CO2	Compare different methods of network analysis.
CO3	Analyze water distribution system network with various tools and techniques.
CO4	Design storm water and sewerage network system.
CO5	Develop the hydraulic flow diagram for a treatment plant.

2. Syllabus

- **FUNDAMENTALS (05 Hours)**
  Basic equations for fluid flow analyses including Reynolds transport theorem – Basic concepts of flow through pipes.

- **WATER DISTRIBUTION SYSTEM DESIGN (10 Hours)**
  General design requirements – Methods of analyses – Control of water hammer in long distance transmission. – Introduction to optimization of water distribution system.

- **URBAN STORM DRAINAGE DESIGN (10 Hours)**
  Introduction to drainage problems in difficult climates. – Planning concepts, Rainfall intensity-duration – Frequency curves. – Design of drainage system elements, – Control of storm water pollution.

- **SEWERAGE SYSTEM DESIGN (10 Hours)**
  General design principles of sewers, Recent Development in sewerage system design. – Application of Software

- **GROUND WATER DEVELOPMENT (10 Hours)**
  Well development – Artificial recharge – Salinity of Ground water – Ground water pollution – Infiltration Galleries.

(Total Lectures: 45 hours)

3. Books Recommended

1. Chow V.T., Flow through open channel, McGraw–Hill Book Company, International editions, New Delhi.1973.
2. Ranga Raju K.G., Flow through Open Channels, Tata McGraw–Hill, New Delhi,1997.
3. Bhave P.R, Analysis of Flow in Water Distribution Network, Technomic Publishing Co., Lancaster, USA, 1996.
4. Bear, Jacob. Hydraulics of ground water, McGraw Hill Inc.1979.
5. Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
6. Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	0	3	1	2	2
CO2	2	0	3	2	2	2
CO3	2	0	3	2	2	3
CO4	2	1	3	3	2	3
CO5	2	2	3	3	3	3

CE 619 SUSTAINABLE WASTE MANAGEMENT

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Introduce the concept of sustainability.
CO2	Compare different methods of network analysis.
CO3	Understand the concept and design of water conservation techniques
CO4	Design of natural and decentralized treatment
CO5	Design of various systems for waste management

2. Syllabus

- **INTRODUCTION (06 Hours)**
  Concept of sustainability in water and waste management – Environmental indices-Bio remediation

- **WATER CONSERVATION (12 Hours)**
  Rainwater Harvesting – Roof water harvesting – Technology – Quality – Health issues – Groundwater recharge – Techniques – Case studies – Wastewater reuse and reclamation.

- **NATURAL WASTEWATER TREATMENT SYSTEMS (10 Hours)**
  Centralized Vs decentralized – Natural and constructed wetlands – Different types – Mechanisms. Performance – Design – Case studies – Land treatment systems.

- **LOW–COST SANITATION (08 Hours)**
  Dry sanitation methods – Pit latrines – VIP latrines – Aquaprivy – Septic tank

- **ORGANIC SOLID WASTE MANAGEMENT TECHNIQUES (09 Hours)**
  Composting/vermicomposting – Biogas technology – Plasma technology

(Total Lectures: 45 hours)

3. Books Recommended

1. Cites R.W., Middlebrooks E.J., Reed S.C., Natural wastewater Treatment Systems, CRC Taylor and Francis, 2006.
2. Cairncross S., Feachem R. Environmental Health Engineering in the Tropics; John Wiley & Sons 1993.
3. Bajwa, G.S. Practical Handbook on Public Health Engineering, Deep Publishers, Simla, 2003.
4. White, I.D, Mottershed, D.N and Harrison, S.L., Environmental Systems – An Introductory Text, Chapman Hall, London, 1994.
5. Martin, A.M., Biological Degradation of Wastes, Elsevier Appl. Science, New York, 1991.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	1	1	1	1
CO2	3	1	1	1	2	1
CO3	3	1	2	1	2	2
CO4	3	2	3	3	3	3
CO5	3	2	3	3	3	3

CE 621 GLOBAL CLIMATIC CHANGES AND DISASTER

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the scientific basis of the greenhouse effect and climate change.
CO2	Understand how climate change has the potential to exacerbate catastrophic pollution events.
CO3	Evaluate the social and economic externalities of climate change.
CO4	Integrate knowledge on different aspects of the natural and manmade emergencies and disaster.
CO5	Formulate strategies for mitigation in future scenarios from lessons learned from earlier disasters.

