



**GOKUL  
GLOBAL  
UNIVERSITY**

Approved By Govt. of Gujarat  
(Recognized by UGC under Section 22 & 2(f) of 1956)  
(Gujarat Private State University Act 4 of 2018)

# COURSE STRUCTURE

## MASTER OF ENGINEERING (ENVIRONMENTAL ENGINEERING)

### DEPARTMENT OF CIVIL ENGINEERING

Under

Choice Based Credit System (CBCS)



Faculty of Engineering  
**Hansaba College of Engineering & Technology**



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### **PROGRAMME OUTCOMES (POs)**

- PO-1. Apply the mathematics, science and engineering principles to understand the environmental issues and challenges.
- PO-2. Understand, identify, formulate and solve various environmental engineering problems.
- PO-3. Modelling environmental systems using modern tools and techniques.
- PO-4. Use modern engineering tools, software and equipment to analyze problems.
- PO-5. Introduce the principles and concepts of various aspects of sustainable development elements in the design and development projects or activities.
- PO-6. Pursue life-long learning as a means of enhancing the knowledge and skills in treatment technologies and management practices.
- PO-7. Enhance communication skill & successfully apply research aptitude among student to R&D activities & consultancy works.

### **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

- PSO-1. Design a system, component and/or process as per needs of the project with appropriate consideration for the environmental impact, public health and safety.
- PSO-2. Understand and assess the impact of engineering projects and solutions on the environment and society assess the potential environmental impacts of development projects and design mitigation measures.
- PSO-3. Independently carry out research / investigation to solve practical problems and write / present a substantial technical report / document.





**Semester-I**

SR. NO.	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	I	FEM110001	Research Skill & Methodology	2(1+0+2)	MLC
2	I	FEM110002	Disaster Management	0(2+0+0)	Audit 1
3	I	FEM115701	Analytical Method and Instrumentation in Environmental	5(4+0+2)	CORE 1
4	I	FEM115702	Fundamentals of Water & Wastewater Treatment	5(4+0+2)	CORE 2
5	I	FEM115703 FEM115704	1.Collection and Conveyance of Water and Wastewater 2.Environmental Monitoring	4(3+0+2)	PROGRAM ELECTIVE I
6	I	FEM115705 FEM115706	1. Environmental Impact Assessment 2.Environmental Management System	4(3+0+2)	PROGRAM ELECTIVE II
TOTAL				20	





**Semester -II**

<b>SR. NO.</b>	<b>SEMESTER</b>	<b>SUBJECT CODE</b>	<b>SUBJECT NAME</b>	<b>CREDIT</b>	<b>CATEGORY</b>
1	II	FEM120001	Research Paper Writing	0(2+0+0)	AUDIT 2
2	II	FEM125701	Air and Noise Pollution: Analysis, Treatment and Management	5(4+0+2)	CORE III
3	II	FEM125702	Solid & Hazardous Treatment and Management	5(4+0+2)	CORE IV
4	II	FEM125703 FEM125704	1. Environmental Audit 2. Environmental Modelling and Computational Methods	4(3+0+2)	PROGRAM ELECTIVE III
5	II	FEM125705 FEM125706	1. Environmental Legislation & Management 2. Fundamental of Sustainable Development & Cleaner Production Mechanism	4(3+0+2)	PROGRAM ELECTIVE IV
6	II	FEM125707	Mini Project with Seminar	3(0+0+6)	CORE
<b>TOTAL</b>				<b>21</b>	





**Semester -III**

SR. NO.	SEMESTER	SUBJECT CODE	SUBJECT NAME	CREDIT	CATEGORY
1	III	FEM135701	Internal Review 1	4(0+0+8)	Internal Review 1
2	III	FEM135702	Dissertation Phase I	6(0+0+12)	Dissertation
3	III	FEM135703 FEM135704	1.Industrial Safety 2. Waste to Energy	3(3+0+0)	Open Elective
4	III	FEM135705 FEM135706	1. Advanced Wastewater Treatment Technologies 2.Urban Environment & Sustainability	3(3+0+0)	Program Elective V
TOTAL				16	





**Semester -IV**

<b>SR. NO.</b>	<b>SEMESTER</b>	<b>SUBJECT CODE</b>	<b>SUBJECT NAME</b>	<b>CREDIT</b>	<b>CATEGORY</b>
1	IV	FEM145701	Internal Review - 2	4(0+0+8)	Dissertation
2	IV	FEM145702	Dissertation Phase-II	12(0+0+24)	Dissertation
<b>TOTAL</b>				<b>16</b>	





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Research Skill and Methodology	<b>Course code :</b>	FEM110001
<b>Course type :</b>	MLC	<b>Course credit :</b>	02

**Pre-requisite :** NA

**Rationale :** NA

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
1	0	2	3	2	00	00	50	50	100

**Course Objectives:**

The main objective of this course is to introduce the basic concepts in research methodology. This course addresses the issues inherent in selecting a research problem and discuss the techniques and tools to be employed in completing a research project. This will also enable the students to prepare report writing and framing Research proposals.

**Course Outcome:**

1. Conduct a quality literature review and find the research gap.
2. Identify an original and relevant problem and identify methods to find its solution.
3. Validate the model
4. Present and defend the solution obtained in an effective manner in written or spoken form
5. Take up and implement a research project/ study.

**Content:**

Unit No	Subject Content	Teaching Hours	(%) Weightage
1	<b>Introduction to Research:</b> Nature and Scope of Research, Information Based Decision	13	31





	<p>Making and Source of Knowledge. The Research Process, Basic approaches and Terminologies used in Research, Defining Research Problem and Framing Hypothesis, Preparing a Research Plan</p> <p><b>Defining the Research Problem and Research Design</b></p> <p>What is a Research Problem?, Selecting the Problem, Necessity of Defining the Problem, Meaning of Research Design, Need for Research Design, Future of a Good Design, Important Concepts Relating to Research Design, Different Research Design, Basic Principals of Experimental Designs</p>		
2	<p><b>Sampling Design</b></p> <p>Census and sample survey, Implications of a Sample Design, Steps in sampling Design, Criteria of Selecting a Sampling Procedure, Characteristics of a Good Sample Design, Different Types of sample Designs, How to Select a Random Sample, Random Sample from an Infinite Universe, Complex Random Sampling Designs</p> <p><b>Methods of Data Collection</b></p> <p>Collection of Primary Data, Observation Method, Interview Method, Collection of Data through Questionnaires, Collection of Data through Schedules, Difference between Questionnaires and Schedules, Some Other Methods of Data Collection, Collection of Secondary Data, Selection of Appropriate Method for Data Collection</p>	14	34
3	<p><b>Data Analysis</b></p> <p>Data Analysis and Presentation Editing and coding of data, tabulation, graphic presentation of data, cross tabulation, Testing of hypotheses; Parametric and nonparametric tests for Univariate and Bivariate data. Tests of association; simple linear regression and other non-parametric tests, Sampling techniques, Probability, Probability Distributions, Hypothesis Testing, Level of Significance and Confidence Interval, t-test, ANOVA, Correlation, Regression Analysis</p>	7	12
4	<p><b>Interpretation of Data and Paper Writing</b></p> <p>Layout of a Research Paper, Journals in Computer Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing, Plagiarism and Self-Plagiarism, Use of Encyclopedias, Research Guides, Handbook etc., Academic Databases for Computer Science Discipline.</p>	4	10







<b>5</b>	<b>Report Writing</b> Significance of Report Writing, Deferent Steps in Writing Report. Layout of the Research Report, Types of Report, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing a Research Report <b>Patent Rights</b> Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	<b>4</b>	<b>13</b>
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### Reference Books:

1. Research Methodology Methods and Techniques by C. R. Kothari, New Age International Publishers.
2. Research Methodology by D. K. Bhattacharyya, Excel Books Publications.
3. Research Methodology: A Guide for Researchers in Management and Social Sciences by Taylor, Sinha & Ghoshal, PHI Publications.

### List of Tutorials:

1. Difference between an experiment and survey.
2. Problems faced by researchers.
3. A research scholar has to work as a judge and derive the truth and not as a pleader who is only eager to prove his case in favour of his plaintiff. Justify the statement.
4. Examine the significance of research.
5. Research is much concerned with proper fact finding, analysis and evaluation. Do you agree? Support your answer.
6. Issues to be attended by researchers in formulating research problem.
7. Develop a research plan.
8. Different ways of sampling.
9. Merits and demerits of different data collection methods.
10. Interpretation is a fundamental component of research process. Justify the statement.
11. Layout of research report.

### List of Open-Source Software/learning website:

- Students can refer to video lectures available on the websites including NPTEL. Students can refer to the CDs which are available with some reference books.





Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	1	1	1	-	1	3	-	-	3
CO-2	-	1	1	1	-	1	3	-	-	3
CO-3	-	1	1	2	-	-	3	-	-	3
CO-4	-	1	1	1	-	1	3	-	-	3
CO-5	-	1	-	2	-	1	3	-	-	3





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester:** 1<sup>st</sup>

**Course title :** Disaster Management

**Course code :** FEM110002

**Course type :** Audit 1

**Course credit :** 00

**Pre-requisite :** Nil

**Rationale :** Nil

**Teaching Examination Scheme :**

Teaching (Hours/week)			Examination Scheme			
Lecture	Tutorial	Practical	Internal		External	Total
			Mid	CE		
02	00	00	30	00	70	100

**Course Objective:** The students should get familiar with the Disaster and its challenges. To gain understand approaches of Disaster Risk Reduction (DRR) and the relationship between vulnerability, disasters, disaster prevention and risk reduction.

**Course Outcome:**

- CO-1:** Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- CO-2:** Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- CO-3:** Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- CO-4:** Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.
- CO-5:** Understand impact of Disasters and realization of societal responsibilities.
- CO-6:** Apply Disaster management principles.