2. Syllabus

- **BASICS OF CLIMATE CHANGE STUDY (12 Hours)**
  Climate, weather and Climate Change; – Overview of Earth's Atmosphere; Layers of Atmosphere; – Temperature, Radiation and Variation; – Heat- Balance of Earth Atmosphere System; – Temporal Variation of Air temperature; – Temperature Change in Soil; – Thermal Time and Temperature Extremes, – Hydrologic cycle. – Climate Variability like Floods, Droughts, Drought Indicators, Heat waves, Climate Extremes Causes of Climate Change; – Modelling of Climate Change, Kyoto Protocol Montreal protocol and IPCC Scenarios, difference between climate change and climate variability Carbon trading and clean development mechanism Role of countries and citizens in containing in global warming

- **INTRODUCTION TO DISASTER (09 Hours)**
  Overview of disaster, major natural disasters – flood, tropical cyclone, droughts, landslides, heat waves, earthquakes, fire hazards, tsunami, etc. – Factors for disaster – climatic change and global sea rise, erosion, environmental degradation, large dams and earthquakes, road building and landslides, Chemical and Biological weapons – case studies.

- **DISASTER MANAGEMENT AND ITS MITIGATION (12 Hours)**
  Techniques of monitoring and design against the disasters. – Management issues related to disaster; – Mitigation through capacity building, legislative responsibilities of disaster management; – Disaster mapping, assessment, pre-disaster risk and vulnerability reduction, post disaster recovery and rehabilitation; disaster related infrastructure development. – Disaster management plan, national crisis management committee, state crisis management group.

- **EMERGENCY WATER SUPPLY AND SANITATION (12 Hours)**
  Water supply preparedness and protection, emergency water supply strategy, rural and urban emergencies. – Assessment of damage. – Emergency water supply schemes – Sources, quality, treatment, storage and distribution, operation and maintenance. Sanitation – Human waste and health, strategy for excreta disposal in emergencies, techniques for excreta disposal, disposal of wastewater, management of refuse.

(Total Lectures: 45 hours)

3. Books Recommended

1. Alexander D, Principles of emergency planning and management, Oxford University Press, 2002.
2. Hallow G. and Bullock J. Introduction to Emergency Management: Elsevier, 2002.
3. Anil Markandya, Climate Change and Sustainable Development: Prospects for Developing Countries, Routledge, 2002.
4. Jepma, C.J., and Munasinghe, M., Climate Change Policy - Facts, Issues and Analysis, Cambridge University Press, 1998.
5. R.B. Singh, Disaster Management, Rawat Publication, New Delhi, 2000
6. H.K. Gupta, Disaster Management, Universiters Press, India, 2003
7. M.C. Gupta Manuals on Natural Disaster management in India, National Centre for Disaster Management, IIPA, New Delhi, 2001

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	0	3	1	2	2
CO2	1	0	3	1	2	2
CO3	1	1	3	3	2	3
CO4	2	2	3	3	2	3
CO5	2	2	3	3	3	3

SEMESTER-2

L	T	P	C
3	1	0	4

CE 602- SOLID AND HAZARDOUS WASTE MANAGEMENT

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Describe solid and hazardous waste management issues and the related rules and regulations
CO2	Characterise and quantify solid and hazardous wastes.
CO3	Design collection, transportation and processing of waste management system.
CO4	Design disposal and treatment facility for solid and hazardous waste.
CO5	Design waste management facilities for biomedical, plastic, E waste and construction and demolition wastes

2. Syllabus

- **INTRODUCTION (05 Hours)**
  Solid waste sources – Nature and characteristics – Quantities and Qualities – Generation rates – Potential of disease – Nuisance and other problems.

- **COLLECTION AND STORAGE (10 Hours)**
  Solid waste management – Functional elements of solid waste–on–site storage –Collection and separation – Containers and its location – Collection systems and its example – physical , chemical and microbiological characteristics of waste – Vehicle routing – Route balance – Transfer station – Processing – Recovery and reuse.

- **PROCESSING OF MUNICIPAL SOLID WASTE (10 Hours)**
  Conveying and compacting waste – Shredding – Types of shredders – Shredders Design– Material separation – Types – Devices for material separation – Thermal processing of municipal solid waste – incinerator and pyrolysis – Refuse Drived fuel – Biological process like composting, vermi composting and biomethanation

- **DISPOSAL (08 Hours)**
  Disposal methods – Sanitary land filling – Planning – Site selection – Design – Landfill Process Monitoring Closure – Post closure monitoring – Other methods like incineration, pyrolysis, and composting, biological digestion.