**Content:**

Unit	Description in detail	Teaching Hours	Weightage
I	<b>Introduction:</b> Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters:	<b>04</b>	<b>17%</b>





	Difference, Nature, Types And Magnitude.		
II	<b>Repercussions Of Disasters and Hazards:</b> Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War And Conflicts	<b>04</b>	<b>17%</b>
III	<b>Disaster Prone Areas In India:</b> Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	<b>04</b>	<b>17%</b>
IV	<b>Disaster Preparedness And Management:</b> Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness	<b>04</b>	<b>17%</b>
V	<b>Risk Assessment:</b> Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival. <b>Disaster Mitigation:</b> Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	<b>08</b>	<b>32%</b>

### Reference Books :

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "New Royal book Company
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies" ,Deep &Deep Publication Pvt. Ltd., New Delhi.





Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	1	1	1	-	1	-	-	-	-
CO-2	-	1	1	1	-	1	-	-	-	-
CO-3	-	2	1	1	1	1	-	-	-	-
CO-4	-	1	1	1	-	1	-	-	-	-
CO-5	-	2	1	1	1	1	-	-	-	-
CO-6	-	1	1	1	-	1	-	-	-	-





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Analytical Method and Instrumentation in Environmental	<b>Course code :</b>	FEM115701
<b>Course type :</b>	CORE 2	<b>Course credit :</b>	05

**Pre-requisite :** Fundamental knowledge of sensors & transducers

**Rationale :** Climate change is a big issue in today's scenario. Change in climate affecting not only the farmers but also affecting the living species on the earth. This subject will help to know the threats to environment, measurement of the parameters affecting the environment and control techniques by which such parameters are maintained at specified limit.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

**Course Objective:**

This course exposes the student to a variety of analytical techniques and instruments utilized in environmental chemical analysis.

**Course Outcome:**

1. Able to understand the fundamental characteristics, terminologies, sensing and transduction principles of various types of sensors and transducers used for environment monitoring.
2. Able to justify the use of an analytical instrument in monitoring and maintaining the quality of water and air for solving real world environmental problem.
3. Able to summarize and classify capabilities and limitations of analytical instruments.
4. Able to prepare a report on various cases of environmental parameters monitoring and control.
5. Perform hands-on experiments and computations relevant to Environmental engineering.





**Content:**

Sr. No	Content	Total Hrs	% Weightage
1	<b>Introduction:</b> Necessity of Instrumentation & Control for environment, sensor requirement for environment.	4	10%
2	<b>Quality of water:</b> Standards of raw & treated water, sources of water & their natural quality, effects of water quality. Water quality parameters. Water treatment: Requirement of water treatment facilities, process design. <b>Waste water monitoring:</b> Automatic waste water sampling, optimum waste water sampling locations, and waste water measurement techniques. Instrumentation set up for waste water treatment plant. Latest methods of waste water treatment plants.	16	30%
3	<b>Sedimentation &amp; flotation:</b> General equation for settling or rising of discrete particles, hindered settling, effect of temperature, viscosity, efficiency of an ideal settling basin, reduction in efficiency due to various causes, sludge, storage & removal, design criteria of settling tank, effect of temperature on coagulation.	8	20%
4	<b>Air pollution:</b> definitions, energy environment relationship, importance of air pollution, air pollution from thermal power plant, their characteristics & control. Air sampling methods & equipments, analytical methods for air pollution studies. Control of air pollution. Flue gas analysis for pollution control – Measurement of CO, carbon di-oxide, NOX and SOX, dust and smoke measurement.	8	20%
5	<b>Air monitoring:</b> measurement of ambient air quality. Flow monitoring: Air flow measurement, gas flow, non-open channel flow measurement, open channel waste water flow measurement. Rain water harvesting: necessity, methods, rate of NGOs municipal corporation, Govt., limitations. Quality assurance of storage water.	8	20%

**References Books:**



1. Environmental Instrumentation & Analysis Handbook by Randy D. Down and Jay H. Lehr, John-Wiley & Sons, ISBN 0-471-46354-X
2. Principles of Instrumental Analysis by Skoog, Holler, Nieman, Thomson books-cole publications, Sixth ed., 2006.
3. Introduction to Instrumental Analysis by Braun, Robert D., Pharma Book Syndicate, Hyderabad. 2006
4. Analytical Instrumentation by Sherman, R.E. and Rhodes L.J., ISA Press, New York, 1996.
5. Process Measurement and Analysis by Liptak B.G, 3rd Edition, Chilton Book Company, Pennsylvania, 1995.
6. Process / Industrial Instruments and Controls Handbook by Considine D.M, 4th Edition, McGraw Hill, Singapore, 1993.
7. Air pollution engineering – M. N. Rao & H. V. N. Rao
8. Air pollution control technology – Wark & Warner

#### Online Resources:

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

#### Practical/Activity :

1. To find out transmittance and absorbance of a given sample using colorimeter
2. Qualitative and quantitative analysis using UV-Visible spectrophotometer
3. To analyze a given water sample using turbidity meter
4. To detect hydrocarbon contents from a gas sample
5. Test and calibrate the pH electrode and pH meter.
6. To calibrate the conductivity meter and measure the conductivity of given sample.
7. Study of Gas Chromatograph
8. Study of HPLC system
9. Study of measurement for air polluting parameters like SO<sub>2</sub>, NO<sub>x</sub>, etc.
10. Prepare a report on weather stations
11. Prepare a visit report on water/waste water/ effluent treatment plant.
12. To design low cost analytical instrument.

**At least one industrial visit is preferable to any water/ waste water/ effluent treatment plant.**

#### Major Equipment:

Analytical instruments, Ambient condition monitoring system, etc.







Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	2	3	3	1	-	-	-	2	-
CO-2	2	2	2	3	2	-	-	1	1	-
CO-3	-	-	1	1	2	-	-	1	2	2
CO-4	1	2	3	2	2	1	-	2	2	1
CO-5	1	1	2	1	1	-	-	1	1	-





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Fundamentals of water and wastewater treatment	<b>Course code :</b>	FEM115702
<b>Course type :</b>	CORE 2	<b>Course credit :</b>	05

**Pre-requisite :** Student shall have studied basics of water & wastewater engineering

**Rationale :** To provide knowledge related to the requirement of water and wastewater treatment technologies and its design.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:** To apply knowledge of mathematics, physics, chemistry, and microbiology to solve and analyse engineering problems related to water and wastewater collection, transport, quality and treatment. To use the fundamental principles of mass balance, chemical kinetics and equilibrium to design water or wastewater reactors to achieve a desirable treatment goal.

**Course Outcome:**

1. Describe various types of process units used for preliminary and primary treatment, e.g. screening, equalization, primary settling and explain their functions.
2. Describe and explain how biological wastewater treatment removes pollutants.
3. Describe various biological wastewater treatment processes and recognize pros and cons of each process.
4. Explain the principles of the suspended and attached growth biological processes and the factors that influence and control these processes.
5. Describe a disinfection process in terms of contact time and chemicals usage.
6. Discuss wastewater treatment excess sludge handling, treatment, disposal and biosolids applications.

**Content:**





Sr. No.	Content	Total Hrs	% Weightage
1	<b>Quality and Quantity of Water:</b> Quantity and quality of water, Water demand, Drinking water standards, waste water effluent standards, water quality index, impurities in water and physical, chemical and biological characteristics of water. <b>Types of Wastewater Treatment:</b> Unit operations, physical process, chemical process, biological process, primary, secondary and tertiary treatment, water supply scheme, design period, layout of water and wastewater treatment plant, treatment plant selection	13	25%
2	<b>Physico-chemical Treatment of Water &amp; Wastewater:</b> Aeration and gas transfer, Coagulation, Rapid mixing and flocculation, coagulation processes, stability of colloids, destabilization of colloids, transport of colloidal particles, Jar test, Types of settling, Clariflocculation, Softening	5	25 %
3	<b>Filtration:</b> Theory of granular media filtration, classification of Filters, slow sand filters and rapid sand filters, Mechanism of filtration, modes of operation and operational problems, negative head and air binding: dual and multimedia filtration, pressure filters, principle of working. <b>Disinfection:</b> Disinfection mechanism, Factors affecting disinfection, Disinfection agents, ozonation, UV radiation	11	25 %
4	Biological Treatment for Wastewater: Types of biological treatment: Suspended & attached Growth Processes, Design Parameters for Biological Treatments, activated sludge and trickling filter processes, rotating biological Contactor, UASB  Advanced Water & Wastewater Treatment Methods: Ion Exchange process, Membrane Processes, Reverse Osmosis, Microfiltration, Nano-filtration, Dialysis and Electrodialysis and Nanotechnology.	13	25 %

### Reference Books:

1. Wastewater Engineering, Treatment and Reuse by Metcalf and Eddy, Tata McGraw-Hill Publication, New Delhi, 2003
2. Water & Waste Water Engineering by Fair and Gayer.
3. Introduction to Environmental Engineering by Mackenzie
4. Physicochemical processes for water quality control by Weber, W.J., John Wiley and sons, Newyork, 1983
5. Environmental Engineering by Peavy, H.S., Rowe, D.R. and Tchobanoglous, G.,



McGraw Hills, New York 1985

6. Water Quality and Treatment (A handbook of community water supplies 5th edition):  
Published by American Water Works Association.

#### Practical / Activities:

1. Introduction to Standards, collection and preservation of samples, sampling techniques and
2. laboratory equipment.
3. Physical Parameters of water & wastewater quality like turbidity, conductivity, colour and odour etc.
4. Major Chemical Characteristics of water & wastewater like Solids, DO, Chlorides, Hardness, Acidity, Alkalinity, heavy metals etc. using most modern instruments
5. Jar Test for determining optimum dosage of coagulant
6. Major Biological parameters of water using Presumptive, confirmative and completed test using appropriate culture media and microscope
7. Experimentation based on Optimum doses required for different field condition turbidity
8. Experiment on BOD and COD of water and wastewater
9. Model of water & wastewater treatments

#### Online Resources:

- <http://nptel.ac.in/>
- <http://elearning.vtu.ac.in/>

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	3	2	1	3	1	-	2	2	-
CO-2	1	2	3	2	3	1	-	3	2	2
CO-3	1	2	3	2	3	1	-	3	2	2
CO-4	1	2	3	2	3	1	-	3	2	1
CO-5	1	2	3	2	3	1	-	3	2	1
CO-6	2	2	3	2	3	1	-	2	2	-





**Program:** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Collection and Conveyance of Water and Waste Water	<b>Course code :</b>	FEM115703
<b>Course type :</b>	CORE 1	<b>Course credit :</b>	04

**Pre-requisite :** Student shall have studied basics of water & wastewater engineering

**Rationale :** To provide knowledge related to the requirement of water and wastewater and its design

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:** To enable the students understand about the drinking water, source, quality, demand conveyance, water treatment. To design of treatment unit, waste water treatment, STP, & solid waste collection, treatment along with house plumbing & different sanitary fitting learning outcomes.

**Course Outcome:**

1. Select or construct appropriate treatment schemes to remove certain pollutants present in water or wastewater
2. Design a water or wastewater treatment component.
3. Balance chemical reactions and use balanced reactions to determine the distribution of species at equilibrium.
4. Learn how to characterize source water, and the best Department Syllabus available technologies (BAT) for physical and chemical treatment of drinking water.
5. Learn how to characterize wastewater, and the BAT for physical, chemical and microbiological treatment of wastewater
6. Understand selected contemporary global water and wastewater issues such as water shortage, wastewater reuse and emerging contaminants.



**Content:**

Sr. No.	Content	Total Hrs	% Weightage
1	<b>Principle of Hydraulics:</b> Fluid properties, Types of fluid flow, Continuity principle, energy principle and moment principle, Flow through pipes and head losses, Flow measurement, Venturimeter, Orifice meter, Notches.	8	25 %
2	<b>Water Transmission and Sanitation:</b> Need for transport of water and wastewater, pipe network-water transmission main design, Gravity and Pumping, Water Hammer Low cost sanitation system: septic tank, soak pit	10	25 %
3	<b>Conveyance of water:</b> Water distribution networks, Analysis of water distribution system, Introduction of use of computer software in water transmission and water distribution. Storage capacity of reservoir. <b>Urban Storm Drainage system:</b> Necessity of Storm Drainage-Separate and Combined system, Rainfall Intensity-duration frequency curve estimation of runoff-control of storm water pollution-Rain water Harvesting	14	25 %
4	<b>Municipal Waste water Collection and Conveyance:</b> General design Principle of sewer, Method of Collection of sewer, Layout and design of municipal sewer, sewer appurtenances, sump well and sewage pumping, Recent development in sewerage system design-maintenance of sewers.	10	25 %

**References Books:**

1. “Manual on water supply and Treatment” by CPHEEO, Ministry of Urban Development, Government of India, New Delhi, Latest Edition.
2. “Manual on Sewerage and Sewage Treatment” by CPHEEO, Ministry of Urban Development, Government of India, New Delhi, Latest Edition.
3. Water Supply and Sanitary Engineering by G.S. Birdie and J.S. Birdie, Dhanpat Rai Publishing Co.-New Delhi
4. Wastewater Engineering: Treatment, disposal Reuse by Metcalf and Eddy, (Revised by G. Tchobanoglous) Tata-McGraw Hill, New Delhi
5. Practical Handbook on Public Health Engineering by Bajwa, G.S. Deep Publishers, Shimla, 2003



6. Water Supply and Pollution Control by Viesman, Hammer, Dun Donnelley Publisher, New York

#### Online Resources:

3. <http://elearning.vtu.ac.in/>
4. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

#### Practical / Activities:

1. Numerical on various methods of Population Projection, water demand and waste water generation
2. Design of water distribution network by hardy cross method.
3. Design of Sewer Network.
4. Estimation of storm water runoff
5. Basic Application of Water GEMS and Sewer GEMS for water distribution and sewage network.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	3	2	1	3	1	-	2	2	1
CO-2	1	2	3	2	3	1	-	3	2	-
CO-3	2	2	3	2	3	1	-	3	2	1
CO-4	2	2	3	2	3	1	-	3	2	2
CO-5	1	2	3	2	3	2	-	3	2	1
CO-6	2	2	3	2	3	2	-	2	2	-





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Environmental Monitoring	<b>Course code :</b>	FEM115704
<b>Course type :</b>	PROGRAM ELECTIVE I	<b>Course credit :</b>	04

**Pre-requisite :** Fundamentals of Environmental Monitoring

**Rationale :** Nil

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

- To develop sampling and analytical skills of the students which are required in environmental monitoring.
- The students will be able to perform quantitative analysis of various physical, chemical and biological parameters involved in water, air, soil and microbiology research.

**Course Outcome:**

After learning the course, the students should be able to:

- Describe the need and importance of environmental monitoring in environmental engineering field and problems associated with it.
- Identify the pros and cons of various approaches to monitoring the environmental data.
- Use sampling techniques.
- Prepare different solutions during analytical procedures for determination of water and air pollutants content.







5. Prepare and interpret monitoring report/s.

**Content**

Unit	Description in detail	Hours	Weightage
I	ENVIRONMENTAL MONITORING. 1.1 Definition, Objectives and Functions of monitoring. 1.2 Selection of monitoring sites. 1.3 Types of monitoring Programme. PROBLEMS ASSOCIATED WITH MONITORING. 2.1 Environmental Variability. 2.2 Place and location of monitoring. 2.3 Time of monitoring.	6	15%
II	SAMPLES AND TESTS. 3.1 Sampling- Grab, Composite, Integrated Composite etc 3.2 Sampling frequency and preservation. 3.2.1. Sampling frequency. 3.2.2 Sample container. 3.2.3. Water samplers. 3.2.4. Sample collection. 3.2.5. Labeling of container & transportation of samples. 3.2.6. Time interval between collection & analysis. 3.2.7. Preservation of water samples. 3.3. Preparation of Standard Solutions. 3.3.1 Important terms for expressing the concentration of a solution like, primary standards, secondary standards, stock solution, standard solutions, normality, molarity, percent solution. 3.3.2. Standardization of solutions. 3.3.3. Expression of results: mg/l, ppm.	6	15%
III	ERRORS & TREATMENT OF ANALYTICAL DATA. 4.1 Error : Determinate Error , Indeterminate Error. 4.2 Accuracy & Precision. 4.3 Distribution of random errors. 4.3.1 Frequency distributions. 4.3.2 Statistical treatment of finite samples.	5	15%
IV	WATER QUALITY MONITORING. 5.1 Determination of physical water characteristics. 5.1.1. Color True & apparent color, Temperature, Odor, Taste, Turbidity – Visual & Instrumental method, Solids - Total solids, Total Suspended Solids, Total Dissolved Solids. 5.2 Determination of inorganic & non-metallic constituents. 5.2.1. pH : Potentiometric method. 5.2.2. Alkalinity, Hardness, Acidity, Sulfate by titration method. 5.2.3. Nonmetallic constituents : Chloride, Fluoride, Sulfide, Sulfite. 5.3 Determination of metallic constituents. 5.3.1. Chromium, Fe, Copper by spectrophotometer. 5.4 Determination of organic constituents. 5.4.1. BOD, COD, TOC, Oil & Grease, Surfactants. 5.5 Structure of monitoring report for water quality monitoring.	9	25%
V	AIR QUALITY MONITORING. 6.1 Ambient Air Quality monitoring. 6.2. Source Air Quality monitoring. 6.3. Frequency	16	30%





	& mode of sampling , sampling time and sampling locations for Air Quality monitoring. 6.4. Environmental Procedure for determination of NO <sub>x</sub> , SO <sub>x</sub> , CO, SPM 6.5. Structure of monitoring report for Air Quality monitoring.		
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**Reference Books:**

- Air Pollution; Causes and Effective control by, R.K. ARRORA
- Air Pollution Control by, S.P. MAHAJAN
- Air Pollution Control In Industries by, T.K.RAY
- Air Pollution by, S. K. AGARWAL
- Air Pollution and Its Control by, Summit Malhotra
- Air pollution by Wark & Worner.

**Online Resources:**

- <http://elearning.vtu.ac.in/>
- [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

**Practical / Activities:**

- Tutorial based on classification of air pollution.
- Tutorial based on sources of pollution & its effect.
- Tutorial based on meteorology.
- Tutorial based on air pollution sampling & measurements.
- Tutorial based on air pollution control methods & equipment.
- Tutorial based on control of specific gaseous pollutants.
- Seminar May be arranged in group of three students. Students should report their seminar.

**Note:** - Technical Visit Must Be Arranged on Air Pollution Control System

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	3	2	3	3	2	-	2	3	-
CO-2	1	2	3	2	3	1	-	3	2	1
CO-3	2	2	3	2	3	1	-	3	2	2
CO-4	2	2	3	2	3	1	-	3	2	-
CO-5	1	1	2	2	2	2	1	3	2	1





**Program:** Master of Engineering

**Subject / Branch :**Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :**1<sup>st</sup>

<b>Course title :</b>	Environmental Impact Assessment	<b>Course code :</b>	FEM115705
<b>Course type :</b>	PROGRAMELECTIVE II	<b>Course credit :</b>	04

**Pre-requisite :** Sustainable Development, environmental studies, environmental statement etc

**Rationale :** The purpose of EIA is to identify potential environmental impacts from proposals, such as projects and programs, and to propose means to avoid or reduce the significant impacts.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

To minimize the adverse impacts of developmental projects. The online / classroom training course has been designed to capacitate environmentalists and prospective environmentalists to develop a better understanding of the EIA process.

**Course Outcome:**

1. Prepare portions of environmental documents through administrative and legal Requirements and standards of professional practice.
2. Fully participate in interdisciplinary environmental report preparation teams.
3. Critically review an EIA document for completeness and adequacy.
4. Analyze proposed development project plans for possible environmental effects and prepare appropriate initial studies.
5. Utilize EIA documents for policy development, project planning or for legal or political action planning.
6. Illustrate the necessity of public participation in EIA studies.