- **HAZARDOUS WASTE MANAGEMENT (12 Hours)**
  Introduction to hazardous waste – Definition – Characterization and composition – TCLP test – Storage and transportation of hazardous waste – Labeling of hazardous waste – Physical, Chemical and Biological treatment of hazardous waste – Bioremediation of hazardous waste – Treatment of Bio medical – Nuclear waste and Radio – Active waste – Fly ash management and E-waste management

(Total Lectures: 45 hours)

3. Books Recommended

1. David Rimbers, Municipal Solid Waste Management: Pollution Technologies Review, Noyes Data Corporation, London. 1990.
2. Charles A. Wentz, Hazardous Waste Management, McGraw Hill, New York. 1995.
3. Tchobanoglous G., Solid Wastes: Engineering principles and Management issues, McGraw Hill Book Company, Delhi. 1977.
4. Michael D. Lagrega, Phillip L. Buckingham, Jeffrey C. Evans, Hazardous Waste Management McGraw Hill, New York. 1994
5. Gaynor W. Dawson, Basil W. Mercer, "Hazardous Waste Management" Wiley Interscience, New York. 1986

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2
CO2	2	1	2	1	2	2
CO3	2	2	3	2	3	3
CO4	2	2	3	2	3	3
CO5	2	2	3	3	3	3

CE 604 ENVIRONMENT IMPACT ASSESSMENT

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Interpret and explain the objectives and scope of EIA.
CO2	Categorize the importance of environmental attributes.
CO3	Describe the legal provisions and statutory requirement of environmental clearance.
CO4	Calculate the identification and prediction of environmental impacts of new/expansion projects.
CO5	Formulate an EIA for any given project.

2. Syllabus

- **EIA: INTRODUCTION AND PLANNING (15 Hours)**
  Evolution of EIA – EIA at project – Regional and policy levels – EIA legislative and Environmental clearance procedures in India – EIA methodologies – Screening and scoping criteria – Rapid and Comprehensive EIA – Environmental health impact assessment – Significance of public participation / hearing in EIA – Resettlement and rehabilitation issues.

- **EIA: METHODOLOGIES AND STRATEGIES (20 Hours)**
  Baseline collection of data – Significant impacts – Assessment of impacts of physical, biological and socio – economic environment – Impact prediction tools / techniques such as Adhoc method, checklist method etc – Development of environment management plan – Post project monitoring
  EIA report and EIS – Review process – EIA case studies / histories for industrial projects – water resources and irrigation projects – ports and harbours – mining – transportation and other projects sectors.

- **ENVIRONMENTAL MANAGEMENT (10 Hours)**
  Environmental Management plan – Disaster Management – Post project monitoring – Environmental Audit – Life cycle assessment – ISO –14000.

(Total Lectures: 45 hours)

3. Books Recommended

1. Larry W. Canter, "Environmental Impact Assessment", Tata Mcgraw Hill Co, Singapore, 1996.
2. Munn R.E., “Environmental Impact Assessment”, John Wiley & Sons, Toronto, 1979
3. Suresh K. Dhameja, “Environmental Engineering and Management”, S. K. Kataria & Sons, Delhi. 2004.
4. Relevant MoEF Notifications and CPCB / GPCB Acts & Rules. New Delhi, 2006.
5. Hillary, R., Environmental Management Systems and Cleaner Production, Wiley Publishers, New York, 1997.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	3
CO2	2	3	2	2	1	2
CO3	1	3	1	1	1	1
CO4	3	1	3	3	2	3
CO5	3	3	3	3	3	3

CE 606 INDUSTRIAL WASTE MANAGEMENT

L	T	P	C
3	1	0	4

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Explain the sources of industrial pollutants and its impact on the environment
CO2	Classify the pollutants from various industries
CO3	Develop plan and strategies using tools and techniques for prevention of pollution in industrial area.
CO4	Select advanced control technology for waste minimization programme.
CO5	Develop and formulate Waste Control strategies to minimise industrial pollution.

2. Syllabus

- **INTRODUCTION (05 Hours)**
  Sources of wastes – Industrial and domestic – Nature and characteristics of wastewater – Industrial wastewater and environmental impacts – Regulatory requirements for treatment of industrial wastewater – Toxicity of industrial effluents and Bioassay tests – Quality and quantity of industrial wastes.

- **INDUSTRIAL POLLUTION PREVENTION (10 Hours)**
  Prevention Vs Control of Industrial Pollution – Benefits and Barriers – Waste minimization – Source reduction – Techniques – Waste Audit – Mass balance – Evaluation of pollution prevention options – waste volume reduction – Waste strength reduction – Neutralization – Removal of suspended and colloidal solids – Removal of inorganic and dissolved solids – Disposal of sludge solids.

- **WASTEWATER REUSE AND RESIDUAL MANAGEMENT (10 Hours)**
  Individual and common effluent treatment plants – Zero effluent discharge systems – Wastewater quality requirements for its reuse – Residuals of industrial wastewater treatment – Quantification and characteristics of Sludge – Thickening, digestion, conditioning, dewatering and sludge disposal.