**Content:**





Sr. No.	Content	Total Hrs	% Weightage
1	<b>Introduction and Basic Concept of EIA:</b> Concept of Sustainable Development, Evolution of EIA, concepts, Screening, Scoping, Base line studies, Mitigation, General Structure of EIA, EIS, Limitation of EIA, Environmental Risk Assessment	06	25 %
2	<b>Methodologies and strategies:</b> Impact prediction techniques, Adhoc Method, Checklist, Matrix, Network methods, Cost benefit Analysis, Public participation, public hearing procedure	12	25 %
3	<b>Practical Consideration and Case studies:</b> Economic development and environmental degradation, environmental impacts of typical industries, power plant, larger projects, present scenario of various government resolution on selecting the location of industries, case studies related to infrastructure, mining, thermal power plant, hydro electric, Nuclear power Plant.	12	25 %
4	<b>EIA Notification by MOEF(Govt. of India):</b> Provision in the EIA notification, categorization of Industries for seeking environmental clearance from concern authorities, Procedure for environmental clearance, Procedure for conducting EIA Report, Rapid and Comprehensive EIA. <b>Environmental Management:</b> Environmental Management Plan, Post Environmental monitoring, Life cycle assessment, ISO-14000	12	25 %

#### Reference Books:

1. Environmental Impact Assessment: By Larry Canter, Mc Graw Hill Pub.
2. Handbook of EIA by John Ray and Rau Whooteen
3. Environmental Impact Analysis - a Decision Making Tool: By R K Jain, L. V. Urban and G.S. Stacey Publishers : van Nostrand reinhold New York
4. Handbook of Environment Impact Assessment: By Judith Prett
5. Theory and Practice of Environmental Impact assessment: By Abbasi and Ramesh
6. Environmental Impact Assessment: By Shrivastava Environmental Impact Assessment and Statement. John E. Heer, Joseph Hoggerty.

#### Online Resources:

1. [http://eia.unu.edu/course/index.html%3Fpage\\_id=173.html](http://eia.unu.edu/course/index.html%3Fpage_id=173.html)
2. <http://elearning.vtu.ac.in/>

#### Practical / Activities:

1. Delphi technique for assigning significance to Environmental Attributes.
2. Adhoc Method of EIA





3. Matrices Method of EIA
4. Network Method of EIA
5. Overlays Method of EIA
6. Visit to a Project site/ Office of EIA expert
7. A report of EIA is to be prepared by a student on the project of his specialization.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	1	2	2	1	1	-	2	3	-
CO-2	1	1	2	2	1	1	-	2	3	1
CO-3	1	1	2	2	1	1	-	2	3	-
CO-4	1	2	3	2	1	1	-	3	2	2
CO-5	1	2	3	2	1	1	-	3	2	-
CO-6	1	2	2	2	1	1	-	2	2	1





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 1<sup>st</sup>

<b>Course title :</b>	Environmental Management System	<b>Course code :</b>	FEM115706
<b>Course type :</b>	PROGRAM ELECTIVE II	<b>Course credit :</b>	04

**Pre-requisite :** Fundamentals of Environmental Management system.

**Rationale :** As the concept of curbing pollution changes from end-of-pipe solutions to pollution prevention, it becomes vital for students to become acquainted with the complex and trans-disciplinary nature of environmental management issues specially in a corporate setting and of the inherent challenges in multidisciplinary group approaches. Students are then introduced to the wide range of tools used in environmental management and for environmental decision-making. To conclude the course, the evolution of environmental management from being a side issue for firms to becoming a core issue and newer approaches are discussed so that firms practice sustainable management is discussed.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

- Understand environmental management system (EMS) definitions, concepts, and guidelines and requirements of the ISO 14001 standard.
- Understand the stages of EMS implementation, learn best practice techniques, apply environmental management principles to achieve continual improvement in an organization
- To provide a basic understanding of various tools and techniques such life cycle assessment, environmental audits, evaluation of environmental performance for environmental decision-making

**Course Outcome:**



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After learning the course, the students should be able to:

- Acquainted with the environmental management system and its benefits
- Able to identify and review audit-related documentation, prepare checklists and audit process
- Able to apply tools such life cycle assessment & environmental audits.
- Able to evaluation of environmental performance for environmental decision-making.
- To evaluate the effectiveness of systematic EMS monitoring processes.

**Content:**

Unit	Description in detail	Hours	Weightage
I	The context of environmental management, overview of the state of the global environment, the earth's natural systems, sustainability and sustainable development–Case study Introduction to the evaluation tools, environmental management system (EMS), organizational barriers, management responsibility, elements and extent of application, EMS structure	6	20%
II	ISO 14000-Background, the ISO 14000 series, business and standards, voluntary standards and GATT/WTO, ISO 14000 and world practice, ISO 14000 in US, ISO Europe, international chamber of commerce principles, ISO in developing world; ISO 14001 & elements of EMS environmental policy, planning, implementation and operation checking & correction action and management review–Case study	8	25%
III	Auditing Scope and objectives, standards for auditing, registration, implementing the audit, procedures, benefits, environmental auditing as a management tool-Case study Life Cycle Assessment Components of LCA, measuring environmental impact (life-cycle stages of product, boundaries, functional unit, issues at each life-cycle stage, benefits of LCA), strategic framework for LCA and LCA-a tool for sustainability-Case study	16	30%
IV	Newer concepts of corporate environmental management product design for the environment (ISO 14062), product stewardship, principles of clean production, packaging, sustainable procurement, the social responsibility function of corporations, ecolabelling, ecological and carbon footprints (ISO 14064-65)–Case study Evaluating Environmental Performance Collecting data, analyzing data, evaluating information, reporting and communicating, reviewing–Case study	12	25%





Minor project and presentations: Mid-term and at the end of the semester		
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### Reference Books:

- Christopher S. and Mark Y. (2007) Environmental Management Systems, (third edition), Earthscan Publications, First South Asian Edition.
- David L.G. and Stanley B.D. (2001) ISO 14000 Environmental Management, Prentice Hall.
- Earthscan J.B. (edited) (2005) Environmental Management in Organizations, the IEMA Handbook (Sections 1.1, 1.2, 1.3, 3.2, 3.4, 4.3, 4.4, 5.3).
- Gilbert M.M. (2004) Introduction to Environmental Engineering and Science, Second Edition, Pearson Education.
- Harrison R.M. (edited) (2001) Pollution: Sources, Effects and Control, (selected chapters), Royal Society of Chemistry.
- LaGrega M.D., Buckingham P.L. and Evans J.C. (1994) Hazardous Waste Management, McGrawHill International Edition, New York.
- Madu C.N. (2007) Environmental Planning and Management, Imperial College Press, (Chapters 2, 3, 4, 6, 7, 8, 10).

### Online Resources:

- <http://elearning.vtu.ac.in/>
- [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

### Practical / Activities:

Tutorial contain with different topic suggested as per syllabus.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	3	3	1	3	1	-	2	3	1
CO-2	-	1	2	2	1	1	-	2	3	2
CO-3	-	2	2	2	1	1	-	2	3	-
CO-4	-	2	3	2	1	1	-	3	2	1
CO-5	-	2	3	2	1	1	-	3	2	-







**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Research Paper Writing	<b>Course code :</b>	FEM120001
<b>Course type :</b>	Audit Course	<b>Course credit :</b>	00

**Pre-requisite :** NA

**Rationale :**

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
2	0	0	2	2	70	30	00	00	100

**Course Objectives:**

To familiarize students with the fundamentals of research. Understand that how to improve your writing skills and level of readability. Learn about what to write in each section. Understand the skills needed when writing a title ensure the good quality of paper at very first-time submission.

**Course Outcome:**

CO 1: Understand that how to improve your writing skills and level of readability.

CO 2: Learn about what to write in each section.

CO 3: Understand the skills needed when writing a Title.

CO 4: Ensure the good quality of paper at very first-time submission

CO 5: Relate the quantum concepts in electron microscopes

CO 6: Describe the unit cell characteristics and the growth of crystals.

**Content:**

Sr. No.	Subject Content	Teaching Hours	(%) Weightage





1.	Planning and Preparation, Word Order, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4	17
2.	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4	17
3.	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check	4	17
4.	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature	4	17
5.	skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions , useful phrases, how to ensure paper is as good as it could possibly be the first-time submission	08	32

#### Reference Books:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book
4. Adrian Wallwork, English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	1	1	1	-	1	3	-	-	3
CO-2	-	1	1	1	-	1	3	-	-	3
CO-3	-	1	1	2	-	-	3	-	-	3
CO-4	-	1	1	1	-	1	3	-	-	3
CO-5	-	1	-	2	-	1	3	-	-	3
CO-6	-	-	-	-	-	-	-	-	-	-





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Air and Noise Pollution: Analysis Treatment and Management	<b>Course code :</b>	FEM125701
<b>Course type :</b>	CORE III	<b>Course credit :</b>	05

**Pre-requisite :** Basics & Fundamentals of air and noise pollution

**Rationale :** Select appropriate technology to control the emission of pollutants.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
4	0	2	6	5	70	30	30	20	150

**Course Objective:**

To enable the students about Ambient Air Quality Monitoring of different locations. To enable the students about various pollution. To enable the students about stack monitoring.

**Course Outcome:**

- CO-1:** Evaluate the impacts of air pollution on human, vegetation and animal.
- CO-2:** Prepare plan strategies to control and reduce air pollution.
- CO-3:** Identify the sources of air and noise pollution.
- CO-4:** Monitor the ambient air quality.
- CO-5:** Understand the concepts involved in control technologies.
- CO-6:** Identify the sources of vehicular pollution & prevention.

**Content:**

Sr.	Content	Total Hrs	% Weightage





1	<b>Air pollution:</b> Definition, sources and types of air pollution, effects of air pollution measurement unit of air pollution, Ambient air quality standards, air quality in dices, global and local level scenario of air pollution. <b>Meteorology:</b> Introduction, Role of meteorology in environmental engineering, types of lapse rates, stability conditions, wind velocity profile, maximum mixing depth, wind rose diagram, inversion, plume rise and plume behaviour	12	25%
2	<b>Modelling of Dispersion of Air Pollutants:</b> Wind Dispersion, Dispersion models, Gaussian Plume Equation with assumptions, Point source dispersion formula, other mathematical modelling for dispersion of air pollutants, determination of effective stack height <b>Sampling and control methods for Particulate Pollution and Gaseous pollution :</b> Atmospheric sampling and analysis for grit, dust, smoke, Sulphur dioxide, Carbon Monoxide, Hydrocarbon, Oxides of Nitrogen, Ozone, Types of Gaseous Pollution Control Methods–Absorption, Adsorption and Combustion Processes.	10	25 %
3	<b>Vehicular pollution:</b> Vehicular Pollution, Emission Standards for Indian Context, Influencing Parameters for Vehicular Emissions, Remedial Measures, Catalytic Converters, Exhaust Gas Recirculation, Current Practices for Controlling Emissions	10	25 %
4	<b>Noise Pollution:</b> Source sand Effects of Noise Pollution, Noise Emission Immersion, Measurement Of Noise, Legislative Standards, Pathand Receptors of Noise	10	25 %

### References Books:

1. Air Pollution by M.N. Rao Tata Mc-Graw Hill Publication
2. Air Pollution control Engineering by NoeldeNevers,Mc-GrawHillPublication,NewYork.
3. Environmental Engineering by Peavyand Rowe, Mc-Graw Hill Publication
4. Environmental Engineering by Davis. Mc-Graw Hill Publication
5. Environmental Engineering Hand Book by Leeand Liptak ChiltanBook Co.,Philadelphia.
6. Rao C.S., Environmental pollution control Engineering, New age international Ltd, New Delhi,1995.
7. Air Pollution and Control By K.V.S.G.MuraliKrishna,KindleEdition
8. Environmental Pollution Control Engineering by C.S.Rao, New Age International Publication
9. Control of Noise Pollution by N.S. Kamboj, Deep & Deep Publications
10. Noise Measurement and Control by Lord NT homas, HEYWOOD& Company Ltd.
11. Noise Control in Industry by E.&F.N.Spon, Sound Research Laboratories Ltd.





**Online Resources:**

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

**Practical / Activities:**

1. Experiment based on Instrument of High-Volume Air Sampler (PM 10) and PM2.5 for Ambient Air Quality Monitoring of Different locations.
2. Experiment based on Stack Monitoring Kit for Stack Monitoring in different Industries.
3. Experiment on Noise level Measurement of Different Areas.
4. Exercise on effects of combination of different sound
5. Report of an noisy area of a town ship and creation contour of loudness
6. Visit of field for noise pollution
7. Preparation report of field visit
8. Presentation of report

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	3	3	2	2	1	-	2	3	-
CO-2	-	3	2	2	1	1	-	2	3	2
CO-3	-	1	2	2	1	1	-	2	3	3
CO-4	1	2	3	2	1	1	-	3	2	-
CO-5	-	2	3	2	1	1	-	3	2	2
CO-6	1	2	2	2	1	1	-	2	2	-



**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Solid And Hazardous Treatment & Management	<b>Course code :</b>	FEM125702
<b>Course type :</b>	CORE IV	<b>Course credit :</b>	05

**Pre-requisite :** Fundamentals of Environmental Systems.

**Rationale :** To understand the dynamics of environmental system and control the parameters causing deterioration of environment system

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

Understanding of problems of municipal waste, biomedical waste, hazardous waste, e-waste, industrial waste etc. To enable the students about various pollution. Knowledge of legal, institutional and financial aspects of management of solid wastes. Become aware of Environment and health impacts solid waste mismanagement. Understand engineering, financial and technical options for waste management.

**Course Outcome:**

**CO-1:** Classify & identify of sources of solid waste.

**CO-2:** Understand various physical, chemical and biological characteristics of solid waste and know the generation rates of various solid waste.

**CO-3:** Describe the major environmental problems caused by in appropriate production and disposal of solid by-products manufacturing and consumption.

**CO-4:** Analyze the role of regulatory systems in solid & hazardous wastes management.

**CO-5:** Assess hazardous & solid treatment and disposal.



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**CO-6:** Assess and design waste recycling, reuse, recovery, treatment and disposal.

**Content:**

Sr.	Content	Total Hrs	% Weightage
1	<p><b>Introduction:</b> Solid waste sources – Types and sources – Generation rates– Potential of disease –Nuisance and other problems–Need for solid and hazardous waste management–Elements of integrated waste management and roles of stakeholders–Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes, electronic wastes, plastics waste.</p> <p><b>Waste Characterization and Source Reduction:</b> Waste generation rates and variation–Composition, physical, chemical and biological properties of solid wastes–Hazardous Characteristics–TCL Pest’s–waste sampling and characterization plan–Source reduction of wastes–Recycling and reuse.</p>	12	30%
2	<p><b>Storage, Collection and Transport of Wastes</b> Functional elements of solid waste–Handling and segregation of wastes at source–Collection and separation–Containers and its location–Collection systems and its example – physical, chemical and microbiological characteristics of waste – - Need for transfer and transport–Transfer stations Optimizing waste allocation compatibility, storage, labeling and handling of hazardous wastes–hazardous waste mani fests and transport -Transfer station</p>	6	15%
3	<p><b>Waste Processing Technologies</b> Objectives of waste processing–material separation and processing technologies–biological and chemical conversion technologies – methods and controls of Composting - thermalconversiontechnologiesandenergyrecovery–incineration–solidification and Stabilization of hazardous wastes-treatment of biomedical wastes.</p>	6	15%
4	<p><b>Waste Disposal</b> Waste disposal options–Disposal in landfills-Landfill Classification, types and methods –sites election-design and operation of sanitary landfills, secure landfills and landfill bioreactors–leach ate and land fill gas management–land fill closure and environmental monitoring– Rehabilitation of open dumps–land fill remediation</p>	6	15%
5	<p><b>Solid &amp; Hazardous Waste Management and standards:</b> Guidelines, Relevant Legislation etc., Standard so collection, Reception, Treatment, Transport, Storage and Disposal as per Environmental Protection Act, 1986, Elements of integrated</p>	10	25%





	waste management. Economy and financial aspects of waste management.		
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### Reference Books:

1. Manual on Municipal Solid waste management by Central Public Health and Environmental Engineering Organization (CPHEEO), Government of India, New Delhi, latest edition
2. Integrated Solid Waste Management by Hilary Theisen and Samuel A, Vigil, George Tchobanoglous,,McGraw-Hill, New York, 1993
3. Solid Wastes by Tchobanoglous, Theisen, Eliassen-McGrawHill
4. Solidwaste Engineering by Vesilind P.A.,WorrellWandReinhart,Thomson LearningInc.,Singapore, 2002.
5. Management of Solid Wastes in Developing Countries by Flintoff-WHO
6. Hazardous Waste Management by Charles A.Wentz, Second Edition, Pub: Mc Graw Hill International Edition, New York, 1995.
7. Environmental Lawand Policyin India by Rosencranz &Divan &Noble

### Online Resources:

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

### Practical / Activities:

- Study of waste generation, sources and classification all types of wastes.
- Study of identification and characterization of wastes
- Collection of data with detail investigation on system of solid waste management and analysis of the system
- Preparation of report of a city solid waste management system including positive points and lacuna in the present system
- Study of hazardous waste producing industry with details of points of generation in various forms.
- Study of manifestation system of particular hazardous waste with processes including handling, storage, transportation and disposal
- Study on treatment technology of hazardous waste.
- Study of relevant standards on hazardous waste generation, storage  
Visit report preparation of a hazardous waste case







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(Gujarat Private State University Act 4 of 2018)

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	3	3	2	2	1	-	2	3	-
CO-2	-	3	2	2	1	1	-	2	3	-
CO-3	-	1	2	2	1	1	-	2	3	2
CO-4	-	2	3	2	1	1	-	3	2	-
CO-5	1	2	3	2	1	1	1	3	2	2
CO-6	1	2	2	2	1	1	1	2	2	1



Faculty of Engineering  
**Hansaba College of Engineering & Technology**



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**Program** : Master of Engineering

**Subject / Branch** : Environmental Engineering

**Year** : 1<sup>st</sup>

**Semester** : 2<sup>nd</sup>

<b>Course title</b> :	Environmental Audit	<b>Course code</b> :	FEM125703
<b>Course type</b> :	PROGRAM ELECTIVE III	<b>Course credit</b> :	04

**Pre-requisite** : Fundamentals of Environmental Audit.

**Rationale** : To provide knowledge for working with environmental issues, including environmental problems, selecting relevant audit topics, developing suitable audit criteria and audit methodology, and making meaningful recommendations

**Teaching Examination Scheme** :

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:** This course is designed to provide knowledge for working with environmental issues, including recognising environmental problems, selecting relevant audit topics, developing suitable audit criteria and audit methodology, and making meaningful recommendations.