- **CASE STUDIES (20 Hours)**
  Industrial manufacturing process description– Wastewater characteristics– Source reduction options and waste treatment flow sheet for Textiles, Tanneries, Pulp and paper, metal finishing, Petroleum Refining, Pharmaceuticals, Sugar and Distilleries, Food Processing, fertilizers, Thermal Power Plants and Industrial Estates.

(Total Lectures: 45 hours)

3. Books Recommended

1. Frank Woodard, Industrial Waste Treatment Handbook, Butterworth–Heinemann, 2001.
2. Rao M.N. and Datta A.K., WastewaterTreatment, Oxford and IBH Publishing Co. Pvt. Ltd.
3. Nemerow N.L., Industrial Waste Treatment, Elsevier Science & Technology Books, 2006.
4. Eckenfelder- "Industrial Water pollution Control"- McGraw hill Company, New Delhi, 2001.

5. Frank Woodard, 'Industrial waste treatment Handbook', Butterworth Heinemann, New Delhi, 2001.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	3	2	2
CO2	1	0	3	3	2	2
CO3	2	1	3	3	2	2
CO4	2	1	3	3	3	3
CO5	3	2	3	3	3	3

CE 608- AIR POLLUTION AND CONTROL

L	T	P	C
3	1	0	4

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Identify the sources of air pollutants and their effects on various receptors
CO2	Understand the fate and transport of air pollutants under various meteorological conditions
CO3	Understand particulate and gaseous air pollutant sampling methods in the environment
CO4	Simulate the air pollution concentrations using various mathematical, numerical models and software
CO5	Design and apply pollution control devices for different environmental conditions.

2. Syllabus

- **AIR QUALITY AND STANDARDS (09 Hours)**
  Air Pollution – Definition – Sources and classification – Pollutant emission – Its effect on Health, vegetation, materials and atmosphere – Reactions of pollutants and their effects – Smoke–smog and ozone layer disturbance – Greenhouse effect – Ambient air and stack sampling – pollutant measurement methods– Principles and instruments – Air quality standards – Air pollution case studies.

- **AIR POLLUTION METEOROLOGY AND DIFFUSION/DISPERSION MODELS (15 Hours)**
  An introduction to air pollution meteorology – Atmospheric motion – Lapse rates – Atmospheric stability – Inversions and its effects on pollutants – Atmospheric diffusion of pollutants – Transport – Transformation and deposition of air contaminants – Removal processes– Maximum Mixing Depths – Plume rise – Types of dispersion models.

- **AIR POLLUTION CONTROL TECHNOLOGY (03 Hours)**
  Air pollution control principles – Control of particulate and gaseous emissions.

- **PARTICULATE CONTROL (08 Hours)**
  Settling chambers, cyclone separation – Wet collectors – Fabric filters, electrostatic precipitators and other removal methods like absorption – Adsorption and precipitation.

- **GASEOUS CONTROL (05 Hours)**
  Removal of gaseous pollutants by adsorption, absorption, reactions and other methods.

- **AUTOMOBILE POLLUTION (05 Hours)**
  Motor vehicle emissions – Combustion – Air fuel ratio – Emissions, engine modification for emission control – Catalytic converters.

(Total Lectures: 45 hours)

3. Books Recommended

1. Wark Kenneth and Warner C.F., Air pollution its origin and control. Harper and Row Publishers, New York, 1997.
2. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New

Delhi, 1995.
3. De Nevers H. Air Pollution Control Engineering, Mc Graw Hill, New York, 1995.
4. Griffin R.D., Principles of Air Quality Management. CRC Press Boca Raton, USA, 2000.
5. Richard W. Boubel , Fundamentals of Air pollution, Academic Press, New York, 1994.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	2
CO2	2	1	2	2	2	2
CO3	2	2	3	3	3	3
CO4	2	2	3	3	3	3
CO5	3	3	3	3	3	3

CE 612- ADVANCED ENVIRONMENTAL ENGINEERING LAB

L	T	P	C
0	0	4	2

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Identify suitable treatment processes for a given water and wastewater.
CO2	Apply physico-chemical and biological processes for water and wastewater treatment.
CO3	Characterize solid waste.
CO4	Determine air pollutants concentration in ambient air.
CO5	Determine first order and second order kinetics.