**Course Outcome** :

- CO-1:** define environmental auditing and describe the main components of the environmental auditing process
- CO-2:** identify methods for auditing specific environmental issues associated with the activities of an organization and product/service
- CO-3:** describe the main components of an environmental management system
- CO-4:** understand key principles underpinning a range of environmental management tools and techniques





**CO-5:** assess critically the use and application of environmental auditing and management tools.

**CO-6:** Understand the activities in environmental auditing.

**Content:**

Unit	Description in detail	Total Hrs	Weightage %
I	HISTORICAL AND CONSTITUTIONAL PERSPECTIVES. 1.1 Discuss Historical Perspective of Environmental protection. 1.2 State Constitutional guarantees to environmental protection. 1.3 Discuss National and International environmental policies. STUDY OF VARIOUS SECTIONS AND CLAUSES OF WATER ACT, 1974.	7	15%
II	AIR ACT, 1981. 3.1 Study of various sections and clauses of Air ( prevention and control ) act, 1981 ENVIRONMENTAL ( PROTECTION) ACT, 1986. 4.1 Study of various sections and clauses of Environment ( Protection) Act, 1986.	8	25%
III	HAZARDOUS WASTE RULES. 5.1 Study of various provisions of Hazardous waste rule, 1989 for management and handling of hazardous waste. WATER CESS ACT. 6.1 Study of various sections 6.2 Clauses of water cess act with their lacuna.	5	15%
IV	COASTAL REGULATION ACT. 7.1 Study of various provisions. Various Other regulations and acts like Biomedical Wastes (Management and Handling), Municipal Solid Waste Rules, Plastic Manufacturing Sale and Usage Rules etc.	6	15%
V	ENVIRONMENTAL AUDIT. 9.1 Define the term, Explain Methodology –pre audit activities on site activities, post audit activities. 9.1 .1 Concept & need of Environmental Audit. 9.1.2 Audit procedures. 9.1.3 Pre audit activities. 9.1.4 Onsite activities. 9.1.5 Post audit activities. 9.2 Case studies (Minimum FIVE) related with environmental audit for different types of industries.	16	30

**Reference Books:**

- Constitution of India.
- Water act, 1974,78,88
- Air act, 1981,87
- Water cess act,1977, 92
- Environmental Protection Act, 1986
- Environmental law and policy in India, Armin Rozencaranz, Shyam Divan, and Martha L. Noble, Tripathi Publication.
- Environmental Auditing, CPCB Publication. 8. Related I.S. 9. GPCB literature





### Online Resources:

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

### Practical / Activities:

- Historical and Constitutional Perspectives
- Study National and International policies
- Study of various sections and clauses of Water Act,1974 At least two or three Case studies
- Study of various sections and clauses of Air Act -At least two or three Case studies
- Study of various sections and clauses of Environmental Protection Act At least two or three Case studies
- Study of Hazardous waste rule At least two or three Case studies
- Study of various provisions of Water Cess Act
- Study of various provisions of Coastal Regulation Act
- Case studies related with methodology of Environmental Audit

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	3	3	2	2	1	1	2	2	1
CO-2	1	3	2	2	1	1	1	2	2	1
CO-3	1	1	2	2	1	1	1	2	3	2
CO-4	1	2	3	2	1	1	1	3	2	1
CO-5	1	2	3	2	1	1	1	3	2	2
CO-6	1	2	2	2	1	1	1	2	2	1





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Environmental Modeling and Computational Methods	<b>Course code :</b>	FEM125704
<b>Course type :</b>	PROGRAM ELECTIVE III	<b>Course credit :</b>	04

**Pre-requisite :** Nil

**Rationale :** To provide knowledge related to requirement of Environmental modelling and computing Techniques

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

- Understand the idea, methodology and basic tools of environmental modeling
- Understand the different modeling approaches, their scope and limitations
- Understand the fate and transport of pollutants
- Become aware of a wide range of applications of modelling in environmental management & decision making

**Course Outcome:**

After learning the course, the students should be able to:

- Understand the idea, methodology and basic tools of environmental modeling.
- Understand the different modeling approaches, their scope and limitations.
- Apply the Knowledge of computing techniques in environmental engineering.

**Content:**





Unit	Description in detail	Hours	Weightage
I	<b>Introduction:</b> Mathematical Modeling: Scope and problem definition, Defining Systems and its component, types of model and their application, Basic and fundamental of simulation	8	20%
II	<b>Environmental Modelling</b> Water quality modeling: Surface water quality modeling, rivers and streams, ground water pollution modeling	10	25%
III	<b>Environmental Applications</b> Air quality modeling, box model, Gaussian plume model, point source, Line source, Area Source	10	25%
IV	<b>Introduction to Soft Computing Techniques:</b> Analytical Hierarchy Process, Fuzzy set theory, Neural Network, Application of GIS and RS in Environmental Engineering	12	30%

#### Reference Books :

- Ramaswami A., Milford J.B., Small M.J., Integrated Environmental Modeling – Pollutant Transport, Fate, and Risk in the Environment John Wiley & Sons, 2005.
- Chapra S.C., Surface Water Quality Modeling, McGraw–Hil, Inc., New York, 1997.
- Benarie M.M.(1980) Urban Air Pollution Modelling, Cambridge, MA: The MIT Press.
- Schnelle K.B. and Dey P.R.(1999) Atmospheric Dispersion Modelling Complainace Guide, MC graw Hill.
- ZannettiP.(1990) Air Pollution Modelling, Theories, Computational Methods and Available Software, Van Nostrand Reinhold, New York.

#### Online Resources:

1. <http://nptel.ac.in/>
2. <http://elearning.vtu.ac.in/>

#### Practical / Activities:

1. Application of different software in environmental engineering.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	3	3	2	2	-	1	2	2	2
CO-2	1	3	2	2	1	-	1	2	2	1
CO-3	2	1	2	2	1	-	1	2	3	2





**Program** : Master of Engineering

**Subject / Branch** : Environmental Engineering

**Year** : 1<sup>st</sup>

**Semester** : 2<sup>nd</sup>

<b>Course title</b> :	Environmental Legislation and Management	<b>Course code</b> :	FEM125705
<b>Course type</b> :	PROGRAM ELECTIVE IV	<b>Course credit</b> :	04

**Pre-requisite** : Fundamentals of Environmental Management

**Rationale** : Nil

**Teaching Examination Scheme** :

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	5	4	70	30	30	20	150

**Course Objective:**

- to develop sampling and analytical skills of the students which are required in environmental management.
- the students will be able to perform quantitative analysis of various physical, chemical and biological parameters involved in water, air, soil and microbiology research.

**Course Outcome:**

After learning the course, the students should be able to:

- Provide definitions of environment, management, systems and organizations in relation to environmental management.
- Describe organizations as systems and their role in environmental management.
- Understand the usefulness of systems thinking in relation to environmental management in organizations.





- Explain how environmental management can be used as environmental protection and how organizations can define and manage risk.
- Apply the Knowledge of ISO 14000 for obtaining certification.

**Content:**

Unit	Description in detail	Hours	Weightage
I	Environmental policies and programs of the Government of India: Provisions made in the Indian Constitution for Environmental Protection. Duty of citizens Environmental Legislations: Need for environmental legislation, National and state level legislation for prevention of air water and land pollution. All Rule related Environmental Rules related Environmental Protection enacted in India.	12	25%
II	Pollution Control Boards: Functions of water and air pollution control boards of national and state level, difficulties encountered in enforcing legislation, Environmental pollution monitoring. Environmental Audit: Objectives, Concepts, Methodologies and benefits.	9	25%
III	International Standards For Environmental management: ISO – 14000 s Introduction to ISO and Detail ISO 14001 to 14060 Etc Introduction to Environmental Impact Analysis Terms-environmental: Impact and assessment, concept of EIA, Environmental settings, Prediction and assessment of impact on physical, biological and socio-economic environment.	9	25%
IV	Methods of Analysis of Impacts on Environment: Various methods used in EIA : Adhoc , Checklist, Matrix, Network, environmental Media quality Index Method, Cost Benefit Analysis Public Participation in Environmental Management: Concept, Public hearing procedure and guidelines Practical Considerations Economic development and environmental degradation. Practical consideration in impact assessment.	12	25%

**Reference Books:**

- Pollution Control Acts, Rules and Notification Thereunder : Published by central pollution control board 2004 onwards
- Environmental Law and Policy In India by Armin Rosencranz, Shyam Diwan and Martha I Noble Tripathi publisher in association with The book review Literary Trust , New Delhi







- Environmental Impact Assessment by Canter - McGraw Hill
- Environmental Law by Bower - McGraw Hill
- Environmental Impact Analysis by R.K. Jain, L.V. Urban, G.S. Stacey - Van Nostrand Reinhold, New York
- Environmental Impact Analysis – Handbook by John G. Ray and David C. Wooten

#### Online Resources:

- <http://elearning.vtu.ac.in/>
- [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

#### Practical / Activities:

- Exercise shall consists of simple system of Indian Legislations.
- Exercises to be given in the order of followings in subsequent turns.
- Visit to a Project site/ Office of EIA expert.
- Collection data of Environmental attributes of project ongoing nearby.
- A report of EIA is to be prepared by a student on the project of his specialization.
- Exercise on Adhoc Method of EIA.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	3	3	2	2	-	-	2	2	1
CO-2	-	3	2	2	2	-	-	2	2	1
CO-3	-	1	2	2	2	-	-	2	3	-
CO-4	-	2	3	2	2	-	-	3	2	1
CO-5	-	2	3	2	2	-	-	3	2	-





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Fundamental of Sustainable Development and Cleaner Production Mechanism	<b>Course code :</b>	FEM125706
<b>Course type :</b>	PROGRAM ELECTIVE IV	<b>Course credit :</b>	04

**Pre-requisite :** Sustainable waste Management

**Rationale :** To understand the concept of sustainability and to restore the environment for pollution abatement.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	2	4	4	70	30	30	20	150

**Course Objective:**

To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated. To assess the activities involved for the proposed and determine the type, nature and estimated volumes of waste to be generated. To categories waste material where practicable (inert material / waste fractions) for disposal considerations i.e. Public filling areas / landfill.