2. Practicals

1. Determination of optimum dosage of coagulants with Coagulation and flocculation Process
2. Determination of BOD rate constant
3. Filtration Performance Studies
4. Adsorption kinetics and equilibrium
5. Settling characteristics of solids
6. Removal of heavy metals by precipitation
7. pH Buffers and Buffering capacity
8. Study of Wastewater Disinfection
9. Study of Water Softening Process
10. Aeration and Coefficient of Aeration
11. Determination of MLSS and MLVSS
12. Study of Activated sludge Process
13. Analysis of solid wastes
14. Characterization of wastes from different industries
15. Study of Stack monitoring kit
16. Measurement of SPM, SOx and NO_X

(Total Contact Time: 60 Hours)

3. Books Recommended

1. Sawyer C.N., McCarty P.L., and Parkin G.F. Chemistry for Environmental Engineers, McGraw Hill, New Delhi, 1994.
2. Rittman B., McCarty P.L. and McCarty P., Environmental Biotechnology: Principles and Applications, McGraw–Hill, 2000.
3. De. A.K., "Environmental Chemistry", New Age International Ltd., New Delhi, 1995.
4. Standards Methods for the Examination of Water & Waste water", American Public health Association, Washington. D.C. 2005.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	3	3	2	2	3
CO2	2	3	3	2	2	3
CO3	2	2	3	2	2	3
CO4	2	2	3	2	2	3
CO5	2	2	3	2	2	3

CE 614- SEMINAR – II

L	T	P	C
0	0	2	1

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Collect the information on given specific area/topic.
CO2	Update with latest knowledge through exhaustive literature survey.
CO3	Collate the information to prepare a report.
CO4	Communicate effectively through skilful presentation.

2. Syllabus

- Each candidate is required to present one seminar on any chosen topic connected with the field of specialization. The topic shall be chosen in consultation with the concerned faculty. Preparation and Presentation of a seminar is intended to investigate an in–depth review of literature; to prepare a critical review and to develop confidence for making a good presentation. Assessment is based on the presentation and contents of the seminar report prepared. A report has to be submitted in the prescribed format and seminar shall be evaluated by the respective department committee.

- Expert Lectures can be arranged from various Environmental Consultants so that can student can get the exposure to field related problem

3. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	2	1	1	2	3
CO2	3	3	1	1	2	3
CO3	2	3	1	1	2	2
CO4	1	3	1	1	2	2

CE 616- ENVIRONMENTAL SYSTEM MODELLING

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand mathematical models with system definition and components.
CO2	Identify types of models and their applications
CO3	Select appropriate models for diffusion and dispersion of pollutants.
CO4	Develop simple models for transport and fate of different contaminants
CO5	Apply different soft computing techniques in environmental engineering.

2. Syllabus

- **INTRODUCTION (10 Hours)**
  Mathematical modelling and simulation – Defining systems and its components – Types of models and their applications – Evaluation of models – Graphical analysis – Quantitative analysis – Sensitivity analysis – Uncertainty analysis.

- **MODELS FOR TRANSPORT AND FATE OF CONTAMINANTS (25 Hours)**
  Mass and energy balance – Advection – Molecular diffusion – Dispersion – Their application in modelling of rivers-lakes, sediments, wetlands, subsurface flow and transport – Air pollution modelling. Modelling of volatilization, Chemical transformations, sorption/desorption, Photochemical transformations and Biological transformations. Models for activated sludge process – Anaerobic processes – Aquasim – Ginafit.

- **INTRODUCTION TO SOFT COMPUTING TECHNIQUES (10 Hours)**
  Analytic hierarchy process – Fuzzy set theory, Neural networks, Simple applications in environmental engineering

(Total Lectures: 45 hours)

3. Books Recommended

1. Ramaswami A., Milford J.B., Small M.J., Integrated Environmental Modeling – Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons, 2005.
2. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems, Oxford University Press, 1998.
3. Snape J.B., Dunn I.J., Ingham J. and Prenosil J., Dynamics of environmental bioprocesses, modelling and simulation Weinheim: VCH, 1995.
4. International Water Association – Activated sludge modelling ASM1 and ASM2 5. Chapra S.C., Surface Water Quality Modeling, McGraw–Hil, Inc., New York, 1997.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	0	3	2	1	2
CO2	2	0	3	2	2	2
CO3	3	2	3	2	2	3
CO4	3	2	3	2	3	3

CO5	3	2	3	3	3	3

CE 618 ADVANCED WATER AND WASTEWATER TREATMENT

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Design water distribution systems.
CO2	Design various physico-chemical units.
CO3	Develop hydraulic profile of treatment plants
CO4	Design various biological units for wastewater treatment.
CO5	Design sludge treatment units

2. Syllabus

- **WATER SUPPLY AND WASTEWATER COLLECTION SYSTEM (15 Hours)**
  Environmental engineering hydraulic design – Water distribution systems – Design of distribution systems – Hydraulic analysis – Distribution system components – Wastewater collection – Types of collection systems – Types of sewers – Design of urban sanitary and storm water sewers – Structural requirements of sewer under various conditions – Corrosion protection in sewers – Design of surface and subsurface drainage – Roadways and airport drainage – Design of water and wastewater pumping systems.