**Course Outcome:**

- CO-1:** To examine the technical points that are required to set up an integrated solid waste management system.
- CO-2:** To evaluate the existing water treatment system and adopt harvesting methods for water conservation.
- CO-3:** To study reuse, recycle and reclamation of wastewater.
- CO-4:** To analyses the existing EMS and check the feasibility of cleaner production in industries at macro level for overall abatement of pollution.
- CO-5:** Introduced solid waste treatments techniques & current issues of SWM.
- CO-6:** Illustrate the cleaner production & technology



**Content:**

Unit	Description in detail	Hours	Weightage
I	<b>Introduction:</b> Principles of Sustainable Development: History and emergence of the concept of Sustainable Development, Global scenario, Definitions, Environmental issues and crisis, Concept of sustainability in waste management	04	10%
II	<b>Water reuse and reclamation, Water reclamation technologies</b> – process flow diagrams; Public health and environmental issues in water reuse, ground water recharge with reclaimed water – ground water recharge Techniques; Risk assessment for water reuse, Industrial water reuse, Rainwater and Roof water harvesting, economic sanitation methods	14	35%
III	<b>Solid waste treatments:</b> Landfills - Classification - Types and methods. Biological process – Composting - production of bio-fertilizers and energy. Thermal process – Incineration, gasification, wet oxidation, pyrolysis, pelletisation and energy production. Waste management through Reduce, Recycle and Reuse. Kitchen waste management. Current Issues in Solid Waste Management, waste to energy concept and its implementation, Composting: A Sustainable Solution for Bio-waste	14	35%
IV	<b>Cleaner Production:</b> definition of CP and terminology, the need of CP and its benefits, Cleaner Production (CP) In Achieving Sustainability – Prevention Versus Control Of Industrial Pollution – Environmental Policies And Legislations – Regulation To Encourage Pollution Prevention And Cleaner Production	08	20%

**Reference Books:**

1. M. H. Fulekar, Bhawana Pathak, R. K. Kale, Environment and Sustainable Development, Springer Nature; 2014 ed. edition (4 October 2013)
2. Urvashi Dhamija, Sustainable Solid Waste Management: Issues Policies and Structures, Academic Foundation (2006)
3. Cites R.W., Middlebrooks E.J., Reed S.C., Natural wastewater Treatment Systems, CRC Taylor and Francis, 2006.
4. Sanjay K. Sharma (Editor), Rashmi Sanghi (Editor), Wastewater Reuse and Management, Springer; 2013 edition (14 December 2014)
5. Martin, A.M., Biological Degradation of Wastes, Elsevier Appl. Science, New York, 1991.





**Online Resources:**

1. <http://nptel.ac.in/>

**Practical / Activities:**

1. Term work will comprise of assignment and case studies based on natural wastewater system, water conservation systems, smart building, waste to energy, biowastes, Bioremediation etc.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	3	3	2	2	1	1	2	2	1
CO-2	1	3	2	2	3	1	1	2	2	1
CO-3	1	1	2	2	3	1	1	2	3	2
CO-4	1	2	3	2	3	1	1	3	2	1
CO-5	1	2	3	2	3	1	1	3	2	2
CO-6	1	2	2	2	3	1	1	2	2	1





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 1<sup>st</sup>

**Semester :** 2<sup>nd</sup>

<b>Course title :</b>	Mini Project with Seminar	<b>Course code :</b>	FEM125707
<b>Course type :</b>	CORE	<b>Course credit :</b>	03

**Pre-requisite :** Analysis with Environmental Problem.

**Rationale :** The project work aims to develop the work practice in students to apply theoretical and Practical tools and techniques to solve real-life problems of industry.

**Teaching Examination Scheme:**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	6	6	3	0	0	0	100	100

**Course Objective:** To make them understand the concepts of Project Management for planning to execution of projects. Prepare site visit reports. Prepare detailed design report for environmental engineering.

**Course Outcomes:**

1. Identify engineering problems reviewing available literature.
2. Study different techniques used to analyze complex systems.
3. Solve a live problem using software/analytical/computational tools and present solution by using his/her technique applying engineering principles.
4. Learn to write technical reports and develop skills to present and defend their work in front of technically qualified audience.

**Content:**

Sr No.	Content	Teaching Hours	(%) Weightage
01	A mini project requires comparatively less time than major projects. They are comparatively simpler and have shorter duration. Mini Project helps students to explore and strengthen the understanding of	56	100





	<p>fundamentals through practical application of theoretical concepts. Mini Project can help them to boost their skills and widen their horizon of thinking. It will act like a beginners guide to undertake the major project/dissertation during the final year and will ensure preparedness of students to undertake major projects/dissertation. Students will be required to select the topic relevant to their specialization and that has value addition. Students will get an opportunity to work in actual industrial environment if they opt for internship. Based on the selected topic student will also prepare seminar report based on the literature survey Mini Project will have mid semester presentation and end semester presentation. Mid semester presentation will include identification of the problem based on the literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of topic for the work and the methodology adopted involving scientific research, collection and analysis of data, determining solutions highlighting individuals' contribution. Continuous assessment of Mini Project at Mid Sem and End Sem will be monitored by the departmental committee (concept to detailed design &amp; drawing) from above topics along with cost estimation.</p>		
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Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	3	3	3	2	1	1	2	2	2	1
CO-2	2	3	2	2	3	1	2	2	2	1
CO-3	2	1	2	2	3	1	2	2	3	2
CO-4	1	2	3	2	3	1	2	3	2	3





**Program:** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	INTERNAL REVIEW - 1	<b>Course code :</b>	FEM135701
<b>Course type :</b>	Dissertation	<b>Course credit :</b>	04

**Pre-requisite :** NA

**Rationale :**

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	8	8	4	00	00	00	100	100

**Course Objective:**

To present a problem oriented in depth knowledge of Mid semester Thesis Progress Review.  
To address the underlying concepts and methods behind Mid semester Thesis Progress Review.

**Course outcome:**

**CO-1:** The student can identify different areas of mid semester Thesis Progress Review.

**CO-2:** Can find the applications of all the areas in day to day life.

**Content:**

Sr No.	Subject Content
1.	<b>Instructional Method &amp; Pedagogy</b> At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval.





	It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.
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Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	-	-	2	-	-	3	-	-	3
CO-2	1	-	-	2	-	-	3	-	-	3







**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	DISSERTATION PHASE -I	<b>Course code :</b>	FEM135702
<b>Course type :</b>	Dissertation	<b>Course credit :</b>	06

**Pre-requisite :** NA

**Rationale :**

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	12	12	06	00	00	100	00	100

**Course Objective:** To select topic based on structural engineering related requirement as per the current scenario and work accordingly.

**Course Outcome:**

**CO-1:** At the end of the course, students will gain an experience in reviewing various research papers, understanding various newer concepts of problem solving and finalizing the topic related to the course for the work.

**Content:**

Sr. No.	Subject Content
1.	<b>Instructional Method &amp; Pedagogy</b> At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval.





It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	-	-	1	-	-	2	-	-	2





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	Industrial Safety	<b>Course code :</b>	FEM135703
<b>Course type :</b>	Open Elective	<b>Course credit :</b>	03

**Pre-requisite :** Nil

**Rationale :** The basic requirement of an efficient structural design is that the response of the structure should be acceptable as per various specifications, i.e., it should at least be a feasible design. There can be large number of feasible designs, but it is desirable to choose the best from these several designs. The best design, optimal design, could be in terms of minimum cost, minimum weight or maximum performance or a combination of these. Thus, optimization techniques play an important role in structural design. The purpose of optimization is to find the best solutions from which a designer can derive a maximum benefit from the available resources.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

**Course Objective:**

To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models. To understand about fire and explosion, preventive methods, relief and its sizing methods. To analyse industrial hazards and its risk assessment.

**Course Outcome:**

CO-1: Understand Importance of Safety and Important related Accident & electrical hazards.

CO-2: Apply Maintenance techniques as per requirements and able to compare for with different technique for better performance.

CO-3: Understand wear and corrosion, its causes and remedial actions for preventions.





CO-4: To evaluate the effectiveness of systematic EMS monitoring processes. Demonstrate fault tracing, its methods and application.

CO-5: Understand Importance of Periodic and preventive maintenance.

CO-6: Understand the methods of hazard identification and preventive measures.

**Content:**

Sr.	Content	Total Hrs	% Weightage
1	<b>Industrial safety:</b> Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.	8	10%
2	<b>Fundamentals of maintenance engineering:</b> Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment	8	10%
3	<b>Wear and Corrosion and their prevention:</b> Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun,iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods	10	30%
4	<b>Fault tracing:</b> Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion	09	20%





	engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes		
5	<b>Periodic and preventive maintenance:</b> Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.	10	30%

#### References Books:-

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services
2. Maintenance Engineering, H. P. Garg, S. Chand and Company
3. Pump-hydraulic Compressors, Audels, Mcgrew Hill Publication
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

#### Online Resources:

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	-	3	3	2	-	1	1	2	2	1
CO-2	1	3	2	2	-	1	1	2	2	1
CO-3	-	1	2	2	-	1	1	2	1	1
CO-4	-	2	3	2	-	1	1	2	2	1
CO-5	1	2	3	2	-	1	1	2	2	2
CO-6	-	2	2	2	-	1	1	2	2	1





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	Waste to Energy	<b>Course code :</b>	FEM135704
<b>Course type :</b>	Open Elective	<b>Course credit :</b>	03

**Pre-requisite :** Environmental Engineering and Technology

**Rationale :** Environmental Engineering and Technology

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

**Course Objective:**

- The objective of the course is to provide insights into waste management options by reducing the waste destined for disposal and encouraging the use of waste as a resource for alternate energy production
- This course is designed to provide an understanding of the various aspects of Waste to Energy.

**Course Outcome:**

After learning the course, the students should be able to:

- Understand about Agriculture waste, Industrial waste and their conversion process.
- Design construction and operation of Gasifiers.
- Design construction and operation of Bio combustors.
- Applications of Biomass.