- **WATER TREATMENT SYSTEMS (15 Hours)**
  Design of intake structure – Detailed design of water treatment plant – Design of physicochemical unit operations – Screening – Grit – Removal equalization – Sedimentation – Floatation – Coagulation – Flocculation – Filtration – Disinfection – Membrane processes– Desalination – Ion–exchange – Aeration/gas transfer – Precipitation – Adsorption.

  Hydraulics of treatment plant – Flow measurement and hydraulic control points – Hydraulic analysis of unit operations – Hydraulic profile through the treatment plant.

- **DESIGN OF WASTEWATER TREATMENT SYSTEMS (15 Hours)**
  Design of screens – Grit chamber – Skimming tank – Flotation tank – Design of equalization tank
  Design of plug flow and complete mix activated sludge process – Secondary settling tank – Trickling filter – Bio tower, Rotating biological contactors – Sequencing batch reactor – oxidation ditch – Aerated lagoon.

  Design of oxidation ponds – Inhoff tank – Septic tank – Design of sludge digestion – Sludge thickening unit – Sludge trying bed – Incinerators – Design of anaerobic reactor – Design of anaerobic filter – UASB reactor – Design of disposal system.

(Total Lectures: 45 hours)

3. Books Recommended

1. Qasim S.R., Motley E.M. and Zhu G., Water Works Engineering, Prentice–Hall India, 2006.
2. Montgomery – Water Treatment Principles and Design, John Wiley and Sons.
3. Metcalf and Eddy Inc – Wastewater Engineering: Treatment, and Reuse, Tata McGraw

Hill, 2007.
4. Manual on water supply and Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1999.
5. Manual on Sewerage and Sewage Treatment", CPHEEO, Ministry of Urban Development, Government of India, New Delhi, 1993.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	2
CO2	2	1	3	3	2	2
CO3	2	1	3	3	3	3
CO4	2	1	3	3	3	3
CO5	2	1	3	3	3	3

CE 622 INDUSTRIAL SAFETY AND ENVIRONMENT

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the impact of industrial wastewater on environment.
CO2	Quantify and characterize waste generated from different industrial processes.
CO3	Apply industrial pollution prevention techniques.
CO4	Design wastewater treatment plant for a given industry.
CO5	Design advanced waste management system.

2. Syllabus

- **INTRODUCTION TO SAFETY STANDARDS (07 Hours)**
  Safety – Safety and Productivity – Role of Government – National Safety Council – Standards – ILO Model code of safety regulation / legislation – Factory Act – Boiler Act – Electricity Act – Workman's compensation act

- **PLANNING FOR SAFETY (05 Hours)**
  Purpose for planning – planning procedure – Range of plans – Safety policies – Elements of safety policy – Implementation

- **ACCIDENT AND INCIDENT INVESTIGATION (06 Hours)**
  Reporting and Analysis – Accident and Incident Investigation – Identifying the key factors and the immediate and basic causes. Corrective Action – Agencies investigating accident. Accident reporting: Report forms, writing reports, essential elements. Accident and Incident Analysis Standard classification of factors associated with accident – Record keeping.

- **PERSONAL PROTECTIVE EQUIPMENT (03 Hours)**
  Need for personal protection equipment – selection, applicable standards, supply, use, care & maintenance respiratory and non-respiratory personal protective equipment. – Classification and selection

- **OCCUPATIONAL HEALTH AND ERGONOMICS (12 Hours)**
  Ergonomics – Human-body – Health – Posture – Workplace or office ergonomics – Ergonomics for women at work – physical work and environment – Anthropometry – Work related stress – Causes of stress – Signs of stress – Measurement of stress – Stress management systems – Prevention – Stress health and productivity – Occupational safety and health Act – Health program – First Aid

- **SAFETY IN CHEMICAL INDUSTRY (06 Hours)**
  U.N Classification of Hazardous materials – Criteria for siting and layout of Chemical and Petrochemical Plants. Instrumentation for safe plant operations – Hazards in Unit Processes and Unit Operations, Control, precautions and prevention, specific safety measures for certain chemical industry like fertiliser, insecticide, pesticides-choler-alkali, explosives, polymer plants. pharmaceuticals, petro-chemical.

- **TRANSPORTATION OF HAZARDOUS MATERIALS (02 Hours)**

Safety Precautions for transporting hazardous, toxic, flammable, explosive, radioactive substances by all modes.

- **FIRE ENGINEERING (04 Hours)**

Chemistry of fire – Factors contributing towards fire – Classification of fires – Common causes of industrial fires – Determination of fire load – Design of building exists, etc. for fire safety – Fire resistance of building materials Prevention of fire – Portable extinguishers – Hydrant system, sprinkler system, introduction to Carbon-dioxide systems – Foam extinguisher system – Dry Chemical Extinguishing systems Halon replacement of fire fighting products – Fire detection and alarms system.

(Total Lectures: 45 hours)

3. Books Recommended

1. Anupama Prashar & Bansal, "Industrial Safety and Environment", S.K. Kataria & sons, New Delhi, 2005.
2. Agrawal S. K. "Industrial Environment Assessment and Strategy", APH PublishingCorporation, New Delhi, 1996.
3. Safety- Health and working conditions: Training Manual, National Safety Council, Mumbai,2000.
4. Suresh K. Dhameja, "Environmental Engineering and Management", S. K. Kataria & Sons, New Delhi. 2004.

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	3	3	2	2
CO2	2	1	3	3	2	2
CO3	2	1	3	3	3	3
CO4	2	1	3	3	3	3
CO5	2	1	3	3	3	3

L	T	P	C
3	0	0	3

CE 624 APPLICATION OF GIS AND REMOTE SENSING IN ENVIRONMENTAL ENGINEERING

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the Remote Sensing and GIS system for different data types.
CO2	Execute different techniques of image interpretation and processing.
CO3	Create different types of thematic maps.
CO4	Apply various spatial data analysis techniques.
CO5	Analyze and solve complex environmental engineering problems using GIS and Remote Sensing.

2. Syllabus

- **INTRODUCTION (04 Hours)**
  Introduction to GIS and Remote Sensing – Usefulness in Environmental Engineering

- **FUNDAMENTAL OF REMOTE SENSING AND ELECTRO MAGNETIC RADIATION(EMR) (06 Hours)**
  Definition – Components of Remote Sensing – Principles of Remote Sensing Energy Sources – Active and Passive Remote Sensing – Electro Magnetic Radiation (EMR) and the Electromagnetic Spectrum – Interaction of EMR With the Earth's Surface – Interactions with the Atmosphere

- **IMAGE INTERPRETATION AND DIGITAL IMAGE PROCESSING (07 Hours)**
  Interpretation Procedure – Strategies – Keys – Equipments – Digital Image Processing – Rectification and Restoration – Enhancement of Image – Image Transformation, Classification and Analysis

- **GEOGRAPHIC INFORMATION SYSTEM (07 Hours)**
  Components of GIS – GIS Data – Georeferenced data – Data input and output – Data Models – DBMS

- **SPATIAL DATA ANALYSIS (07 Hours)**
  GIS analysis functions – Retrieval – Reclassification –- Buffering and Neighbourhood – Overlaying – Data Output – Implementation of GIS

- **SOFTWARE (07 Hours)**
  GIS and Image interpretation Software – Salient features – Capabilities and Limitations

- **APPLICATIONS (07 Hours)**
  Application of Remote Sensing / GIS in Environmental Engineering – Case studies – Integration of GIS and Remote Sensing – Management and Monitoring of land, air, water pollution – conservation of resources and coastal zone management

(Total Lectures: 45 hours)

3. Books Recommended

1. Lilliesand T.M. and Kiefer R.W., Remote Sensing and image Interpretation , John Wiley and Sons, 1994.
2. Burrrough P.A and McDonnel R.A., Principles of Geographic Information Systems, Oxford university press, 1998
3. A.M. Chandra and S.K. Ghosh,Remote Sensing and Geographical information System, Narosa Publishing House, New Delhi, 2006
4. Bhatta B.,Remote Sensing and GIS, Oxford University Press, New Delhi, 2008
5. Stan Aronoff, "Geographical Information Systems", WDL Publications, Ottawa, Canada, 1989

4. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	1	2	1
CO2	1	1	2	2	2	2
CO3	1	2	2	2	2	2
CO4	2	1	2	3	2	3
CO5	3	2	3	3	3	3

CE 626 CLEANER PRODUCTION AND ENVIRONMENTAL MANAGEMENT SYSTEM

L	T	P	C
3	0	0	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Understand the concept of sustainable development
CO2	Create the Env management plan for industry.
CO3	Encourage the industry for pollution prevention and cleaner production
CO4	Develop the life cycle assessment of the product of industry.
CO5	Analyse the product in terms of environmental economics

2. Syllabus

- **ENVIRONMENT AND SUSTAINABLE MANAGEMENT (08 Hours)**
  Concepts of Sustainable Development – Indicators of Sustainability – Sustainability Strategies, Barriers to Sustainability – Resource degradation – Industrialization and Sustainable development – Socio economic policies for sustainable development

- **CLEANER PRODUCTION (08 Hours)**
  Clean development mechanism, cleaner Production (CP) in Achieving Sustainability – Principles and concepts of Cleaner Production – Role of Industry, Regulations to Encourage Pollution Prevention and Cleaner Production – Regulatory versus Market-Based Approaches

- **ENVIRONMENTAL MANAGEMENT SYSTEM IN INDUSTRY (12 Hours)**
  Source Reduction Techniques – Process and equipment optimization, reuse, recovery, recycle, raw material substitution – Preparing for the Site visits – Data and Information collection – Process Flow Diagram – Material Balance – CP Option Generation – Technical and Environmental Feasibility analysis – Economic valuation of alternatives – Total Cost Analysis – Pollution Prevention and Cleaner Production Awareness Plan – Waste audit – Environmental Statement – Green house gases and carbon credit – Carbon sequestration – Sustainable development through trade – carbon trading.