**Content:**





Unit	Description in detail	Hours	Weightage
I	<b>Introduction to Energy from Waste:</b> Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors	6	14%
II	<b>Biomass Pyrolysis:</b> Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods – Yields and application – Manufacture of pyrolytic oils and gases, yields and applications	8	19%
III	<b>Biomass Gasification:</b> Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation	10	30%
IV	<b>Biomass Combustion:</b> Biomass stoves – Improved chullahs, types, some exotic designs, Fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors	09	20%
V	<b>Biogas:</b> Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction - biochemical conversion - anaerobic digestion – Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India	10	30%

### Reference Books:

- Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd., 1990
- Biogas Technology - A Practical Hand Book - Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd., 1983
- Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd., 1991





- Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons, 1996

**Online Resources:**

- <http://elearning.vtu.ac.in/>
- [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	3	3	2	3	1	2	2	2	2
CO-2	1	3	2	2	3	1	2	2	2	2
CO-3	1	1	2	2	3	1	2	2	1	2
CO-4	1	2	3	2	3	1	2	2	2	1







**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	Advanced Wastewater Treatment Technologies	<b>Course code :</b>	FEM135705
<b>Course type :</b>	PROGRAM ELECTIVE V	<b>Course credit :</b>	03

**Pre-requisite :** Knowledge of physic-chemical and biological treatment of wastewater

**Rationale :** Satisfying the stringent standards for disposal of treated effluents in various sinks and reusing/ recycling of treated effluents for different uses requires that the wastewater be given more exhaustive and advanced treatment. Hence this subject aims to give knowledge to the students regarding advanced wastewater treatment technologies

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

**Course Objective:**

Satisfying the stringent standards for disposal of treated effluents in various sinks and reusing/ recycling of treated effluents for different uses requires that the wastewater be given more exhaustive and advanced treatment. Hence this subject aims to give knowledge to the students regarding advanced wastewater treatment technologies.

**Course Outcome:**

**CO-1:** Apply advanced technologies in Wastewater treatment.

**CO-2:** Select the most appropriate types of membrane processes for tertiary treatment of wastewater.

**CO-3:** Apply advanced oxidation processes to treat concentrated non-biodegradable wastewater.

**CO-4:** Apply tertiary treatment processes like adsorption, ion exchange for optimum removal of pollutants.

**CO-5:** Apply advanced oxidation processes to treat concentrated biodegradable wastewater.





**CO-6:** Apply advanced filtration processes.

**Content:**

Sr.	Content	Total Hrs	% Weightage
1	Need of Advanced Wastewater Treatment, Applications of Advanced Wastewater Treatment	02	5%
2	Nutrient Removal Nitrogen Removal: Nitrification, Denitrification Simultaneous nitrification and denitrification Phosphorus Removal: Introduction, Phosphorus removal by Chemical, biological methods	04	10%
3	Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption isotherms: Freundlich, Langmuir, BET Activated carbon adsorption, Granular carbon adsorption.	04	10%
4	Membrane Filtration Membrane Process Classification and operation: Microfiltration, Ultrafiltration, Nano filtration, Reverse Osmosis, Electrodialysis Membrane Configurations: Plate-and-frame module, Spiral-wound module, Tubular module, Hollow-fiber module Membrane Fouling: Modes of membrane fouling, Control of membrane fouling Application of membrane processes	08	16%
5	Membrane Bio Reactor MBR Process Description, Types of Membrane Bioreactors, MBR System Features, Membrane Module Design Considerations, Process Applications: Industrial Wastewater Treatment, Municipal Wastewater	06	15%
6	Ion Exchange: Fundamentals of Ion Exchange, Types of Ion Exchange Resins for wastewater treatment, Theory of Ion Exchange Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus, Organic chemical removal	04	10%
7	Electrochemical Wastewater Treatment Processes: Introduction, Electro-coagulation: Factors affecting Electrocoagulation, Electrode materials, Reactor configurations; Electro floatation: Factors affecting electro floatation Comparison with other technology, Reactor configurations; Electro-oxidation : Electro oxidation process, Reactor configurations	08	20%
8	Advanced Oxidation Processes: Theory of advanced oxidation, Types of oxidizing agents, ozone based and non-ozone-based processes, Fenton and photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems	06	14%



### References Books:-

1. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy
2. Environmental Engineering- Peavy, Rowe & Tchobanoglous
3. Membrane Systems for Wastewater Treatment – Water Environment Federation
4. Membrane Separation Processes by Kaushik Nath

### Online Resources:

1. <http://elearning.vtu.ac.in/>
2. [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	3	2	1	3	1	1	2	2	1
CO-2	2	2	3	2	3	1	1	3	2	2
CO-3	1	2	3	2	3	1	1	3	2	2
CO-4	1	2	3	2	3	1	1	3	2	1
CO-5	1	2	3	2	3	1	1	3	2	1
CO-6	2	2	3	2	3	1	1	2	2	1





**Program :** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 3<sup>rd</sup>

<b>Course title :</b>	Urban Environment and Sustainability	<b>Course code :</b>	FEM135706
<b>Course type :</b>	Program Elective V	<b>Course credit :</b>	03

**Pre-requisite :** Basic Knowledge of water and wastewater parameters & Basic concepts regarding water and wastewater treatment units.

**Rationale :** To provide knowledge related to requirement of industrial water and wastewater treatment technologies and its design.

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
3	0	0	3	3	70	30	00	00	100

**Course Objective:**

This course examines the impact that urban development has on the natural environment and explores concepts and tools for creating more environmentally.

**Course Outcome:**

After learning the course, the students should be able to:

- To study basic concept of sustainability and urban development
- To study the environmental urban issues and management.
- Prepare plan strategies to control and reduce Urban environmental pollution.

**Content:**

Unit	Description in detail	Hours	Weightage
I	<b>Introduction to Sustainability:</b>	4	10%





	Concept of sustainability, Objectives of sustainability, urbanization and its impact, scenario of sustainability at micro and macro level, approach towards sustainability.		
II	<b>Urban Environmental Issues:</b> urban heat island, climate change, GHG emission, Socio economics impact, disease, urban noise.	6	14%
III	<b>Urban Waste Management:</b> urban water and wastewater management, reuse and recycling of water and waste water, water conservation techniques, evaluation of ambient air quality, vehicular emissions, indoor air quality, odour evaluation and control, urban solid waste management, integrated municipal solid waste management, management of plastic waste, E-waste and Biomedical waste, segregation at source, decentralized solid waste management, 4 R's Management, waste to energy.	20	48%
IV	<b>Urban Planning for sustainability:</b> Location of waste handling facilities, sustainable transportation: Mass transportation and green fuel, green building and energy efficient building, Carbon Footprint.	12	28%

#### Reference Books:

- Management of municipal solid waste by T.V. Ramachandra, TERI press.
- Water Quality and Treatment Hand Book of Public Water Supplies by AWWA - McGraw Hill
- Quenching the thirst sustainable water supply and climate change by George Annandale, createspace independent publishing platform.
- Sustainable Urban Environments and eco system approach by Ellen van bueren, hein van bohemian, laureitard, henkvisscher editors, springer publications.

#### Online Resources:

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- [www.nptel.iitm.ac.in/courses/](http://www.nptel.iitm.ac.in/courses/)

#### Practical/Activity:

- Field visit of green building and urban waste management facilities.
- Report on research paper.
- Preparation of Graduate Report.





Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	2	3	2	1	3	1	1	2	2	-
CO-2	1	2	3	2	3	1	1	3	2	2
CO-3	1	2	3	2	3	1	1	3	2	2
CO-4	1	2	3	2	3	1	1	3	2	1
CO-5	1	2	3	2	3	1	1	3	2	1
CO-6	2	2	3	2	3	1	1	2	2	-





**Program:** Master of Engineering

**Subject / Branch :** Environmental Engineering

**Year :** 2<sup>nd</sup>

**Semester :** 4<sup>th</sup>

<b>Course title :</b>	INTERNAL REVIEW - 2	<b>Course code :</b>	FEM145701
<b>Course type :</b>	Dissertation	<b>Course credit :</b>	04

**Pre-requisite :** NA

**Rationale :**

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	8	8	4	00	00	00	100	100

**Course Objective:**

To present a problem oriented in depth knowledge of Mid semester Thesis Progress Review. To address the underlying concepts and methods behind Mid semester Thesis Progress Review.

**Course outcome:**

**CO-1:** The student can identify different areas of mid semester Thesis Progress Review.

**CO-2:** Can find the applications of all the areas in day to day life.

**Content:**

Sr. No.	Content
1.	<b>Instructional Method &amp; Pedagogy</b> At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.





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Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	-	-	2	-	-	3	-	-	3
CO-2	1	-	-	2	-	-	3	-	-	3



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**Program:** Master of Engineering

**Subject / Branch :**Environmental Engineering

**Year :**2<sup>nd</sup>

**Semester :**4<sup>th</sup>

<b>Course title :</b>	DISSERTATION PHASE -II	<b>Course code :</b>	FEM145702
<b>Course type :</b>	Dissertation	<b>Course credit :</b>	12

**Pre-requisite :** NA

**Rationale :**

**Teaching Examination Scheme :**

Teaching Scheme				Credits	Examination Marks				Total Marks
Th	Tu	P	Total		Theory		Practical		
					SEE (E)	PA (M)	Viva (V)	PA (I)	
0	0	24	24	12	00	00	100	00	100

**Course Objective:**

To present a problem oriented in depth knowledge of Dissertation Phase II.  
To address the underlying concepts and methods behind Dissertation Phase II

**Course outcome:**

- CO-1:** The student can identify different areas of Dissertation Phase II.
- CO-2:** Can find the applications of all the areas in day-to-day life.

**Content:**

Sr No.	Content
1.	<b>Instructional Method &amp; Pedagogy</b> At the start of course, the course delivery pattern, prerequisite of the subject will be discussed. Lecture may be conducted with the aid of multi-media projector, black board, OHP etc. & equal weightage should be given to all topics while teaching and conduction of all examinations. Attendance is compulsory in lectures and laboratory, which may carries five marks in overall evaluation. Assignment based on course content will be given to the student for each unit/topic and will be evaluated at regular interval. It may carry an importance of ten marks in the overall internal evaluation. Surprise tests/Quizzes/Seminar/Tutorial may be conducted and having share of five marks in the overall internal evaluation.





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Course Outcomes	Expected Mapping with Programme Outcomes (1- Weak Correlation; 2- Medium correlation; 3- Strong Correlation)									
	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PSO-1	PSO-2	POS-3
CO-1	1	-	-	1	-	-	2	-	-	2



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