- **ENVIRONMENTAL MANAGEMENT TECHNIQUES (12 Hours)**
  Elements of Life Cycle Assessment **(**LCA) – Life Cycle Costing – Eco Labeling – Design for the Environment – International Environmental Standards – ISO 14001 – Environmental audit, Green building & green energy concepts and management – Industrial applications of CP, LCA, EMS and Environmental Audits – Green energy and green process management in Pharmaceutical, Construction, Textiles, Petroleum Refineries, Iron and Steel

- **ENVIRONMENTAL ECONOMICS (05 Hours)**
  Introduction – economic tools for evaluation – Economic development and social welfare consideration in socio economic developmental policies and planning.

3. Books Recommended

1. Paul L Bishop, Pollution Prevention: Fundamentals and Practice, McGraw Hill

International New york, 2000.
2. World Bank Group, Pollution Prevention and Abatement Handbook – Towards Cleaner Production, World Bank and UNEP, Washington D.C, 1998
3. Prasad Modak, C.Visvanathan and Mandar Parasnis ,Cleaner Production Audit, Environmental System Reviews, Asian Institute of Technology, Bangkok.1995
4. Kirkby, J., O' Keefe, P. and Timberlake, Sustainable Development, Earthscan Publication

5. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	2	2	1	2
CO2	1	1	3	2	1	2
CO3	2	1	3	2	2	2
CO4	2	1	3	2	3	3
CO5	2	2	3	3	3	3

SEMESTER-III

L	T	P	C
0	0	0	1

CE 801 SUMMER TRAINING

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Conduct onsite industrial visit for comprehensive field exposure.
CO2	Obtain practical knowhow about processes, emissions and discharges.
CO3	Understand the work culture and environment of industry
CO4	Identify the environmental engineering problems related to industry.

2. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	2	1	2	0	1	1
CO2	3	1	3	2	2	2
CO3	3	2	3	1	3	3
CO4	3	2	3	3	3	3

CE 803 PROJECT

L	T	P	C
0	0	6	3

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Inculcate the culture of working in group
CO2	Identify a field problem related to environmental issues.
CO3	Compare different methods/solutions through literature review/experiments
CO4	Design and implement optimum/sustainable solution.

2. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	1	1	0	0	3	2
CO2	2	1	2	2	3	2
CO3	2	3	2	2	3	3
CO4	2	3	3	2	3	3

CE 805 DISSERTATION PRELIMINARY

L	T	P	C
0	0	8	4

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Identify and investigate problems related to environmental issues
CO2	Conduct the comprehensive literature review
CO3	Propose the methodology for the identified problem.
CO4	Collate the information to prepare a report.

2. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1	2	3	2	3
CO2	3	3	3	2	1	3
CO3	2	2	3	3	3	3
CO4	2	3	3	2	3	3

SEMESTER-IV

L	T	P	C
0	0	20	10

CE 802 DISSERTATION

1. Course Outcomes (COs)

At the end of the course the students will be able to:

CO1	Analyze the preliminary results and if required, modify the proposed methodology
CO2	Conduct extensive analytical / modelling / experimental / field work
CO3	Propose effective sustainable solution for identified problem
CO4	Prepare a comprehensive report and communicate through a skillful presentation

2. Syllabus

- It is the continuation of the dissertation Preliminary. The Dissertation report is to be submitted at the end of the fourth semester. The evaluation of dissertation will be based on continuous internal assessment comprising presentation of the work proceed and external viva –voce examination.

- The main objective of dissertation work is to provide scope for original and independent study/research, to develop a theme and to demonstrate ability of using analytical approach independently. The theme or topic of dissertation should be within the framework of P.G. Programme.

- Thesis is prepared by each student under the supervision of the faculty advisor and to be submitted as per the specified time and the student has to defend his/her work at the viva-voce examination fixed by the Institute.

3. CO-PO-PSO_Mapping

	PO1	PO2	PO3	PSO1	PSO2	PSO3
CO1	3	1	1	3	2	2
CO2	3	2	2	3	2	3
CO3	3	2	3	3	2	2
CO4	1	3	3	3	1	3